



Surveying for geographical and spatial information in the 21st century

Smart, BIM, Mobile Mapping & Tunnelling

BIMnet: is independent validation the answer?



Hexagon Live: a break from Las Vegas in Anaheim



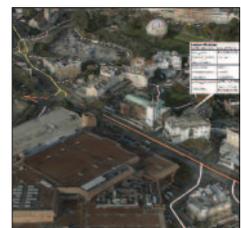
FIG's working week: geodesy and engineering surveying



Jacobs' expectations with mapping on the move



Are we really being smart enough about Smart?



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COVER STORY

The world's longest and deepest rail tunnel is nearing completion. A closure of just 8cms was achieved using Leica Geosystems instruments. Turn to page 20 for the story.

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Are you registered for your FREE copy?

Engineering surveying showcase 2016 ISSUE ONE

Engineering Surveying Showcase No2 will be published in October with major features on UAVs and software. The ensure your FREE copy make sure you are registered via the web address below. Issue No 1 of *Showcase* for 2016 was published in April. RICS members in the UK are entitled to receive a FREE copy upon registration or request. Just drop us an email with your full postal address and we'll pop a copy in the post to you. Overseas readers can still view the latest issue at: <http://www.pvpubs.com/DigitalEdition/Showcase>



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IN THE NEXT ISSUE of GW...

Copy dates for next issue: Editorial: **17 October** Advertising: **25 October**

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Lawyers are rubbing their hands while we worry about tunnels!

We reflect on the lives of surveyors past, whether registered title really does protect you and just how much tunnel surveying has changed, or perhaps not.

In this issue we mark the passing of several significant surveyors. **Derek Browning** (co-founder of Longdin & Browning), Dr **Tony Jones**, **Gary Covington** and as we were going to press, **Jonathan Davy**. So far we have only been able to put together an obituary of one of them.

Gary Covington was amongst that last generation of surveyors who undertook mapping projects before the advent of GPS. Whilst EDM was already available through devices like the Tellurometer and the Aga 6, often they were unsuitable for the task in hand. **Jan Karulus** (himself of that generation) recounts how Gary and his survey party had to set to and hack their way through the Cameroonian Bush to make a trace through which they could measure. Back then the nature of surveying was very different. Months or even years away from home; experiencing people and cultures very different from home, living in rough accommodation, even living off the land all gave young surveyors unique experience. While they would have had an education it was topped off by experience - something you gained and when you needed it rather than just after you needed it.

On the topic of GPS, I am able to provide a review of *Pinpoint*, a book about how the satellite navigation and positioning technology is changing our lives and possibly our brains (page 31). Surveyors should enjoy it as it has lots of insightful anecdotes and tangents.

English Law, the land and Europe

Many do not appreciate the complexities of legal systems. English Law relies heavily on case law – actual disputes tried before a judge whose decision will then be cited by lawyers for ever unless challenged in the Appeal or High Courts.

Carl Calvert's column in this issue provides some interesting reading for those who believe an entry in the Land Registry's register is absolute proof of title. Recent case law found in favour of the original registered owners but not before they were put to the expense of going to trial and learning that even a forged deposition (surely a criminal offence) might not protect your title.

With the UK about to get to grips with the complex work of how we leave Europe, I do wonder how many people realise the amount of work we've gifted to lawyers. I was chatting to one recently who was rubbing his hands at the prospect and looking forward to at least a

decade of work in unravelling commercial contracts and agreements between the UK and Member States. In the meantime there are important issues over initiatives like INSPIRE, the harmonisation of mapping datasets and ERASMUS, the student exchange project, which has allowed so many young students to gain experience of a different country. Fortunately for most surveyors we have only to ponder the topographical and mathematical problems of our relationship with Europe. The British Isles' slow tectonic drift away from the continent, while it may be millimetres each year (unlike Australia's 7.5cms – see Undercurrents page 12) it mounts up over time until coordinates have to be adjusted. We still have much to learn on this topic as Richard Groom discovered in his review of papers presented at the FIG working week in New Zealand (see page 24).

Not bad for nearly 150 years ago

I am always impressed when tunnels driven from each end meet with reasonable accuracy, unlike Colonel Barog's tunnel on the narrow gauge Kalka-Shimla Railway in India. The Colonel's calculations were out and the two tunnelling teams missed each other. The poor man shot himself. The recently completed Gotthard Base in Switzerland had the benefit of some of the most advanced surveying equipment in the world. Nevertheless, tunnelling surveyors and engineers are always nervous about their calculations. Driven from both ends, the 57km tunnel closed to 8cms. Not bad, but what about an earlier drive under the Alps? In 1871 the 7½ mile rail tunnel under Mont Cenis driven from both sides between France and Italy closed to within 12 inches (300cms). Not bad for nearly 150 years ago.

Meet our new publishers

Lastly can I urge readers to try to make the trip to InterGEO, this year in Hamburg 11-13 October. In addition to many UK companies exhibiting, watch out for our new publishers Geomares and their team, who will be distributing copies of this journal and others including *Engineering Surveying Showcase* and *GIS Professional*.

Stephen Booth, Editor

The editor welcomes your comments and editorial contributions by e-mail: editor@pvpubs.demon.co.uk or by post:
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Augmented reality in the sand at InterGEO

This year's InterGEO in Hamburg (11-13th October) is expected to see an unprecedented number of exhibitors showing augmented reality applications, perhaps driven by the latest incarnation of Pokémon. Berlin-based Game Science Center (GSC) will be presenting its augmented reality sandbox.

Transported back to their childhood, visitors can dig in actual sand and see how contour lines and levels simultaneously adapt to the newly created topography. AR makes this possible. Children and adults alike learn to read maps and understand their geography interactively through play. However, the AR sandbox can also be adapted for tasks such as planning the location of wind turbines or measures for protecting against tsunamis. More at www.intergeo.de

RICS backs global geospatial students meeting

For the last 29 years geomatics/geospatial surveying students from around the world have come together at the International Geodetic Student Meeting (IGSM) to exchange ideas and make new friends. This year four students from RICS accredited courses at Newcastle University (**James Gibbs, Jennifer Cowan, Toni Goldsmith and Oliver Smith**) attended the 2016 IGSM in Munich thanks to funding from RICS Geomatics PG.

The students were greeted at the airport and shown to their hostel where they met over 200 other participants of IGSM 2016. They attended numerous lectures and poster sessions covering a range of topics many of which they encountered in their UK studies. This is one of the real strengths of IGSM, it opens UK students' minds to other ways of thinking and helps introduce a global mind-set – something invaluable in the world economy they are about to enter. One of the most interesting lectures was by Dr **Anja Schlicht** on a second generation of Galileo satellites and the potential improvements

ESA may introduce. Dr Schlicht also informed the conference about the benefits of using multiple GNSS systems in a common concept called GETRIS <http://adsabs.harvard.edu/abs/2014EGUGA..1611330S>. This was particularly interesting to the UK students as they had recently compared different satellite systems in their GNSS module at Newcastle University.

There was also time for sightseeing when they took a day trip to the Alps. After hiking to over 1000m they arrived at a chalet where they indulged in some traditional Bavarian food and much needed beers. Days like this were a great opportunity to make new friends from around the world who share our interest in geomatics/geospatial surveying. During the evenings the whole IGSM came together to meet new people and experience Bavarian culture. The students thought that perhaps the best evening was the international food night, in which each nation had to provide delicacies from their home for others to try.

The next year's IGSM will be in Croatia.

Survey4BIM kicks off



Following the launch of Survey4BIM at GeoBusiness, there was a meeting at University College London on 29th June. The meeting opened with two talks. Firstly **Jonathan Iliffe** spoke about datums and map projections. One of the problems that arise is determining the relationship between two grid systems and he described one such instance where he was asked to relate the grid being used to construct CrossRail with that used for the North London Line, so as to avoid piling from one project damaging the other. **Dietmar Backes** described a partnership between UCL and the University of Greenwich to survey the latter's Stockwell Building. Amazingly, the building had only been completed two years previously but there was no 3D model – the only documentation

Survey School's prize-winners



The highest achievers on the TSA Surveying Course were commended for their diligence and professionalism by tutors and industry professionals at the Survey School's annual graduation day ceremony. This year's presentation took place at Worcester Racecourse and included an additional award to recognise the attainment of two outstanding students, separated by just 1 per cent in their results. Jointly sponsored by The Survey Association (TSA) and Leica Geosystems, the award for Best Student went to David Brooks, formerly of Pegasus Group, who gained an overall mark of 92%.

Brooks commented on his achievement, "Studying at the Survey School has been a thoroughly worthwhile and interesting experience. In the time frame of the six blocks I have been able to obtain Associate Membership to RICS and accept a new and more challenging job. None of this would have been possible without the skills and knowledge I acquired during the TSA Surveying Course".

TSA Vice President, Adam Bradley named Luke Allen from EDI Surveys as the first recipient of the new Vice President's Award. Luke gained an overall mark of 91 per cent and produced two assignments marked at A+ standard while Danny Bark of Jacobs UK was presented with the prize for Best Assignment by David Loosemore, President of the Chartered Institution of Civil Engineering Surveyors, (ICES).

Bookings are now being taken for Courses 43 (commencing 24th October 2016) and 44 (commencing 21st November 2016). Visit www.surveyschool.org.uk



RICS GEOMATICS Evening Lectures 2016-2017

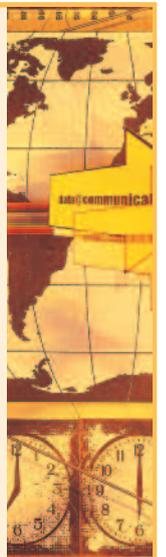
Location: RICS HQ Parliament Square, 17.30 for 18.00, lecture last 1 hour (19.00) and are free and open to all. To book a place send a quick email to internationalssupport@rics.org

Thursday 6th October – Geospatial modelling & Rights of Lights – Andrew Thompson FRICS & Michael Ney.

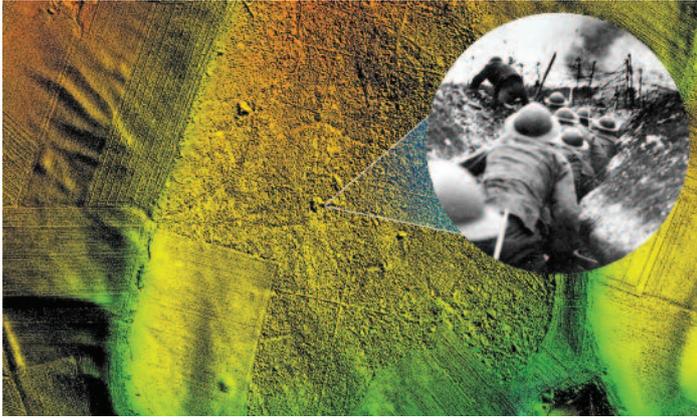
Thursday 10th November – New developments in national mapping – TBC (Ordnance Survey).

Tuesday 6th December – Annual Christmas lecture and Michael Barrett award 2016 – Land Administration, a global view – Prof Stig Enemark HonRICS.

Thursday 26th January 2017 – Geo Forum lecture – TBC.



Revealing the Somme's secrets



A LiDAR survey has revealed previously undiscovered evidence that might potentially help to resolve accusations of a lack of determination by Welsh soldiers during the first Battle of the Somme in the Great War of 1914-1918. Bluesky flew an area in northern France called Mametz Wood, capturing accurate 3D measurements of the terrain and ground cover. Specially commissioned by Bearhug TV, the survey revealed two distinct and previously unrecorded topographies for further investigation and analysis.

The data was stripped of tree cover and other features to reveal two crater-like features, pre-war quarries, with rectangular sides, which were not on any other map. To the east of these anomalies was another, more subtle feature, also not depicted on wartime maps or in reconnaissance information. A series of deep interconnected German trenches was discovered, which experts say was incomparable on the entire Somme battlefield. This was a major new discovery that would never have been made without the LiDAR data.

available was on paper. He also revealed that there is an alarming gap between the design and the actual performance of buildings. The business of the evening was a brainstorming session on the Big 5 Challenges, concentrating on Accuracy and Interoperability.

A further meeting on 15th July held at Ordnance Survey's GeoVation Hub in Clerkenwell took the questions of accuracy and interoperability a stage further by setting up sub-committees to consider 'problem statements' and 'stakeholder engagement' for each question. A further meeting is being held in Sale to spread the word, and the work, beyond the South East.

40% have lost kit

A poll of 100 land surveyors has revealed that 40% of companies have lost survey equipment with an average replacement cost of over £10,000. Fewer than a quarter use ID tagging and less

that one in five use remote locking. 85% of those polled use a locked area to store equipment overnight and 41% said they take the costly measure of employing extra security staff on site to protect equipment.

Peter Roberts, technical support manager at Topcon GB commented: "...it is essential that security software is more widely adopted to deter thefts. Recently our TSShield technology has located instruments stolen in the UK as far afield as an Island in the Indian Ocean and Central America. Widespread adoption of this technology would have a serious deterrent to thieves of equipment, decreasing the re-sale value for stolen equipment."

The poll was conducted by PCP Market Research on behalf of Topcon GB & Ireland.

Hydrogen powered drone

The first drone powered by solid hydrogen made its maiden flight in February – the fruit of a long-

term collaboration between the private sector and scientists at the Scottish Association for Marine Science (SAMS). It flew for just ten minutes and stayed below a height of around 80 metres, but it proved the new power system works. The team are planning another flight this summer, lasting an hour or two.

The drone uses a system developed by UK firm Cella Energy, which stores hydrogen as solid pellets that are gently heated to release it as a gas. A fuel cell devised by Arcola Energy then turns this hydrogen stream into electricity, which powers an electric motor. The partners were initially brought together by Innovate UK to help accelerate the development of this new technology. Source: NERC Planet Earth Summer 2016.

Bluesky expands to Ireland

Bluesky has launched a wholly-owned subsidiary company in the Republic of Ireland. The company is currently capturing high-resolution aerial photography and colour infrared imagery for the whole of the Republic of Ireland. Products already available include 25 cm and 20 cm resolution aerial photography coverage for nearly 22,000 square kilometres.

National Digital Terrain Models (DTM) at 2m resolution and Digital Surface Models (DSM) at 25 cm resolution, are also being created.

OGC's new marine working group

The Open Geospatial Consortium (OGC) is calling for public participation in a new Marine Domain Working Group (Marine DWG). The group will address applicability of the OGC standards baseline regarding marine geospatial data and ensure knowledge is exchanged effectively between relevant standards organizations, OGC membership and the broader geospatial community. While this group will not create new standards, it will be an open forum to discuss and understand any issues, concerns, or barriers to interoperability with the aim to ensure that marine data can be used effectively by the wider community. More at

www.opengeospatial.org/projects/groups/marinedwg

Professions unite for land tenure security

Standards bodies representing land professionals in more than 150 countries met at the Food and Agriculture Organization of the UN (FAO) in Rome recently to launch a major new initiative aimed at improving land reporting systems. They are seeking to establish the first globally applicable framework for recording land information under the Voluntary Guidelines for the Responsible Governance of Tenure in a drive to improve tenure security, land rights, access to investment and economic development.

The standards organisations involved (including RICS) will establish a joint coalition to oversee the creation of the new, high-level framework and to lead public consultation. The coalition is expected to grow in the months and years ahead as more standards organisations join the effort. More details of the initiative are expected to be published by the coalition member organisations in the coming months.

Topcon training approved

Topcon GB & Ireland's training and development schemes have been approved by the Chartered Institution of Civil Engineering Surveyors (ICES) Approved Development Scheme (ADS), certifying them as above industry standard.

WYG framework appointment

Project management and technical consultancy, WYG, has been appointed on a 12-year AMP6 Geospatial Framework for United Utilities Plc. Effective from now, this appointment consolidates WYG's position as a leading provider of asset management consultancy services. The framework is valued at approximately £100k per annum over its duration, and the initial five-year agreement has the option to be extended for a further seven years. One of five consultants on the framework,

WYG will provide a range of geospatial surveying services across the North West of England.

Skyward and senseFly Join Forces

Skyward and senseFly are partnering to deliver a custom operations management software and consulting services package for senseFly aircraft. The package, available for customers in North America through the senseFly distribution network or Skyward, gives operators a preconfigured Skyward account with senseFly flight log import, senseFly manuals, customized pre-flight checklists, and other information specific to senseFly operations. These features are part of the Skyward drone operations management platform that includes up-to-date airspace information and tools to plan and log flights, manage personnel and equipment, flight hours, and meet regulatory reporting requirements.

Plowman Craven scans Parliament

Plowman Craven has been awarded a five-year framework to provide surveying services for the Parliamentary Estate as part of the ongoing Restoration and Renewal Programme for the Palace of Westminster. The commission from the Parliamentary Estates Directorate involves a laser-scan survey to capture measurement data of the entire Palace, including the Houses of Parliament. The company will then produce a Building Information Management (BIM) model which will be the platform for the estate's Restoration and Renewal Programme. This 3D model will help to facilitate the subsequent planning, design and construction work, as well as the future management of the Palace.

Drone collision avoidance

senseFly, has teamed up with the aviation navigation app, Air Navigation Pro, to launch Safer Together. This joint initiative has been designed to address one of the biggest issues facing the General Aviation (GA) and unmanned aircraft communities: mid-air collision.

Safer Together (www.safertogether.aero) will make the skies a safer place by providing GA pilots and drone operators with awareness of each other's airborne activities, giving them the knowledge they need to take any actions necessary to avoid mid-air incidents around 200 – 400 feet (60 – 120 m) above ground level, where most light-weight drones currently fly.

In the coming weeks, senseFly will release new GA functionality for its eMotion flight planning software. This will enable operators of its drones to create a special 'advisory' when activating their automated drone flights. The advisory will be transmitted to Air Navigation Pro's server and thence to all smart devices of connected Air Navigation users. In the coming months, senseFly drone operators will be able to view the Air Navigation users' flights in real time providing bi-directional awareness of aerial activity for GA pilots and drone operators.

Cox calls for bridge monitoring

The recent collapse of a rail bridge at Barrow upon Soar has prompted Dr **Chris Cox**, senior engineer at 3D Laser Mapping, to call for a greater focus on mobile monitoring in the rail industry. Half the railway bridge wall and a large section of brickwork collapsed onto the tracks, putting the Midland Main Line out of action for 48 hours. "With many of today's bridge designs dating back to the Victorian era, there has never been a greater need to survey and monitor these decaying structures and to schedule regular, necessary maintenance to prevent such costly and disruptive events", commented Dr Cox.

GNSS for Latvian forest management

Sokkia has announced that Latvia's State Forests (LVM) the largest forest management company in Latvia, has chosen its latest compact GNSS receivers for forest data collection. The company will use 140 Sokkia GCX2 receivers to gather GIS data for assistance in forest management. Employing more

than 6000 people, LVM manages 1.63 million hectares of Latvian Republic forestland.

Revolutionary web browser

A ground-breaking hyperdata web browser that makes it simpler for people to access and use online data about themselves has been developed at WMG, University of Warwick, with Engineering and Physical Sciences Research Council (EPSRC) funding. RUMPEL gives users the ability to browse their very own private and secure 'personal data wardrobe' – called a HAT (Hub-of-all-Things), which collates data about them held on the internet (e.g. on social media, calendars and their own smartphones). RUMPEL is compatible with all computer operating systems and excludes all third parties, advertisements and 'hard selling'. It is also being made available as an open source programme, under Mozilla Public License managed by the HAT Community Foundation and available at <http://hubofallthings.com/>

BRIEFS

Lidar technology developer Velodyne has completed a combined US\$150m investment from co-investors Ford and China's leading search engine company Baidu. The investment allows

Velodyne to rapidly expand the design and production of high-performance, cost-effective automotive Lidar sensors, accelerating mass adoption in autonomous vehicle and Advanced Driver Assistance Systems (ADAS) applications.

A recent survey by Topcon GB & Ireland has revealed that GPS machine control isn't being used to its full potential in the construction industry, despite over 90% of users stating it improves their productivity. The survey also revealed that over a third of operators have never used machine while 73% believe it would improve their productivity.

Whittles Publishing has just published 3D Recording, Documentation and Management of Cultural Heritage by Stratos Stylianidis and Fabio Remondino. This is a handbook that illustrates the application of geomatics-based tools and techniques in digital conservation of archaeological heritage. With the world's cultural heritage coming under increasing threat, this subject is becoming ever more important. GW hopes to bring you a review in a future issue.

EVENTS CALENDAR 2016

• SEMINARS • CONFERENCES • EXHIBITIONS • COURSES • WORKSHOPS

GW welcomes advance details of events of interest to the Geomatics community. Details to: editor@pvpubs.demon.co.uk

Inspire Conference 2016
26-30th September 2016, Barcelona
<http://inspire.ec.europa.eu/events>

GeoDATA 2016 Brussels
19th October, Brussels, Belgium
www.geoaware.info/

GeoDATA Showcase 2016 Scotland
6th October, Edinburgh, Scotland
www.geoaware.info/#!/geodata-seminars/c23xn

Blue Marble User Conference 2016
25th October 2016, Pittsburgh, USA
www.bluemarblegeo.com

BGS - SoC Conference 2016
6-8th September 2016, Cheltenham
www.cartography.org.uk/default.asp?contentID=581

Trimble Dimensions 2016 User Conference
7-9th November 2016, Las Vegas, USA
www.trimbledimensions.com/

InterGEO 2016
11-13th October, Hamburg
www.intergeo.de

GSDI Conference
28th November - 2nd December, Taipei, <http://gsdiassociation.org/>

The Commercial UAV Show 2016
19-20th October 2016, London, UK
www.terrapinn.com/exhibition/the-commercial-uav-show/index.stm

GeoDATA Showcase 2016 London
1st December 2016, ILEC Conference Centre, London, UK www.geoaware.info/#!/geodata-seminars/c23xn

Researchers, The Business Advantage Group has announced details from its Worldwide CAD Trends 2016 Survey on current and predicted BIM use. It found that 19% of professional CAD users and managers across all industry sectors now use BIM and that is forecast to grow to 29% in the next 3-5 years. BIM current and future usage unsurprisingly will continue to be dominated by the Architecture, Engineering and Construction (AEC) where 38% of respondents now use BIM, with the number predicted to rise this year to over 50%.

For the first time Optical Survey Equipment will be exhibiting at InterGEO this autumn. If you are planning on making the trip to Hamburg, why not come by our stand C1.035 in Hall A1 for product demonstrations and the chance to bag yourself some goodies.

Greenhatch Group has recently switched to the Trimble VRS Now

RTK correction service. For Greenhatch this has entailed the introduction of a completely new positioning correction service for use with their 14 GNSS/GPS systems. The move was facilitated by Trimble partners KOREC.

European Space Imaging (EUSI), a very high-resolution satellite imagery provider, has entered into an agreement with Vricon, a supplier of high-accuracy 3D data and digital elevation models with global coverage. The partnership gives European customers easy access to "The Globe in 3D" and will be of particular benefit to government and security customers.

Fugro has been awarded a photogrammetric and LiDAR surveying and mapping contract by the US Army Corps of Engineers, St Louis District, Missouri. The five-year, indefinite delivery indefinite quantity (IDIQ)

contract has a ceiling value of US\$12.5 million and marks Fugro's third consecutive mapping contract with the Corps, making this a partnership that has spanned more than 30 years. Mapping completed under this contract will support the Corps' Center of Expertise for Photogrammetric Mapping in their endeavours to provide full service, rapid response photogrammetric mapping.

PEOPLE

Dr Tony Jones MBE

Brain Whiting reports the sad news that Dr **Tony Jones** passed away on 6th May. Brian says: "Tony was a great character and regular supporter of the surveying teacher's meetings." He was a lecturer at the University of Bangor but better known as a leading mountain rescuer, in which capacity he appeared on "This is your Life" and gained his MBE.

New MD for Fugro GeoServices



Ross Stevens has been appointed MD of Fugro GeoServices Ltd, the UK based site characterisation specialist. Stevens is a chartered civil engineer who joined Fugro Seacore in 2007 after a decade in project management and civils contracting. In 2012, he was appointed deputy MD of Fugro Engineers BV based in the Netherlands. He returned to Fugro Seacore as a director in 2015, ahead of its integration in October 2015 as part of Fugro GeoServices Ltd.

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Public awareness of spatial data is growing: opportunities lie ahead

Smart apps, shifting reference frames, improving mapping in the deep ocean and engagement with the UN's Sustainable Development Goals can all help geospatial to capture the public imagination argues **Gordon Johnston**, chair of RICS Geomatics Professional Group.

“Great opportunities lie ahead to see new technologies, talk to developers and network with users...”

Gordon Johnston
welcomes your comments and thoughts so please email to the following address
geochair.rics@gmail.com

It's been a busy few months in the Geomatics domain with some interesting items in the media and events now about to take place being advertised. I mentioned in a previous *GW* the increasing use of smart apps and geospatial data being used for people-centric uses. Geospatial apps and games are really capturing people's imagination; and yet I still bought a couple of paper maps recently, both new and old... but only once I'd found the shop by using my smartphone!

The rise in awareness of spatial data, or information based upon it, has promoted some aspects of our profession into the mainstream media and news. Australia's realignment within the global geodetic reference frames was hailed as a shift of a proportion equal to that of a red kangaroo, at 1.8 metres; then we had ambitious goals set by GEBCO (see <http://www.gebco.net/>) to improve our mapping of the oceans from the current 30 arc second grid (well over 800 metres) to an appropriate accuracy and resolution for all the main oceans of our planet by 2030 and so align with the UN Sustainable Development Goals. These are now newsworthy items whereas a few decades ago it's likely that only professionals reading the likes of *GW* would get to hear and understand some of these initiatives.

A few decades ago there were some plans to create seabed monuments as markers. It seemed absurd back then. However, the plans for geodetic monuments on the oceans might actually be a good idea for the future swarms of robotic units to accurately reference themselves across the remote seas. Disputes across our seas and oceans have yet to really escalate and accuracy of data will rely upon initiatives such as those by Australia and GEBCO.

Achievement for vocational land surveyors

The graduation in July of the TSA school's vocational land surveyors was a really positive experience and if we could only develop and expand this fine work and offer similar opportunities across a wider community and generate slightly larger numbers, I think that could be really beneficial to our profession. It

may be particular to the UK, but I know of schemes in Europe and similar initiatives for the offshore sector, which are also developing based around distance and blended learning modules in order to reach their audience. Common to these is the adherence to recognized competencies and professional standards as developed by organizations like RICS.

Recognized standards are often not on a young professional's mind when they first start out but as opportunities occur and careers progress the potential to be involved in key projects, interesting developments and both national and international work may depend upon the individual's professional qualifications and competencies. So having them recognised is important as are the technical standards that the work may require. RICS has developed many agreements and reciprocal arrangements that enable a surveyor to be accepted in a different country. For Chartered Land and Hydrographic Surveyors it is a recognised brand which provides a certain status for the individual.

Important international initiatives

RICS has been instrumental in developing and promoting a number of the recent key reference documents such as the IPMS and BIM and is involved in developing fit-for-purpose Land Administration Guidance. These guiding principles are important in meeting international initiatives to develop land administration systems and secure tenure for many more of the population (currently only about 30% of the world). New technologies and associated methodologies are emerging and RICS and its members should continue to be active in setting bold objectives that fit in with the UN Sustainable Development Goals and contribute to society.

Great opportunities lie ahead to see new technologies, talk to developers and network with users at InterGEO '16 in Hamburg in October and then Hydro '16 in November in Rostok, Germany.

Geospatial technologies and methods may help us achieve some of the key UN Sustainable Development Goals. Achieving these aims really would be newsworthy.

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Olympian events turn spotlight on a drifting continent and photography

by Malcolm Draper, Rentalength

A tour of the Rio Olympics is followed by a geodetic problem and a diversion into an early photographer. We've also been losing too many great surveyors.

Well what a summer it's been! The Rio Olympics have been a real tonic after all Britain's Remain or Brexit Referendum. What a brilliant performance it's been for Team GB's athletes, from the youngest, 16-year old gymnast **Amy Tinkler** to the oldest, 61-year old show jumper **John Whitaker**, from the diving and swimming to the fabulous Women's Rugby Sevens, they all did us proud. I take my metaphorical hat off to all of them.

While Brits certainly shone in South America so did others. I especially loved the success of Fiji in the Rugby Sevens. They started on their knees by preying for success and ended on their knees by prostrating themselves before **Princess Anne** who awarded them with Fiji's first ever gold medal. Very touching and something of a lesson to the rest of us in a world too often lacking a touch of humility.

The comments from athletes have also been interesting. **Usain Bolt** after his triple triumph said to a reporter that he'd just met someone who told him he was immortal. "I like dat!" was the tall Jamaican's cheery response. While GB's first golden boy, swimmer **Adam Peaty** said, after he'd completed the 100 metres breaststroke, "I touched the wall, turned to look round and thought, where is everybody?"

Meanwhile the cycling road races looked distinctly hairy – a bit like Surrey but with fewer potholes! I do hope that young Dutch girl **Annemiek van Vleuten**, who crashed so badly in the women's road race, makes a full recovery; I see that she's already out of hospital and taken to two-wheels again. Great spirit.

How's business?

So how is business for you? Surveyors I've

spoken to in the London area seem incredibly busy. Whether this is a post Brexit bounce or a dead cat bounce remains to be seen. However, at least one survey company to whom I've spoken is active in the London property market, noticed the beginnings of a downturn in the autumn of last year at which time quite a few of my general practice surveyor contacts reckoned the London property market was overheating. That has certainly now been proved and probably accelerated by Brexit. RICS surveys bear this out with many chartered surveyors in the commercial sector reporting falls in investment and new occupations. But at least one firm of surveyors has had more enquiries in the last two months than in the previous 12, so make of that what you will.

Mighty movements

The BBC reports that Australia is drifting about 7.5cm northwards (!) each year due to tectonic movement. As a result, the country is to shift its longitude and latitude to address a gap between local co-ordinates and those from GNSS used in satnavs and other satellite based systems like driverless cars.

Surprised at the amount of this annual drift, GW turned first of all to our Australian correspondent for elucidation. We quote: ". . . if it gets any faster we will be up Kim Il Jun's **** quicker than his hairdresser shaves his... head!

For a more scholarly view we went to **Mark Greaves** at Ordnance Survey. He writes on his blog <https://www.ordnancesurvey.co.uk/blog/2016/08/is-britain-on-the-move/>:

"Australia's mapping system was updated in 1994, and fixed to the ground at that time, to be directly compatible with WGS84. However time and tectonic plate movement have taken their toll, and the mapping system and WGS84 have now drifted apart to a level that might be noticeable to a wider group of users other than geodesists and geologists. Hence everything has now been dragged 1.8m to the north!"

We also turned to Professor **Terry Moore**, Director of the University of Nottingham's Geospatial Institute. He observes, "Interesting. But the parallel story, and big question, is what should happen in the UK, or in Europe? Our coordinates were fixed at a 1989 epoch and so, for the same plate tectonics reason, there is currently a difference between GNSS coordinates (say WGS84 for GPS) and ETRS



Left: Apologies for the early mention of Christmas but some things have to be planned well in advance. My band The Hangovers has been busy raising money for CLOJ (Christmas Lunch On Jesus) to buy pensioners a Christmas Lunch hamper.

coordinates of about 65cm (27 years at roughly 2.4 cm per year)."

So there you have it readers. We're back to Europe again!

Fox Talbot

The Science Museum in South Kensington currently has an exhibition, Fox Talbot: the Dawn of the Photograph. Undercurrents booked tickets in advance and was rather surprised to find relatively few people there. We'd expected long queues, which there were but which turned out to have been because of a bomb scare or some form of security alert.

Along with the French inventor **Joseph Niépce**, William **Henry Fox Talbot** was an early pioneer of photography. Something of a polymath Fox Talbot invented the salted paper and calotype processes, which managed for the first time to fix images. He was also an MP and knew many contemporary scientists including the Astronomer Royal **William Herschel**, **Charles Babbage** who developed mechanical computers and the electricity pioneer **Michael Faraday**.

The exhibition has hundreds of early photographic prints, not all by Fox Talbot. Other early pioneers are represented like Niépce who was a fine artist as well as photographer with probably a better eye for a scene than Fox Talbot. Interesting as many images were the exhibition would have benefited a little more from a better insight into the technology. An exhibition nearby in the museum on clocks and time was rather more attractive but that will have to wait for another time.

Miscellany

The death of **Anthony Jay**, one of the authors of the 1980s brilliant TV series *Yes Minister* and *Yes Prime Minister* brought forth some amusing anecdotes. He once said that "Politicians like to panic – it's their substitute for achievement!"

Moving on alas

On a less cheerful note the summer has seen the passing of some great surveyors.

Last issue's *GW* recorded the death of General **John Kelsey**, former head of Military Survey and head of Field Survey at Ordnance Survey. I recall meeting Kelsey with Wild's sales manager **Brian Snelling**. It was not long after the launch at the FIG Congress in London in 1968 of the Wild D110 Distomat. Indeed, I was the first to buy the EDM and named my company Rentalength in honour of it.

Snelling asked me to accompany him on a visit to the General so we could explain the Distomat's awesome features and performance. He was much impressed and Snelling was eager for a sale. However, I just couldn't resist a bit of mischief. I said to the General, "Of course the Japanese have the Nippomat, which is half the price and measures twice the distance." Snelling's jaw dropped in line with the General's heightened interest before they both fell into

my little prank.

Next we must mark the passing of **Derek Browning**, co-founder of Longdin and Browning, has died aged 90. Before moving to Longdin and Browning he was a partner at J A Story and Partners, where **Nick Day** says he gave him his first job. Nick recalls a somewhat stern man, "but technically very qualified and as straight as they come for integrity and requiring the best from everyone." This thought was echoed by **Rory Stanbridge** who met Derek when he and **Colin Boyd** set up Photarc in 1974: "I recall Derek being very helpful and to my mind, very wise and well informed. He and Ron (Craven) must have made an impression as forty two years on the company is still going, albeit under a different name.

Another death to record is that of **Jonathan Davy**, formerly with Walker Ladd and Atkins; and of **Gary Covington**. Although I don't think I knew Gary, I liked his style as the recollections show in the obituary organised by **Richard Groom** and particularly **Jan Karulus**, who both worked with him (see page 17).

Wright-Draper Collection

Readers will recall that I used to collect old electronic surveying instruments and calculators. My collection was looked after by **Alan Wright** who kept it in a shed at his home. Alas, Alan died three years ago and although we tried to find a home in the UK for the collection no one was willing to step up so it went to the University of Ghent's Museum in Belgium.

Prof **Jan De Graeve** informs me that the collection is now on display at the museum and there will be an official opening on 30th September. The Editor and I plan to visit. If there are others interested in a few days in Belgium please get in touch. I am told the beer, mussels and chips are the best in the world!



Above: part of my collection on display at the World of Surveying exhibition.

Right: with Ron Craven (centre) and Roy Furniss at the Commonwealth Survey conference.



Got a tale to tell?

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Undercurrents, in strictest confidence if you wish (we promise to change names,

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Mobile Mapping: Jacobs' Journey

By Ian Coddington

GW editorial board member and senior consultant with Jacobs UK **Ian Coddington** explains the journey the company has travelled in capturing geospatial data from vehicle platforms, evaluating the cost benefit against traditional survey methods and understanding expectations of what accuracy really means.

Jacobs Geomatics provides support and consultancy to the company's wider design and engineering services. In recent years Jacobs' UK geomatics team has been involved in increasingly large infrastructure schemes, typically supporting preliminary and detailed design phases of projects. This requires advising on solutions and the subsequent provision of suitable geospatial data. As our projects have grown in scale and complexity we have increasingly sought to supplement traditional topographical survey capture techniques with rapid data techniques such as terrestrial laser scanning, aerial photography and LiDAR and, over the past three to four years, vehicle-mounted scanning methodologies, commonly referred to as 'mobile mapping'.

To date our experience has largely been within the highways environment, using a combination of in-house resource and supply chain partners to deliver topographical survey data for motorway and trunk road improvement schemes, but we are now also working on projects using mobile mapping technology within the rail environment.

M25 Junction 30

Our first significant involvement with mobile mapping came in late 2013, whilst working on the M25 Junction 30 improvement scheme. The scheme required preliminary and detailed design for elements of the junction, and detailed topographical survey was required for approximately eight kilometres of the M25, six kilometres of the A13 and the junction itself, extending into adjacent private property along the highway boundary. The data available to the design team was limited, both with regards to accuracy and detail. More accurate data, particularly of the carriageway, was considered an urgent requirement to support the critical path activity of determining the 3D alignment of the new design.

Based on the scale of the project and the urgent requirement for data, we proposed the use of mobile mapping, which it was envisaged would provide rapid data capture. An additional

benefit was that this would remove the need to access the site on foot, removing exposure to the risks of working at night within temporary traffic management and the associated disruption to the highway network.

However, following further discussion with the project team, some concerns were raised. A key member of the team had previous poor experiences of using mobile mapping when working for another company, and had particular concerns over the accuracy of the data provided. There was also limited understanding by the team as to what would be provided and in what formats. Finally, the design requirements were extended to include detailed and accurate survey of the heavily vegetated verges and motorway embankments in order to adequately complete their works.

Hybrid approach

Based on discussions with the team and consideration of the programme and safety implications of the work, a combined approach was employed. Mobile mapping was commissioned to capture carriageway levels and features. This was initially controlled using positions from the vehicle mounted GNSS system only, without the use of ground control, with an estimated accuracy of $\pm 30\text{mm}$ RMSE, which was sufficient to complete the preliminary alignment design.

Whilst this activity was ongoing, ground-based topographical survey was undertaken of the site. This was done under the protection of temporary traffic management, with the team establishing high order survey control using static GNSS observations, and then using total station and GNSS network RTK data capture techniques to survey off-carriageway detail. A series of mobile mapping control points were also surveyed, which allowed the mobile mapping data to be re-processed to a higher order of accuracy. This was estimated to be in the order of $\pm 15\text{-}20\text{mm}$ RMSE, and was verified through sample survey and check measurements using total station observations, and then statistical analysis of the data. This approach enabled the design team to fully understand the accuracy of the data they were working with, and make suitable assumptions and allowance within their design. The approach also allowed the survey team to focus their efforts within the constraints of available road space and the limited programme, capturing off-carriageway detail, critical to drainage and geotechnical design.

Did it work?

Overall, our approach to the survey was seen as



Detailed topographical survey was required for approximately eight kilometres of the M25.

a success. Survey data was provided at an early stage, which enabled programme milestones to be met. The use of mobile mapping also provided cost savings, minimising traffic management and network disruption. The project also provided greater opportunity for engagement between the survey team and the multi-disciplinary engineering team undertaking the design. This led to a greater understanding across the team, of both the constraints of undertaking survey work within this environment, and also the design team's requirements, particularly with regards to accuracy at specific phases within a project.



Evaluating costs and benefits

One of the key lessons learnt from the M25 J30 scheme was the need for earlier geomatics engagement within the team. This led to involvement in a new project, which required topographical survey to support preliminary and detailed design for a new bypass scheme and improvement works for approximately 30km of existing dual carriageway and motorway.

Initially this appeared to be a very similar project, but through the experience gained on the M25 J30 scheme we advised against the use of mobile mapping. This advice was based on cost benefit analysis, where we reviewed the cost impact of the design assumptions used on the M25 J30, and compared them with the additional cost of carrying out survey using traditional means.

- As with the M25 J30 scheme, ground survey would be needed to provide details of drainage features running parallel to the highway, and this would require Traffic Management for safe access.
- Traffic Management would also be required to establish ground control points for mobile mapping.
- As such, the only additional cost incurred to survey the carriageway using a total station would be for additional survey crews to work with the planned lane closures whilst the control and drainage survey work was being undertaken.
- The greatest impact was for the pavement and highway design elements. By surveying carriageway levels more accurately using a precise total station the amount of material used for the new road surface could be more accurately calculated.

Given that the scheme required re-surfacing of over 100 lane kilometres of motorway and dual carriageway, the cost savings achieved by using higher accuracy data for design far outweighed the cost of undertaking survey using a total station, with survey costs being less than a tenth of the potential savings.

Client supplied data

Since 2012 Highways England (formerly Highways Agency) has been commissioning mobile mapping data acquisition across its

network of motorways and trunk roads. Initially this data was acquired for asset management but Highways England also makes the data available to engineering consultancies to support design activities. Jacobs has been using this data to support work on several smart motorway schemes including the M56 and M60.

The data supplied is raw 25m² tiles in .LAS format and requires the user to merge the data and model or extract the features they require. The Highways England specification states that data has been captured to ± 30 mm RMSE, with a minimum of 500 points per m².

This data has been particularly useful for supporting preliminary design activities, where it enables the design team to have access to current data within the project programme, without the need to carry out time-consuming site surveys. This in turn enables a more informed design, reducing the risk and cost of assumptions that are often required at this stage of the design process.

Need for QA

Our in-house geomatics capability has been employed firstly to advise on the use of the data, and then to ensure our design teams are informed with regards to accuracy and suitable applications. We have also managed the process of feature extraction.

Through the management of this data, and our work on the M25 J30 scheme, we have established robust quality assurance procedures and have been able to apply these to the use of third-party data. These include site checks, by surveying a sample of data to gain confidence of the stated accuracy of the data. Typically, for projects where we have been supplied data this has been limited to non-contact total station observation from over-bridges, rather than undertaking work within traffic management on motorways. Whilst there is a trade-off with accuracy when using this methodology, it provides a reasonable check whilst minimising health and safety risks and the additional costs that would be incurred to access the motorway.

In addition to site checks of the raw data we have adapted our topographical survey quality assurance procedures to check any extracted data. This includes modelling of extracted data

Above: One of the key lessons learnt from the M25 J30 scheme was the need for earlier geomatics engagement within the team.

“... limited understanding by the team as to what would be provided and in what formats.”

“One of the key lessons learnt through this work is the need to manage expectations with regards to time-scales for extracting data and undertaking quality assurance.”

to check for spikes and rogue levels.

One of the key lessons learnt through this work is the need to manage expectations with regards to timescales for extracting data and undertaking quality assurance. The sites are typically long sections of motorway, tens of kilometres long. Extraction of features is still a largely manual process and to apply rigorous QA procedures is also time-consuming.

Mobile mapping in urban areas

Based on our experiences using mobile mapping for motorway projects we have more recently started to utilise the technology for local authority projects, where we are often requested to carry out topographical surveys for significant stretches of urban areas to support highways improvements and new cycle schemes.

For the first phase of a recent project, we commissioned mobile mapping of 12km of survey of two 'A' roads in London. Based on the survey extents – a demanding programme for early data to support preliminary design with no requirement for traffic management to establish survey control – mobile mapping was proposed.

Survey control, (all established within publicly accessible locations) and the initial mobile mapping data capture was undertaken swiftly. However, due to the site environment it was found that it was far more challenging to capture the required data. In an urban environment the number of obstacles present such as parked cars meant that even with several passes during the data capture there were significant gaps in the collected data. Given that the site was publicly accessible it was relatively simple to go back to site and infill the dataset (largely undertaken using terrestrial laser scanning to maintain a rich dataset), but this still meant a site revisit and a programme delay.

Tried and tested technology

In addition, the time allocated for feature extraction was underestimated. Compared with a motorway environment an urban site is busier, with a more features such as street furniture, manhole covers, changes in surface and so on. This led to further programme challenges and when we were asked to provide a proposal for the second phase of the project, a further 4km of survey to the south of phase 1, we needed to carefully weigh up the use of mobile mapping and the use of traditional survey techniques. On assessment of the programmes for both methodologies, and also the distorted mobilisation costs of the mobile mapping system to survey a relatively short site, we opted for survey using total station. Whilst lessons were learnt during the first phase which would no doubt have made for a smoother phase 2 survey, our client required a reliable programme and it was considered this could be better provided using more tried and tested methodology.

However, by not undertaking mobile

mapping of the phase 2 site we have not captured the rich dataset that was surveyed during phase 1. The additional data surveyed in phase 1 may prove useful in later stages and this project will provide interesting comparison of the longer term benefits of the phase 1 dataset with the benefits gained through reliable programme, and slightly better accuracy provided during phase 2.

Much of the insight gained is proving useful across a number of projects we are working on.

Re-enforcing quality

All of our experiences have re-enforced the need for strong and robust quality assurance procedures, applied at regular milestones in the same way as we would for a traditional survey.

For our design team to develop an informed design, which can be taken to construction, it has been essential that we verify that the accuracy of the data captured meets the accuracies specified. To date our experiences have generally been good, but mobile mapping data, particularly when provided without ground control, has been typically towards the limits of expected accuracies.

Secondly, the manual nature of feature extraction opens itself up to human error. It has therefore been important to check deliverables, both with regards to the correct level of detail and that levels have been picked correctly, and in locations that generate an accurate digital terrain model. It is also important to allow adequate programme time to thoroughly undertake this task.

Level of detail

One of the common issues we have found is ensuring that the correct level of detail is extracted from the captured data. Typically we have been using mobile mapping technology as a tool to safely and more quickly deliver a 3D topographical survey model, in a format that our engineering teams are comfortable with. It has been important to clearly specify what information is extracted and at what density. In addition, good communication is required with the team undertaking the extraction element, so that the client's requirements are fully understood. As our clients demand more complex 3D models for Building Information Modelling (BIM) projects, ensuring requirements are fully documented will become even more key to successful project delivery.

What is accuracy?

Our experiences have also highlighted the different ways surveyors and engineers define accuracy: particularly regarding the surveyors definition of accuracy using Root Mean Square Error (RMSE) and normal distribution. RMSE arguably becomes more relevant and measurable when using mass datasets such as those captured using mobile mapping, but our design teams have often been a little

About the author



Ian Coddington graduated from the University of Newcastle Upon Tyne in 1999 with a degree in Surveying and Mapping Science. He is now a senior consultant working for Jacobs UK Ltd, specialising in the management of geomatics works for large-scale infrastructure design projects. Ian is a member of the RICS and supports the Institution as an APC counsellor and assessor.

disappointed to learn that having specified $\pm 20\text{mm}$ accuracy, potentially only 68.3% of the data provided will meet this requirement. Open and honest discussion within our teams has led to greater understanding on both sides. The use of the accuracy banding table in the new RICS Measured surveys of land, buildings and utilities' (3rd edition) when preparing specifications has also allowed us to clearly set expectations at an early stage in the project.

Horses for courses

In summary, our experience in the use of mobile mapping to date has been challenging at times but the added benefits that this has provided

has been worth the effort. The technology is not suitable for every job, and being better informed of the limitations of the data and its end use will assist in providing better solutions. It is also essential to maintain focus on good surveying practices and procedures.

To date we have achieved the best results when combining mobile mapping with other more traditional survey methods. As the technology develops (mobile mapping could be described as fast moving technology in more ways than one) higher accuracy with less reliance on ground control will allow greater realisation of the safety and high-speed data-capture benefits it can provide.

“... being better informed of the limitations of the data and its end use will assist in providing better solutions.”

Gary Covington

Recollections of a great surveyor who served time in Africa and retired to The Philippines

It is with sadness that we report the passing of Gary Covington on 4th August in the Philippines after suffering throat cancer. Gary worked for Fairey Surveys and its successor companies in the 1970s and 80s. The younger surveyors who worked with him remember a methodical surveyor whom they respected and learned much, as Peter Roberts recalls: “he enchanted me with stories from his travels overseas of ‘butterflies so big they could knock you over.’”

Many will remember Gary through visions of his pipe smoking and his battered brown estate car. Kathryn Harris recalls an incident in a pub restaurant in Yorkshire when he tried to convince a young waitress that signs with a red line through a cigarette did not apply to pipes, whilst totally agreeing that pipe smoking was a filthy habit that should be stopped.

Kathryn also remembers that car: “The car was a wreck of a brown Ford estate – older than I was – with a hole of rust through the passenger door.” Dave Lewry recalls its replacement: a newer “gleaming” brown Ford Cortina except that the bumper over-rider fell off when Dave put his foot on it. Gary was not happy with Dave, or the garage that sold him the car.

Dave also remembers an incident at a trig point on Dartmoor. “A lady, three teenagers

and two dogs hove into view on the Dartmoor summit we were occupying. Gary was observing. She excitedly told the children that ‘you don’t see surveyors using trig points very often!’ But the dogs, on long extendable leads were even more excited and ran round and round the pillar, binding Gary’s legs to it with their leads. Addressing her tartly as ‘Madam’, he left the lady very sure that he wasn’t impressed, while she unwound him.

When he was with Clyde Surveying Services Ltd, Gary exhibited signs of journalistic flair with his “Not the CSSL newsletter”. His quick wit and withering observations were unique. The fact that, thirty years on, there are still copies of the newsletters in existence bears testament to their impact. He also had a number of articles published in Surveying World, the predecessor to GW.

Jan Karulus writes:

I knew Gary from 1980 to approx 1986 when he was, firstly, party leader of the Cameroon Plantation Ground Survey and then, later, our Resident Liaison Surveyor in Ougadougou, Burkina Faso, during the ground control phase of our joint venture with the Institut Géographique du Burkina Faso (IGB) for the 1/50,000 Scale national mapping of the country’s four major river basins.

Challenging Cameroon survey

The Cameroon survey was an extremely physically challenging project to assess the suitability for development as a palm oil plantation of a site at the

Northern base of Mount Cameroon between the major village of Mbongo and a small settlement some 10 kms distant at Mbonge Creek. The only way that the survey could be conducted was by hacking traces through the primary and secondary biomass to expose and survey the ground by old fashioned tape and tacheometric methods. Gary led our team of ten British surveyors in this daunting task by recruiting the assistance and cooperation of the local Chief Lawrence and his men. It was clear that Gary was more “at home” in Africa than in his native East Anglia despite mosquitoes, crocodiles and pygmy elephants.

Crisis in Burkina

In Burkina a crisis was arising due to creeping sahélisation (the southward encroachment of the Sahara Desert) and the difficulty of using water from the river basins for agriculture due to the effects of river blindness. The government, with assistance from the Islamic Development Bank, launched a tender to produce 65 one quarter degree square 1/50,000 topographical maps (to IGN France standard specification) in four blocks to cover the river basins, complete with survey control in planimetry and height to supplement the single existing line of the 12th parallel survey of Africa and IGN 1/250,000 series mapping (based on astro planimetry and barometric heighting).

The contract was awarded to a consortium of IGB and Clyde (UK). GPS cover was not yet available in this part of Africa so

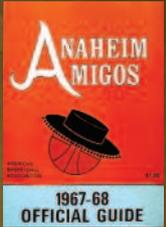
a method was devised to extend planimetry from the 12th parallel by trilateration using EDM antennae mounted on 15-metre high pneumatic masts supplemented by astronomical azimuths where possible and by gyro- theodolite polar coordination for photo control. Height control was by levelling networks also based on the 12th Parallel. IGB was responsible for carrying out all the geodetic and ground control survey works but in view of the unusual methodology Clyde agreed to provide an advisor. Gary steeped himself in all aspects of the methods and instrumentation and participated in full throughout two completely successful field seasons during which he quite obviously won the respect and affection of his African colleagues and shared a good social life with them. For his part he too was obviously happy and fulfilled.

Gary was a dedicated letter writer who maintained regular correspondence with pen-pals around the world. On completion of the project he travelled to the Philippines to meet one of them, Linda, whom he married and they settled in her home town, Davao City. He continued to write, with columns in the local newspaper, the Davao SunStar: the same old Covington, but a shade grumpier! Visit: <http://www.sunstar.com.ph/author/gary-covington>

Note to readers

We rely on the recollections of our readers for obituaries. Please send them to editor@pvpubs.demon.co.uk

HxGN Live 2016: informative storytelling and Disneyland too



The seventh HxGN Live conference was held in California last June. It was the first time it had been hosted in the Golden State, the Anaheim Convention Center marking a break from previous years at the MGM Grand in Las Vegas. Evolving applications for unmanned vehicle use, trends in laser scanning linked to GeoICT and cloud-based services and solutions were all points of interest, while local trips to Disneyland brought back memories of the first Hexagon Live in Orlando, reports **Adam P. Spring**.

The world is becoming a smart place. Hexagon's product portfolio is therefore anything but static. In fact, sensor equipped backpacks, tank-like vehicles and UAVs could be seen across all four days of the event. It was obvious too that Hexagon services and solutions enable their users to collect precise information in most environments. HxGN Live was an event where multiple narratives were taking place, a fact reiterated in the opening keynote from Hexagon President and CEO **Ola Rollén**.

The power of stories

Rollén used storytelling in order to highlight the value of provenance in an information rich world. In this case, the end of a bedtime story was one example used to detail how Hexagon users should fuse their narrative with data. Without the details, the end result are seen to lack context and the information that give it value. It was an opening keynote that would have made **Immanuel Kant**, the German philosopher who developed the idea of Empirical Provenance or Origin in 1781, very proud!

Integration of mobile sensors was also discussed in a way that brought together a lot of the technologies on display. **Geoff Jacobs** - a foundation stone of the Leica Geosystems HDS brand - had hinted at a new trend emerging before the conference began. Rollén's discussion of advanced analytics and artificial intelligence fed into this trend on a broader scale. Sensors and sensing were enabling Hexagon users to document and bring multiple degrees of measurement together, all in real time. Rollén used crowd analysis and gun

control at a rock concert as an example. Hexagon services and solution were seen to be making the world a safer place.

Overall, the symbiotic relationships between information flows, technologies and people were alive and well in the opening keynote for 2016. Rollén ended the session by breaking this down into a basic overview in terms of workflow: "So the feedback loop is already there between the modern world and the real world. But we need to augment this feedback loop to make it more efficient so that we can continue to enjoy an open society."

GeoICT and HDS

User trends associated with the rise of location aware devices like mobile phones (now well ingrained in GIS-driven markets) had started to make their way into high-definition survey (HDS) based workflows. Fusing topographic maps and real-world positions with point cloud information was popular at HxGN Live. It ran across all HDS track sessions and could be seen in a diverse range of presentations.

For example, **Nikolas Smilovsky** of BPG Designs demonstrated that communication hubs like data centres were becoming money-rich clients for HDS providers in the US. Project communication tools like Truview are helping to communicate point-cloud data to his clients, while his background in GIS enable him to put a location-aware spin on things. While **Dana Lockett** and the National Park Service were combining experience of HDS in pre-existing plan drawings using panorama tools like Kolor and PTGui with interactive maps. The end user experience for high definition survey and documentation was now being interwoven with information and communication technologies (ICT). It was online, interactive and being transformed by handheld devices like mobile phones and tablets.

Retelling stories

When **Stan Lee** was lead writer at Marvel Comics he wrote each of his stories to include one feature. He always reintroduced character back-stories so that readers new to the likes of Iron-Man or Spider-Man were never excluded from the action. The lesson learnt by Lee was never assume your customer knows anything about the subject matter you are communicating. Otherwise, you may exclude the audience and prevent your customer base from growing.



Mike Harvey, product applications manager for HDS, put this idea into practice at HxGN Live 2016. The Introduction to 3D laser scanning / HDS was first given at SPAR 2016, where Harvey and Larry Kleinkemper of Lanmar Service had co-presented the session. It was popular at that gathering in Texas to the point where Hexagon customers were also treated to a lesson in laser scanning for beginners. Point-cloud based survey and design was a key player in Anaheim.

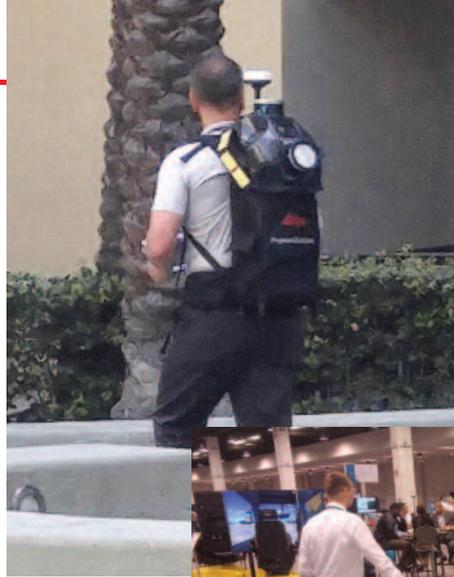
Actionable information

The term Actionable Information has been at the centre of all Hexagon conferences. Though the idea can be traced back to the 1990s, when technology based user networks started to form and required communication based Action Workflows to be developed, HxGN 2016 really did show information in action. For example, Hexagon Geospatial had already announced the Incident Analyser M. App before the conference. Where real-time maps are packaged around incident detection and response times in urban environments, it is an extension of the Smart M.App cloud-based service announced in 2015. **Andy Wells**, MD at Sterling Geo, was quick to point out how the lines were blurring for Hexagon customers.

As official distributors of ERDAS and GeoMedia products, Sterling Geo were well placed to comment on Hexagon related consumer trends. For Wells, cloud based services like Smart M. Apps and the Hexagon Imagery Programme (HxIP) were proving to have limitless potential. It provided content that could be used across all services and solutions under the Hexagon umbrella, be it Intergraph or Leica Geosystems products.

Disney Land Park

Disneyland opened in Anaheim, California in 1955. It later changed its name to Disneyland Park when it expanded in the 1990s. **Walt Disney** himself came up with the idea for this theme park where both adults and children could have fun. It came to him when he watched his daughters ride the merry-go-round in Griffin Park, Los Angeles. HxGN Live attendees were treated to A Night at the Park on June 16th and were happy to prove Walt



Vehicles and backpacks were to the fore at HxGN Live 2016.



had the right idea.

Anaheim Convention Center

The Anaheim Convention Center was designed by Adrian Wilson & Associates and opened in July, 1967. Its arena was first used by a basketball team called the Anaheim Amigos for their 1967-68 season. The Amigos eventually relocated to Utah, changed their name to the Utah Stars, and lay the foundation for the NBA's Utah Jazz.

Summary

The six conferences that have been held in North America provide snapshots for the evolution of Hexagon as a company. For example, there was a general sense of wonderment at the first event in Florida, 2011. The big question that year, which has continued to subsequent events in Las Vegas, was the acquisition of Intergraph and how it would develop. Fast forwarding to California in 2016, it was now hard to imagine a time when Intergraph had not been part of the Hexagon business portfolio. This feeling spread beyond product integration alone (of which manufacture and mobile mapping solutions were big themes in 2016). Employees organically see themselves as working under one overarching brand.

It was interesting to see the difference in customer attitudes at HxGN Live 2016. The obvious spectre of Brexit loomed large for British customers. Whereas, fascinations with popular culture in the US continued to feed into the travel plans of Australian attendees: the adult "Disneyland" of Las Vegas had been replaced by family trips to the real Disneyland in Anaheim. For American customers, of which there were new and returning faces, the gold rush of domestic economic recovery had carried on from the previous year. The competitive edge was alive and well at HxGN Live 2016.

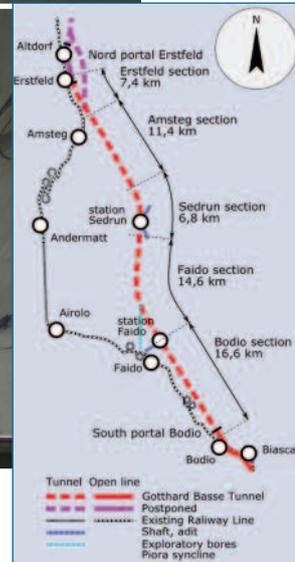


Adam P. Spring is a visiting lecturer in Digital Cultures, Humanities and Sciences in the Department of Archaeology, University of Plymouth. He has over ten years experience in research and commercial sectors. His most recent projects include laser scanning and UAV work in Guatemala. For more information, visit <http://remotelyinterested.com> and <https://soundcloud.com/remotelyinterested>. You can follow Adam on Twitter at @ThatInterested



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Surveying and monitoring systems ensure safety on record-breaking alpine tunnel



The world's longest and deepest rail tunnel under the Alps has been completed to line and level thanks to Swiss measurement and monitoring technology.

On 1st June 2016 the 57km twin-bore Gotthard base tunnel was inaugurated with full service expected to begin in December 2016. The tunnel, which is the longest rail tunnel in the world, will provide a high-speed rail link under the Swiss Alps between northern and southern Europe. The previous longest tunnel was the Seiken in Japan at 53.9km, which beat Eurotunnel's 50.5km.

The Gotthard tunnel's inauguration was marked by an odd opening ceremony featuring dancers and a partially naked woman decked out as a bird with great white wings hovering above actors dressed as tunnel workers, apparently to honour the nine men killed during construction.

Surveying and monitoring systems made the construction of the Gotthard Base Tunnel possible. The tunnel comprises a total of 151.84 km of tunnels, shafts and passages, it is the world's deepest traffic tunnel and the first flat, low-level route through the Alps.

The main purpose of the tunnel is to increase local transport capacity through the Alps, especially for freight, notably on the Rotterdam–Basel– Genoa corridor, and more

particularly to shift freight from trucks to trains. This not only significantly reduces the danger of fatal road crashes involving trucks, but also reduces the environmental damage caused by the ever-increasing amount of freight hauled by heavy trucks. The tunnel will provide a faster connection between the Canton of Ticino and the rest of Switzerland, as well as between northern and southern Europe, cutting the Zürich–Lugano–Milan journey time for passenger trains by one hour (and from Lucerne to Bellinzona by 45 minutes).

The breakthrough, which was achieved six years ago on 15 October 2010 was made possible by highly precise surveying and monitoring technology supplied by Leica Geosystems.

Boring the tunnel started from both sides of the mountains and met in the middle with barely any deviation; it was a truly challenging task. Highly precise measuring instruments were needed to successfully accomplish the project.

Measuring down to millimetre accuracy

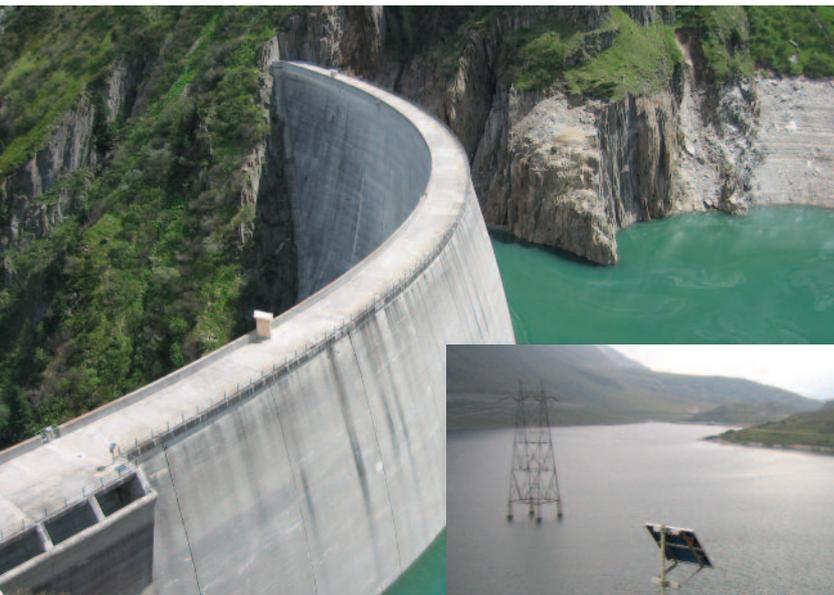
At the tunnelling site, the surveying consortium VI-GBT began measuring in 1996, when construction work began 20 years ago. The surveying engineers set up a basic network with 20 reference points. For this task, they used total stations and GNSS solutions from Leica Geosystems.

The tunnelling began at Erstfeld (north portal) and Bodio (south portal), but also at three intermediary points where side channels joined the main tunnel: Amsteg, Sedrun and Faido. In Sedrun (1,405 m high), a vertical tunnel 800 m long was drilled down to the main tunnel so construction workers could push north as well as south from that point.

During tunnel construction, surveying and measuring tasks had to be repeated every 400 metres. In order to make sure the tunnel was on course, the surveyors had to check coordinates of the reference points. In addition, the exact height had to be measured with levelling devices, also from Leica.

Breakthrough

"When we broke through in the middle of the tunnel on October 15, 2010, the two tunnel sections met with a deviation of only 8



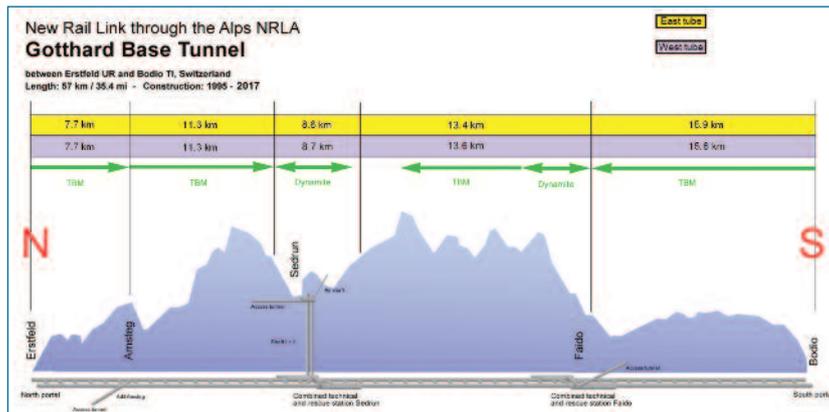
Above: the the Curnera Dam and lake. **Right:** some of the lake's monitoring infrastructure.

centimetres or 3.1 inches, whereas 25 centimetres would have been tolerated," said **Ivo Schaetti**, a surveying engineer of VI-GBT. He explains that surveying tunnels is very demanding due to temperature changes, humidity and dust. "Thankfully, we could always rely on the accuracy of the surveying solutions from Leica Geosystems," Schaetti adds. "They are very precise. You can measure a distance of 400 metres with accuracy of less than a millimetre or 0.03 inches."

Monitoring the dams above the tunnel

During the entire construction period, the surrounding land of three artificial lakes above the tunnel required monitoring: Curnera, Nalps and St Maria. There was a slight probability that the construction of the tunnel – 1.4 kilometres beneath the lakes – could affect the stability of their dams. This monitoring was also done with Leica instruments using fully automated devices throughout the entire tunnel construction from 2000 until 2015.

"Our total stations monitored the tiniest movement of the prisms that were mounted near the dams," says **Falko Henning**, Leica Geosystems product manager. "Happily, no unusual movements occurred." There was no major delay during construction time, and the tunnel will be inaugurated as planned.



A Swiss tradition

Leica Geosystems has a rich history in Switzerland. From its origins with Kern & Company founded in 1819 in Aarau, to a global leader in measurement technology serving customers in many segments.

"Looking back on a tradition of nearly 200 years, we're honoured to once again take part in a significant milestone in Swiss history by providing the surveying and monitoring resources to successfully open the Gotthard Base Tunnel," said Juergen Dold, Leica Geosystems CEO. "With a commitment to Swiss quality and a global outlook, we will continue to innovate and support professionals around the world achieving feats of engineering like this tunnel."

Above: project schema by Cooper.ch - translated from an existing german scheme, public domain. <https://commons.wikimedia.org/w/index.php?curid=433931>

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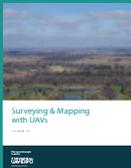

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Are we being smart enough about Smart?

By Simon Navin

With location the common denominator, there are great opportunities ahead for surveyors, argues Ordnance Survey's **Simon Navin** (above), if we realise the benefits for communities through interoperable data from Smart technologies like BIM, Big Data and the Internet of Things.

In man's universal search for simplicity, sometimes we do make life hard for ourselves. The term 'Smart' – according to British Standards Institute (BSI) Smart Cities – may mean 'visionary; citizen-centric; digital; open and collaborative'. Or (if we look at ISO 37101), it may mean '... to contribute to sustainable development and resilience, through soundly based decision making and the adoption of a long and short term perspective'.

There are other, even more complex interpretations. Some are even less helpful. And all too often, they infer that Smart – and Smart Cities in particular – is all about technology, nothing more.

Sustainable efficiency

We believe there is infinitely more to Smart than deploying tech to the right places: it's about using what we have already (from basic resources, through to 'Big Data' and beyond), to be more efficient and to improve people's lives in a sustainable way. When you think about it, that could be something as simple as getting water to a remote community deprived of natural resources.

From health and resilience, through to mobility in communities; from simple air-pollen sensors, right through to driverless cars – the Internet of Things (IoT) and connections to BIM, environments will ensure that Smart continues apace... so there's a need to focus carefully on where our efforts lie.

That's why Ordnance Survey is championing the need to focus on end users' needs, first: by using connected, integrated systems, operations and processes to be more efficient and more sustainable. And if we're doing that effectively,

then we'll see better outcomes for the people who visit, live or work in a place – and for the governments or businesses operating there.

So, where does geomatics fit in? And will technology, data availability and growing initiatives such as crowd-sourcing impact on the role of the geospatial specialist or surveyor?

Deeper, richer data

Opportunities for the geospatial professional lie in the interpretation of deeper, richer data. The geospatial professional can provide authority on data, how it was captured or derived and crucially, why we should and shouldn't rely on it.

It's here that we see the interface between BIM and Smart. Both rely on well-defined interoperable data; both need an understanding of location, objects and connections; both need multi-disciplinary skills allied with data and technology capabilities – and both require collaboration and a requirement to share data in ways that facilitate better outputs and enable effective decision making.

Innovative sharing models

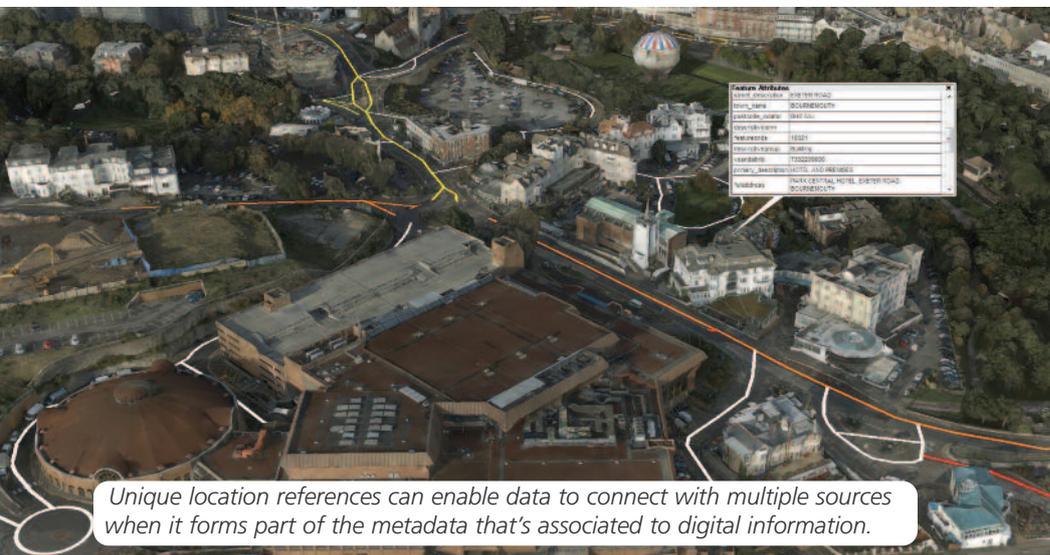
So, if geospatial requirements for Smart/BIM are essential, then where will data come from, for these intelligence-led projects and initiatives? Clearly there are privacy and commercial considerations, but long-term benefits should see more innovative sharing models that overcome those concerns. Those models should reduce costs too, which will enable greater economies of scale and access to more open data or premium data: fit for purpose, easy to use, simple to integrate.

However, things get even more complex

when we start factoring in a new wave of data from mobile devices and the Internet of Things. Our attitudes and approaches to privacy must move away from granting or asking for blanket permissions on usage – technology can assist here like never before.

Location – the common denominator

Data will underpin the quality and reliability of all outputs for smart places in the areas of mobility, health, resilience, sustainability, demographics for example and for connecting land, property and construction. All sorts of places are wrestling with these issues and no one has the monopoly on the good ideas. The use of data to both analyse the problem and the impact of



Unique location references can enable data to connect with multiple sources when it forms part of the metadata that's associated to digital information.

any interventions has to be a first step. However, not all of these datasets or feeds are recognisable to the geospatial community as they are often abstract, lacking authority or a traditional geometric structure. However, everything happens somewhere. Location – something that is familiar – can be the unique common denominator by which we connect all of these data and content packages.

Unique location references, such as the UPRN (Unique Property Reference Number) and the USRN (Unique Street Reference Number), can enable data to connect with multiple sources when it forms part of the metadata that's associated to digital information. These unique identifiers can also be applied to real-world objects at a more granular level, much as you'd expect to see in BIM environments. The connections between these objects and environments that touch the BIM-defined assets can definitely contribute to the success of Smart.

User-centric solutions

We know technology isn't the only, or primary answer for Smart to be a success. A bottom-up approach that's focused throughout on putting users at the heart of the solution is what's needed. The data that underpins the improvement of services and solutions needs to be accessible and collaborative; places need to encourage users to consume it in ways that

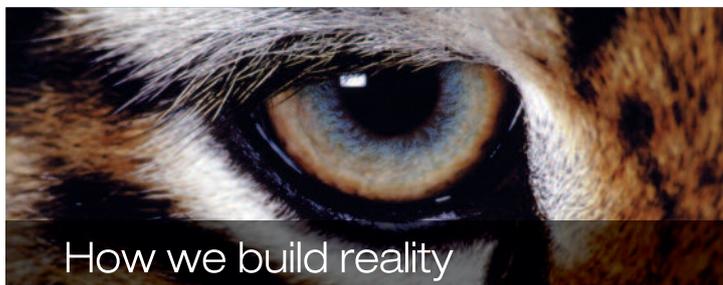
work for them, right down to the individual level. In fact, there may be a danger in prescribing overt 'big data!' solutions, when success is more likely by enabling data to work in the background for individual citizens.

The geospatial community has a great opportunity to bring their data management expertise to the centre of Smart projects and urban development. As population increases, and technology becomes less prohibitive, the need to capture, manage and share more and better quality geospatial data will grow. Surveyors will benefit enormously if they can incorporate some less familiar disciplines, and as a result, put the geospatial professional right at the heart of urbanisation.

About the author

Simon Navin MRICS MCInstCES is project lead within Smart Practice at Ordnance Survey. He currently is responsible for the management, coordination and delivery of OS's Smart/IoT sector projects including the UK's key Internet of Things demonstrator project, CityVerve in Manchester. Simon began his career in the built environment in 1990 and has extensive experience in environmental management, planning, design, architectural visualisation and construction. He is a chartered surveyor and OS's representative for Survey4BIM and a member of the CICES Anglia and Central Region committee.

“Surveyors will benefit enormously if they can incorporate some less familiar disciplines, and as a result, put the geospatial professional right at the heart of urbanisation.”



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Geodesy & engineering surveying papers

Not enough time or too costly to go to New Zealand for a week? Never mind, our technical editor **Richard Groom** has rummaged through the papers from the recent FIG working week in Christchurch New Zealand and provides readers with an informative summary enough to whet appetites for those who yearn for more.

The FIG working week was held at Christchurch, New Zealand and had 'Recovery from Disaster' as its theme. This article is a review of those papers with a geodesy or engineering surveying flavour that were presented at the technical sessions.

Datums and tectonics

Crook, Hansen and Gentle (TS01B) presented a most informative paper on aligning the New Zealand Datum with the ITRF and the problems arising from tectonic disturbance. The New Zealand Geodetic Datum (NZGD) 2000 includes a deformation model that links the datum, which most users will perceive to be static for the purposes of mapping and location, with ITRF. NZGD2000 is a 'plates-fixed' datum: a description that replaces the term 'semi-dynamic'. The paper is useful not just for interest but also as a geodetic refresher following GW's last issue's update on new transformations for the UK and Ireland.

Nepal is considering the development of a semi-dynamic datum to deal with movements due to its position on the boundary between the Indian and Eurasian plates. **Pearson, Manandhar and Denys** (TS01B) describe the options covering the process used to derive velocities on a grid to model normal tectonic movements. Earthquakes cause sudden and sometimes large movements – up to two metres were recorded after Nepal's 2015 earthquake and these are incorporated by writing 'patches' to cover deformation of the affected area.

Susilo et al (TS05B) discuss the development of a deformation model for the Indonesian Geospatial Reference System 2013. Indonesia sits across four tectonic plates and seven tectonic blocks. The study made use of data from 300 continuously operation GPS receivers (COGRs) and 1000 episodic stations.

Geoid modelling

Roman and Li (TS08D) give a fascinating update on the development of GRD22, the geodetic reference datum for the USA planned for implementation in 2022. This is riveting reading for anyone interested in geodesy and furthermore is written in straightforward flowing language. What a joy!

In another useful article for rusty geodesists, **Kempe, Jivall, Lidberg and Lilje** (TS02B) describe the management of geodetic reference frames in Sweden. Sweden is notable because it completed its third geodetic levelling network, known as RH3000 in 2003 and plans to keep it up to date with new sets of observations every twenty-five

years. The main crustal deformations experienced are due to isostatic rebound from the last ice age. Surprisingly, isostatic rebound has a component in plan as well as in height.

In a slide presentation, **Amos** (TS08D) explains how New Zealand has produced an improved geoid model from an accuracy of 60mm down to 30mm (in developed areas) using airborne gravity measurements.

Japan has just produced a new geoid model as described by **Matsuo, Miyazaki et al** (TS08D) with a precision of 78mm. This was produced using gravity data from GOCE and altimetry-derived gravity data over marine areas. They see further room for improvement using a 10m grid digital elevation model of the country.

Improving GNSS observations

Alizadeh-Khameneh, Sjoberg and Jensen (TS01D) look at correlation effects in GNSS observations. For double-difference phase observations the correlations are mathematical and physical due to differencing and environmental effects. The result is over optimistic variance covariance matrices. The authors look at a simulated GNSS network with a view to optimising the variance factor for each session of observations involving more than one baseline.

Lidberg, Jarlemark, Ohlsson and Johansson (TS02B) assert that the accuracy of continuously operating reference stations (CORS) station coordinates is now the limiting factor in Network-RTK. Their studies show that electrical coupling between the antenna and 'its near-field environment' changes the characteristics of the antenna. They have carried out a field calibration at nine CORSs and, because their existing antennas can only receive GPS signals, they have installed second antennas at each site to record from all constellations (see Figure 1). The new antennas are installed on steel grid masts to reduce multipath effects and have also been calibrated. The effect was a change in the antenna heights of between 7 and 16 mm.

"Does Beidou Enhance Positioning Performance within Corsnet-NSW?" was the question asked by **Vanderstappen, Roberts and Grinter** (TS02B). Their investigations in Australia revealed a 30mm bias in height which they attribute to 'inappropriate Antenna Phase Centre Variation' modelling.

The attraction of web-based GNSS data processing is clear: no need to purchase proprietary software or to maintain it. **Alkan Veli et al** (TS07B) report on a comprehensive comparison of the various services over a

"... riveting reading for anyone interested in geodesy..."

twenty-four hour period with data broken down into one, two, four, six and twelve hour sessions and computing using precise point positioning (PPP) and differential methods. The data came from CORU, a station in the Turkish RTK network. A scan of the results table suggests that four hours is now the optimum time for observations to obtain heights within 20mm using PPP and relative techniques. However, the magicGNSS service seems to give consistently poor results. The test was for static data, although some services can process kinematic data too.



Above: Figure 1, Swedish CORS showing concrete pillar and steel grid mast.

Real time PPP was the subject of **Harima, Choy et al** (TS07B). They tested three service providers and found horizontal accuracy of 6cm and vertical accuracy of 10cm following an hour for solution convergence. They also provide an explanation for poor performance of the magicGNSS service. This is probably the best article for those who wish to keep up to date with PPP.

Ashcroft Tawk et al (TS07B) gave an exhaustive description of Leica's VADASE algorithm, which can derive velocity autonomously for Leica's reference and monitoring receivers and then by integrating, can derive movement. As well as being standalone, the computation is real time and instantaneous.

Kowaleski, Heinen et al (TS07B) introduce the concept of Open GNSS Receiver Protocol (OGRP). The protocol would give developers the opportunity to work with raw data and to optimise software for specific applications.

Leong (TS07B) describes research into ionosphere modelling. This is useful for work with single-frequency receivers. He obtained interesting results when using the Centre for Orbit Determination in Europe (CODE) Global Ionosphere Maps (GIM).

Tang and Roberts (TS07B) presented on relative positioning performance with the BeiDou constellation. Like many presentations, the proceedings only provide the speaker's slides, from which one can only obtain an outline of the presentation. Of particular interest with this one however, is the significantly improved vertical positioning with BeiDou as opposed to GPS, which are better still when they are combined.

Tsugi, Matsuo et al (TS07B) describe a project to develop a new processing technique for multi constellation GNSS and the result is open source GSILIB and a manual for carrying out 'public surveys'. The paper gives a description of the various biases that affect GNSS positioning in a multi-constellation world.

Monitoring tectonics

Ozener, Aktug et al (TS04B) describe a project to determine fault slip rates for active faults in Turkey. Whilst **Pahlevi et al** (TS04B) investigate the effect of ocean tide loading on CORS

stations in Indonesia and **Rangelova and Piretz** (TS04B) consider modelling of the geoid rate of change and vertical crustal movement in the context of Canada's new vertical datum.

Chien-Zheng, Denys et al (TS03B) report velocity changes of tectonic plates in Peninsular Malaysia following earthquakes in the region in 2005 and 2012.

Surveying in the aftermath

Perwick (TS07E) describes the surveying work resulting from the Christchurch earthquakes and particularly the subsequent monitoring work. There was certainly plenty to be done.

BIM

Bugge and Øyvind (TS02J) asked "What is BIM without surveying engineers?" and urged surveyors to take a new step. The conference proceedings only contain slides, but these give some idea about their approach.

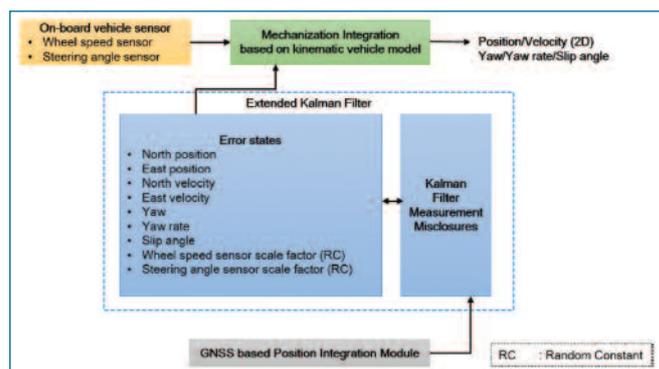
3D data fusion is the subject of a paper by **Nesse and Hågnefelt** (TS07D). They concentrate on the energy sector and present a number of case studies involving the merging of point cloud data from LiDAR, terrestrial scanning, multibeam bathymetry and photogrammetry from UAV photography. They encourage surveyors to influence their clients to make the most of 3D digital data as the backbone for BIM.

Controlling mobile mapping

Han, Lee and Kwon (TS03B), tackle the problem of determining sensor position for mobile mapping in urban canyons. They have investigated the use of vehicle speed (WSS) and steering angle sensors (SAS) to help with this problem (see Figure 2). It is work in progress and they are looking to carry out further performance analysis, filter tuning and

"... the magicGNSS service seems to give consistently poor results."

Right: Figure 2, GNSS/SAS/WSS data integration strategy





Above: Figure 3, Lidar Validation vehicle in the Philippines records topo data.

to integrate additional sensors.

High precision survey

How do you carry out an alignment survey to a precision of a few tens of microns over 70m? **Martin** (TS01D) describes how this was done for the European Synchrotron Radiation Facility, predominantly using laser trackers. **Roberts** and **Tang** (TS01D) describe monitoring of the Severn Bridge using GNSS to measure the effect of temperature variation on the bridge structure.

Ever wondered how to determine the offsets between a GNSS station and a radio telescope at a geodetic IGS station? **Gentle, Crook et al** (TS05D) provide a set of slides showing how it was done at Warkworth, near Auckland.

Analysing reflections

Neil et al (TS04E) have studied multibeam bathymetry data for ecological mapping of the sea floor. This involves creating a benthic terrain model (BTM) to classify the sea floor into zones based upon analysis of the dimensional bathymetry, metrics derived from bathymetry (e.g. slope and aspect) together with backscatter data.

Mukupa, Roberts et al (TS06D) analyse intensity from laser scans of concrete structures and conclude that scanning can be used to detect fire damage.

Nugroho et al (TS04E) describe a method of mapping underground rivers and cavities using surface resistivity measurements and **Al Mistarehi** and **Schwieger** (TS08B) describe a new algorithm for classifying cracks in road pavements using data from mobile mapping surveys.

Radar

Mark Bell is business development manager for radar manufacturer IDS Australasia. His paper (TS05D) is useful for its up-to-date coverage of the uses of radar observations for a multitude of purposes, from precise monitoring – he claims higher accuracy than a top of the range total station, ground and aerial based interferometric synthetic aperture radar (inSAR) through to ground penetrating radar for detecting utilities and underground anomalies.

Deformation monitoring

Becker et al (TS05E) describe a system for monitoring embankments (dikes) in Germany. It consists of sensors in the embankments as well as wave and other environmental sensors, communication of data to a hub and then real-time simulation of the effects on the embankment and delivery of warnings to those who could be affected. They call it a Sensor and Spatial Data Infrastructure (SSDI) and, although the concept is quite straight forward, it is well worth reading about its architecture, which could apply in many other situations.

The use of laser scanning for deformation modelling is becoming more popular and **Harmening, Kauker et al** (TS06B) have been researching this area. Their paper is an update

on their progress and worth a skim read for surveyors involved in monitoring.

Bathymetric Lidar

And so to French Polynesia, where **Sinclair et al** (TS05E) have used bathymetric LiDAR to map inter-tidal zones. Their article is useful as an update on what is now possible thanks to greater depth penetration, higher data density and higher accuracy. LiDAR bathymetry was also used to survey inshore waters around Samoa, as reported by **Quadros** and **Chamberlain** (TS05E), for a study of environmental hazards. In addition to LiDAR bathymetry, they used normal LiDAR to cover the land areas and satellite radar to fill in some gaps that arose due to cloud cover.

Indoor positioning

Indoor positioning is an active area of research and **Retscher** and **Hofer** (TS06B) describe a navigation and positioning method called WiFi location fingerprinting, which makes use of WiFi signals for absolute positioning and accelerometers and compass for dead reckoning observations. In the same session **Retcher** and **Tatschl** (TS06B) describe research into another technique – DWi-Fi – which is analogous with the familiar GNSS.

Sport is now a business shrouded in a cloud of commercialism, all of which is dependent upon the sportsperson's performance. According to **Wieser, Boffi et al** (TS06B) GNSS is here to help by computing velocity – a vital aspect of training. Their results show that precision can be better than 10mm per second.

Surveying for flooding

Sisell, Hallengren et al (TS07E) describe the development of a watercourse and water body network GIS in Sweden, but it is labelled 'hydrographic' when 'hydrological' might be more appropriate, although it is the former term that is used in the INSPIRE directive. This would seem to be an essential national dataset akin to geodetic networks, but I wonder how many countries have one. They highlight maintenance of the network as a significant issue.

Balicanta, Caballero et al (TS08E) describe surveying for flood modelling in the Philippines. They validate their surveys in an unusual way by setting up two GNSS receivers on a vehicle and recording continuous topo data whilst driving along roads crossing the LiDAR runs (Fig 2). They also observe PPK points manually on concrete surfaces to cross check the vehicle data.

Finally, on a historical note, **Henderson** (TS04J) looks at the work of Colonel **William Light**, first Surveyor General of South Australia in planning Adelaide with disaster risk management in mind and all based upon common sense alone. Work that was vindicated 150 years later when the River Torrens Flood Inundation Mapping Study proposed the same measures.

“... radar observations for a multitude of purposes...”

• Papers can be downloaded from: http://www.fig.net/resources/proceedings/fig_proceedings/fig2016/techprog.htm. For the next issue we plan to focus on Land administration and other areas not covered in this article.

Construction Verification – a question of trust

In creating an accurate BIM it's all about trust. So how can you trust surveyors? Is independent validation the answer? Richard Groom reports from the latest meeting of the BIMnet group.

“The solution offered was independent validation throughout the life cycle of the project...”

Below: Michael Johnson, 'the cost of verification surveys is less than the potential cost resulting from out-of-tolerance construction.'



BIMnet is a digital environment networking group aimed at bringing together interested parties and key players within the Building Information Modelling (BIM) sector in an informal environment. The group's sponsors are Bespoke recruitment specialists, Plowman Craven, Skanska, Levitt Bernstein architects and Willmott Dixon. It organises evening networking events in London, which are free to attend and provide an ideal opportunity for BIM enthusiasts and senior executives to network with decision makers and influencers within the construction environment.

The member organisations are at the forefront of BIM implementation and focus their attention on the difficulties encountered when trying to turn the BIM strategy into something practical and one that works throughout the asset's lifecycle. This was a point emphasised during the latest event: the BIM Strategy is just that, a strategy. Work has to be done to develop efficient implementations from the high level document.

Is it right?

Last time I reported from BIMnet the topic was facilities management. This time the question can be summarised as: you have a model, but how do you know it is right? It is a timely question as government has set a supplementary stretch target for October 2016, over and above the April 2016 compliance mandate, to encourage data verification and drive up quality.

Three speakers, **Michael Johnson** (senior BIM Consultant at Plowman Craven), **Paul Thorpe** (BIM/VDC Coordinator at Brookfield Multiplex Construction Europe Ltd) and **Shaun Farrell** (associate director, technology BIM at Turner & Townsend) presented their views on the subject in three engaging talks.

Repeated validation

The problem lies in the requirement for each participant in a project to validate the data they receive before using it. It's a process that is currently repeated as the data passes through the supply chain. The same item of data may be validated by many different organisations, which is wasteful.

Furthermore, whilst it is fine, the argument goes, to run clash detection on the design model, the theoretical building evolves into an actual

building. Trades will turn a design that may well be 'unbuildable' into shop drawings and then it is constructed. Also, structures settle and respond to environmental factors. If the position of elements has changed, then clash detection should be re-run on the model 'as-is'. As the construction industry further embraces prefabrication, the accuracy of the model will become even more important.

As-is models

The data may be the same, but each subcontractor will probably use it in a different way, so how do you imbue the data with the trust needed for such a concept to work? What is needed, said Thorpe, are models that are correct in almost real time – 'As-Is' models, whether containing the latest design version, a 'shop drawing' model, part build or as-built.

The solution offered was independent validation throughout the life cycle of the project, with the clear view that the validators should be surveyors. Johnson argued that the cost of carrying out a verification survey is less than the potential cost resulting from out-of-tolerance construction. The survey cost could come out of contingency money traditionally reserved for sorting out problems later in the construction process. But this means more front-loading of construction costs and that takes faith on the client's part.

It may be fairly easy to detect if something is missing, but what if it has been constructed outside the required tolerance? This is much more difficult to detect. And, to complicate matters further, different elements will have different construction tolerances.

Trust

The problem boils down to trust, which happens to be an essential quality for effective collaboration and prompted an interesting if alarming question from the floor: "How do you trust surveyors?" The answer offered from one speaker was to ensure a robust specification, with the implication that you clobber the surveyors if they don't meet it. If that is really the answer, does it not imply failure on the part of the surveying institutions to live up to their constitutions? Not only do the independent surveyors themselves have to be trustworthy but they also have to be recognisable and recognised as trustworthy.

Like its predecessor, this event was well run and invaluable. For more information visit www.bimnet.com

Conference brings BIM alive

Cadline's Autodesk user conference took place in the heart of the City of London in June. **Richard Groom** reports that BIM was the hot topic this year.

“... the coordinates appeared as the national grid expressed in millimetres.”

Cadline invited delegates to participate in a free Discovery review to see how, as an Autodesk Platinum Partner they can help guide individual clients on to a successful road to BIM adoption.

With the deadline passed for central government contracts worth over £50 million to be using BIM level 2, this year's conference concentrated on helping delegates to get to grips with the nuts and bolts of BIM.

For early birds there was a pre-conference session on 'BIM leadership', which was aimed at anyone 'new to BIM or confused about what they should be doing next'. There were a lot of us! **James Philip** put 3D modelling in the centre of BIM and explained how federated modelling is the means by which different disciplines contribute their expertise and retain ownership, whilst enabling collaboration. This integrated approach means design can proceed concurrently, with plenty of tools to detect and resolve difficulties before construction commences.

Licensing

Following the pre-conference session for newbies, **Scott Woolven** welcomed delegates and gave an update on Autodesk licences. He began with a warning that renewals have to be received by Autodesk before the current licence expires or users will have to buy a new licence. Licences can be renewed up to 90 days before expiry of the old one so the advice is to order with plenty of time to process the orders.

From 31st July 2016 Autodesk will remove all remaining perpetual licences and all 'suites' will be withdrawn from sale. From 1st August, three software 'collections' will be introduced – architecture engineering & construction; product design; media & entertainment. These can be rented on a three-month or one, two or three year basis. This reduces the upfront cost. There are various options to migrate from perpetual licences to the new licence rental system.

Woolven also introduced Cadline's 'Journey plan'. This is intended to help users in particular disciplines to implement BIM. He also said that Cadline has noticed a trend towards more work being done in-house with less out-sourcing.

BIM in 90 mins

PAS1192 is the document that defines the BIM process in Britain. It gives structure by specifying key documents, roles and responsibilities. Early on in the evolution of BIM, the Royal Institute of British Architects (RIBA) drafted a BIM 'Plan of Works', which has been adopted by the AEC industry as a de facto standard for implementing BIM. The Cadline team took us through all six stages of the Plan of Works.

The task was a hotel development at Glastonbury. Stage One: preparation involved downloading OSMapBuilder data for Infracore 360. For stage two a building was sketched using

Autodesk's answer to SketchUp – Formit360 and then transferred to Infracore360, a conceptual design tool that enables outline design work for the site and road access on a DTM with map or imagery background. It's a quick way to work up options, which can be used as the basis for consultation. When the outline design is ready it can be exported as an IMX format file and then read into Autodesk Civil3D. At this point the file might be saved to a Common Data Environment on Autodesk's Vault. From here on, audit tracing is automatic.

When we returned from coffee the project was at RIBA stage 3, the developed design phase. The IMX file was read into Civil3D and then the site grid set up by clicking on two points to define the origin and orientation. No discussion about scale factors and the coordinates appeared as the national grid expressed in millimetres. Help!! I hope every surveyor is aware that Ordnance Survey does not measure to millimetres.

Swiftly on to step 4: technical design, where we were shown how to combine the federated models using BIM360 GLUE, which enables any partner in the project to view any model and make mark-ups. It can also detect clashes between different models to see if, for example, elements in the structural model clash with those in the MEP model. It is at this point that component manufacturers can get involved. The example we were given was a fanlight window. The idea is that the manufacturer can see the fanlight as depicted in REVIT, then use Autodesk Inventor to design the window and export to Autodesk360 as a new component. The interface between BIM as used for design and for shop drawings used by trades is at last being addressed.

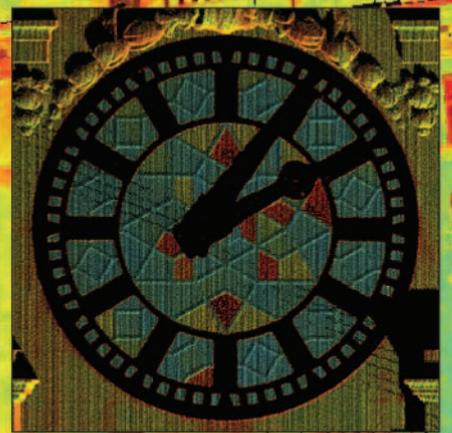
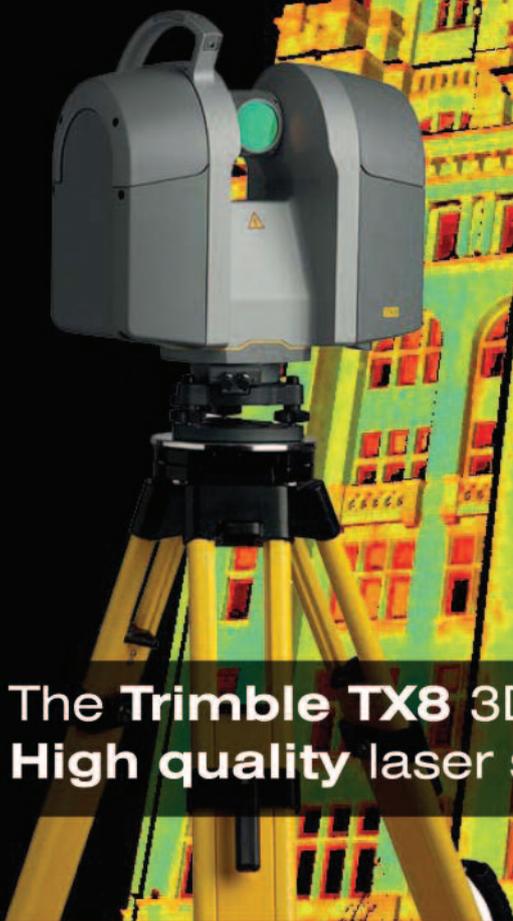
And so, on to stage 5 – construction. Here, the team used Navisworks tools to produce contract documents and then simulate construction and produce animations for site project meetings. BIM360 is then used to allocate construction tasks and track them by monitoring in real time.

Stage 6 is project handover and close out, including hand-over of as-built models and commissioning documentation. Another neglected area has been building operations but Autodesk has software to do that too. A mobile phone app can be used to set maintenance tasks, create job cards and monitor the work.

Bringing it together

Cadline were able to demonstrate how a project is handled throughout its lifecycle. It was certainly a brave live demo but gave a valuable overview of the whole BIM process. This event was time well spent and free of charge, to boot.

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Entry on the Land Registry's register is proof of title. Or is it? **Carl Calvert** and m'learned friends examine some recent judgments and find that it may not necessarily be the case.

“... it is not always about money. Land ownership is also about people's homes and businesses...”

Is the registered proprietor of land really the owner?

By Carl Calvert

The Law Commission Consultation Paper No. 227, 'Updating the Land Registration Act 2002: A Consultation Paper', was published on 31 March 2016. The Stationary Office gives the following paragraph in their sales blurb for the consultation paper:

'Entry on the register is all that is needed to prove title, and the law does not allow buyers of land (or lenders) to look behind the register at the deeds and other documents to establish their title. Furthermore, the law guarantees the correctness of the register.'

Is that really the case? The discussion below considers the guarantees of correctness, or otherwise, of the register.

Topical lectures

The Blundell Lectures are an annual series of property law lectures for which the speakers give of their time freely and proceeds are split equally between the RICS, Bar Council and Law Society. I have attended these lectures regularly and found them to be highly topical. This year **Joanna Lampert** of Berwin Leighton Paisner and **Janet Bignell** QC of Falcon Chambers gave a lecture entitled; 'Can I really rely on the Register of Title?'

Rectification and correction

Gold Harp Properties Ltd v Macleod and Others [2014] EWCA Civ 1084 is a case in point. There were four teachers, all of whom had 135-year leases for part occupation of a house in Kensington; Mr and Mrs Jessell had a lease for the bottom two floors whilst the other two teachers had a lease for half the roof space. The developers, who bought the property, sought to redevelop it and resorted to acts which would mean forfeiture of the four leases. The LR removed references to the leases, issued a new freehold title and a new leasehold title to a person other than the four teachers. The case was brought by the teachers who sought rectification of the register. The judge ruled that there were no exceptional circumstances which would not allow for rectification of the register (Section 2 of Schedule 4 of the Land Registration Act 2002, LRA2002). The defendants, the property developers appealed but the Court of Appeal upheld the decision of the court of first instance which had reinstated the teachers' leases.

So, is there anything special about a mistake being rectified? Rectification is where there is a mistake which is prejudicial to the registered proprietor. In this case it was the leaseholders who were the registered proprietors.

Furthermore the judge ordered that the claimants, the four teachers, should have their lease as superior to the new lease which had been granted by the freeholders to Gold Harp Ltd.

As Joanna Lampert concluded; '... it is not always about money. Land ownership is also about people's homes and businesses. ...' While Janet Bignell QC's opening comment was '... the legal estate will vest in a person even if he is a registered proprietor on the basis of a forged transfer – which is a nullity.'

Forged transfer

In *Mallory Enterprises Ltd v Cheshire Homes (UK)* [2002] EWCA Civ 151 [2002] Ch216 it was held by the Court of Appeal that a registered proprietor who took under a forged transfer held the bare legal estate which was subject to the equitable estate of the true owner. No indemnity is payable by LR where the rectification gives the equitable owner an overriding interest. This is because the registered proprietor was always subject to that overriding interest. This case was brought, and the appeal heard prior to the introduction of the Land Registration Act 2002 (LRA2002): the statute applicable at that time was the 1925 Act.

In *Swift 1st Ltd v Chief Land Registrar* [2015] Civ 330 [2015] Ch 602 the Court of Appeal considered the circumstances in which the proprietor of a registered charge, subsequently shown to have been the result of a forged disposition, is entitled to be indemnified under LRA 2002 where the registered proprietor and rightful owner is in actual occupation at the date of the disposition. The Court of Appeal was required to consider the correctness of the previous decision by the Court of Appeal in *Malory Enterprises Ltd v Cheshire Homes (UK) Ltd* [2002] EWCA Civ 151.

LRA 2002 ("Schedule 4") has a two limb test under paragraph 1:

- "In this Schedule, references to rectification, in relation to alteration of the register, are to alteration which-
- involves the correction of a mistake, and
 - prejudicially affects the title of a registered proprietor".

If both limbs are not satisfied then it is an alteration to the register: if both limbs are satisfied then it is rectification. The Registrar has a discretion under Schedule 4 to pay costs incurred in connection with the alteration of the register but an award of substantial compensation is only available where there has been a rectification.

In *Swift Patten LJ* decided that the decision in *Malory* was decided *per incuriam* ('for lack of care') for two main reasons. Firstly that the Court of Appeal did not take account of an earlier decision in *Argyle Building Society v Hammond* (1984) 49 P & CR, which held that s.69(1) Land Registration Act 1925 has the effect of vesting title by registration even where there has been a forgery in the transfer. An exception to the general principle, *nemo dat quod non*

habet (you can't give that which you don't have).

Secondly, in *Malory* the court had not had its attention drawn to s.114 LRA 1925, which provided that s.20 LRA 1925 (effect of registration on freehold dispositions) did apply in cases of forged disposition.

Patten LJ commented that these points should be considered in the consultation by the Law Commission and they are: paragraph 13.47 of that consultation Paper states:

'The *Malory* 1 argument is a deeply problematic approach. It is unprincipled; it nullifies the provisions of the statute for protection of the proprietor in possession; it is vulnerable to random outcomes; and it raises problems where an indemnity is claimed. The *Malory* 1 argument has now been held to be wrong and cannot be relied upon. . .'

“Land Registration Act 1925 has the effect of vesting title by registration even where there has been a forgery in the transfer.”

Book Review

from Captain James Cook to Charlie Trimble and Javad Ashjee

an amazing technology it is – timing, surveying, telephony, navigation, tracking and much else is dependent on the satellites. GPS is now what we call critical infrastructure, which loss or disruption will cost billions.

Pinpoint is an engaging if somewhat eclectic read. It begins with a discourse on those ancient Polynesian navigators and Captain James Cook's voyages in the Pacific (guided by one of Harrison's early clocks) along with his meeting in Tahiti and travels with Tupaia, a navigator skilled in the ancient mysteries and crafts necessary to reach those far off islands hundreds of miles away. Surprisingly there is no mention of the stick maps used by many Polynesian navigators.

We move to the dawn of rocket science and the International Geophysical Year in 1957 (a starting point for global positioning) and the early failures of Vanguard and the shock the US had when Russia beat them into orbit with Sputnik. You need to remind yourself that whilst humanity has benefited from technology so much of it has been driven by conflict. Navigation improved during the second world war through radio and radar but the game-changer was the US military's need to plant a nuclear missile somewhere to within a few feet.

Milner traces the early history through the Transit satellites

(which incredibly began on a budget of just \$1 million), describes the GPS system in much detail including the ground stations and need to "drop 5 bombs in the same hole"

Desert Storm was what made GPS, argues the author. While we may decry the use of GPS to guide bombs and missiles and accurately target artillery, it has greatly reduced the so-called collateral damage and injuries of the second world war and Vietnam. The 1990 war against the Iraqis, the so-called first Gulf War proved beyond doubt the efficacy of GPS. From airmen to ground troops the technology was widely used even though there was probably no more than 7,000 sets in use by ground forces.

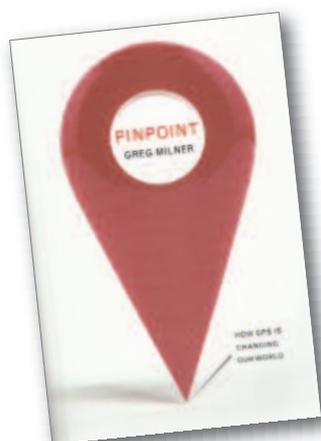
There are many people who have been involved in the development of GPS. Milner draws them well. From generals to scientists and technologists, people like **Brad Parkinson** or **Ralph Eschenbach**. For surveyors two names stand out: **Charlie Trimble** and **Javad Ashjee**. Their relationship in the early days was pivotal in exploiting GPS signals for civilian applications and especially marine where GPS's hyper accurate timing was critical to better navigation at sea. Although the relationship did not last long (Ashjee left Trimble, his first employer after he arrived in the US from Iran) it set the scene for

a growing competitive market in GPS receivers. Ashjee left Trimble to found his own company with allegations that he'd already designed his first product while still with Trimble. There's interesting history there but few are prepared to talk about it, including Charlie Trimble.

There is much about surveying, datums and GIS in *Pinpoint*, not all of it particularly correct or true. As every surveying student should know, EDM does not stand for electronic distance measurement, while many would quibble with describing Google Maps as the "world's most accessible GIS". Neither should we be quick to blame GPS for some of those horrific blunders people have made with sat-navs, which the author recounts in detail – poor maps and human stupidity have always been there. So is GPS changing our world? There is no question that it's part of the black-box world we now live in where so many trust technology yet have not the faintest idea how it works. Perhaps there is hope though through maps; few of us are not attracted by maps ancient and modern.

Pinpoint is a great read with lots of insight and anecdotes even if some fly in the face of GPS's precise positioning trigonometry by heading off on a tangent. Enjoy.

Reviewer, Stephen Booth



Pinpoint – How GPS is Changing our World

By Greg Milner
Published by Granta, ISBN 978 1 84708 708 9

For tens of thousands of years humanity has been exploring this planet and until very recently, without any more than a study of the stars, winds, currents, weather and other natural indicators to guide us. We have some remarkable achievements to our credit. The move to Australia over 40,000 years ago (judged one of humanity's greatest achievements by **Yuval Noah Harari** in his book *Sapiens*) and the occupation of the vast Pacific at a time when most thought the Earth was flat (how did they know they would find land? Left to Europeans they might well have fretted about going off the edge).

Today we have GPS and what



• *John Brock is a Registered Surveyor in Australia and is a stalwart of FIG and its Permanent Institution for the Art and History of Surveying.*

Our very own earthy Aussie gives his views on politicians, the quest for longitude and graveyards. Read on.

Below right: with Lady Mayor of Hills Shire, Michelle Byrne.



Time, longitude and a spot for Australia's greats

While you Englishmen and Boris Johnson were expediting your Brexit we were making serious choices between the incumbent bunch of losers and their various opponents such as the Animal Justice Party, the Sex Party and the Pirate Party. If the latter candidate got in there would have been no one game enough to shake his hook in congratulations that's for sure. Oh well, another hung Parliament until the next call to arms is thrust upon us. Just to reinforce what it means to install another bunch of jibbering buffoons to run our country I do despair for my grandchildren with my granddaughter Sybella turning a feisty four on the first weekend in August.

Juke Box Jive on Alive 90.5

Kerima-Gae has had a radio programme called "Juke Box Jive" going out over the airwaves for over 20 years on FM 90.5 with me more recently filling in as her faithful "barrel boy" to take phone requests for rock 'n' roll songs from the '50's, '60's and '70's on a Friday night between 9 pm and midnight. You can actually stream on your computer if you can work out the time difference between the UK and Sydney when we are on air (*9 hours ahead – Ed*).

She also organized a barbeque within the grounds of the station attended by VIP guests the Lady Mayor of Hills Shire, Her Worship **Michelle Byrne** with Aboriginal elder **Uncle Greg** providing a Welcome to Country supported by a smoking ceremony on behalf of the local indigenous tribe. Nearly 70 announcers, station members and guests partook of an excellent feast cooked by myself and **Frank Dengate** who also has a programme showcasing blues music called "Blues Circus."

Star Sydney surveyor at Australian National Maritime Museum

First Fleet Surveyor from the First Settlement of our far away colony **William Dawes** was once again the flavour of the month, this time for an audience of 40 at the Australian National Maritime Museum at Darling Harbour in Sydney. After my well received effort peppered with lots of questions, Kerima-Gae and I viewed the brilliant exhibit at the museum titled "Ships,

Clocks & Stars – The Quest for Longitude" complete with replicas on loan from the Greenwich Maritime Museum of Harrison's legendary H1 to H4 timepieces, Kendall's K1, the original of which was tested by **James Cook** on his second world voyage between 1772 and 1776 together with an assortment of other such longitude-busting tools by clockmakers like Arnold and Earnshaw. A truly splendid array of quality reproductions working like clockwork of course!

Dead men do tell tales

An exceptional Topp Tour started with Kerima-Gae's brilliant "Talking Tombstones II" presentation during which incredible stories of cemeteries and graveyards (and I can assure you there is a big difference!) from all over the world are brought to life. To clarify for you all a graveyard can only occupy the grounds surrounding a church while a cemetery does not. This does not mean that there are not incorrectly named cemeteries around churchyards but it is most definitely not correct to do so.

We are transported from Sir **Thomas Mitchell** NSW Surveyor-General's resting plot in the graveyard of St Stephen's Church in Sydney to Melk Monastery in Austria and Pompeii in southern Italy. One of your smarter-than-the-average Austrian Kings Joseph II (also called the Holy Roman Emperor) introduced a disposable coffin to demonstrate recycling before it became fashionable but it lasted as long as daylight saving in Queensland because the Catholic majority population found the idea of their relative's bodies dropping out of a trapdoor straight into the ground so that the coffin could be reused unacceptable.

On the tour of Rookwood Necropolis (literally "City of the Dead") which is the biggest cemetery in the southern hemisphere we saw St Michael the Archangel's chapel as well as burials for some famous Australian characters, the more notable of whom were the Toohey brothers, whose name is immortalised in the beer well imbibed by New South Welshmen for well over a hundred years. Even **John Deering**, the original surveyor of the cemetery grounds, is safely stored within the well laid out Victorian design of his own measurement. Retail store magnate Anthony Hordern and his family also lay at rest near the aforementioned chapel. This resting place is a fascinating area to visit but many days would be required to adequately inspect the ornate and interesting occupants of the numerous sites.

Three words to Rio

what3word's unique 3 word addressing system has been integrated into numerous mapping and navigation services, from the award-winning RioGo app (which won the Rio Olympics Transport Challenge) to Navmii, the biggest offline satnav app in the world. Getting around can be complex. Specifying exactly where to meet, or where to go in a pop-up venue like the Olympic park can be difficult. For example, there are four entrances to the Aquatic stadium and were named, expired.stud.cucumber, carbon.padding.puddles, ducks.hillside.frocks and saying.rossette.slogged. Simple yes?

More apps for Luciad

Luciad, a provider of technology that connects geospatial data to deliver real-time situational awareness, has launched version 2016.1 suite of its geospatial software solutions. The new release continues Luciad's R&D focus on four strategic pillars: 3-D in the browser, developer and user experience, data and application integration and visual analytics.

Doubling performance

Thinkbox Software has announced Sequoia 1.1, a new version of the standalone point cloud meshing application that nearly doubles the software's previous performance speed. Additional advancements include native Linux support along with new workflows capable of maintaining georeferenced data precision, and simplifying the process of exporting textured mesh data to 3D applications and game engines.

Measuring with iSTAR

NCTech has announced that the measurement module for its iSTAR panoramic camera has been integrated into Arithmetica's

SphereVision Project Builder and Veesus Arena4D software. The module is delivered as a free-of-charge NCTech SDK and enables iSTAR users to take measurements by combining a stereo pair of images. The measurements generated are valuable for applications such as asset management, construction, forensic evidence collection and surveying.

New Android handheld

The Handheld Group has launched the Nautiz X2 enterprise handheld which integrates a high-quality scanner, camera and mobile phone while offering a compact and ergonomic form factor. The X2 is an all-in-one mobile computer that can handle all the tasks of a day's work, with built-in ruggedness that allows it to be used anywhere from a warehouse to challenging outdoor environments with moisture, dust, extreme high or low temperatures and potential drops. It weighs in at 230g.

Ultrasonic motors for TS

Topcon claims that the GT Series robotic total stations are the fastest, most powerful instruments with the smallest and lightest form factor yet. The source of this speed advancement is found "underneath the hood" through advanced ultrasonic motors. These compact and efficient motors transform sound into energy to power both horizontal and vertical rotation – smooth and fast. Plus, the GT series offers a three-year instrument and five-year motor warranty.

Elite suite solution

Topcon has announced a new suite featuring four integrated solutions — three hardware products "fused" by a single software solution — designed to provide professionals with a powerful and complete survey system. The

Reality modelling



Bentley Systems has announced general access to the latest release of their ContextCapture platform. The release enhances the accessibility, scale, and quality of reality models that can be produced for use in BIM and geospatial workflows. Key capabilities include: new multi-resolution mesh support for third-party formats including Esri i3s, Google Earth KML, SpaceEyes3D, OSGB (OpenSceneGraph), and LODTreeExport formats; multi-resolution mesh support for ContextCapture's native 3MX format and a threefold increase from 30 to 100 Gpxl of imagery that can be processed.

Topcon Elite Survey Suite includes the new GT series of robotic total stations: HiPer HR hybrid GNSS receiver, FC-5000 field computer and MAGNET 4.0 software system. "The individual products of the Elite Survey Suite were designed from the ground up to work together seamlessly through one software solution..." said Jason Hallett, Topcon vice president of global product management.

MAGNET 4.0 provides software support for the hardware through Field and Office applications plus there is a significant update to the MAGNET Enterprise web service to provide integration with Topcon's construction-focused Sitelink3D service for instant data transfer and connectivity into active project sites. MAGNET 4.0 offers a new level of direct communication with other systems, such as Bentley's ProjectWise and continues to provide integration abilities with Autodesk software products, including seamless data exchange between MAGNET and Autodesk Point Layout software.

"Smartphone" controller

Spectra Precision has announced MobileMapper 50 GNSS, a handheld device for simple GIS data collection or for use as a data controller for Spectra Precision's SP60 and SP80 GNSS receivers. Available with an Android OS, the MobileMapper 50

combines smartphone capabilities with a ruggedised design to improve positioning accuracy. The company has also introduced an Android OS version of its MobileMapper Field software and Survey Mobile software to control SP60 and SP80 GNSS receivers.

Low cost sub metre GNSS

Geode is a new low-cost sub-metre GNSS receiver from Juniper Systems' for use with its rugged handhelds or any Windows, Windows Mobile, or Android device.

CAA quals & monthly demos

Leica Geosystems has now achieved the PFAW certificate (Permission for Aerial Work) which allows it to fly and operate sub 7kg UAVs commercially in the UK. Robert Heaver, Technical Specialist UAS at Leica Geosystems said: "For us as a company who want to showcase not only our UAS abilities but also our commitment to lawful and responsible flying, completing all mandated qualifications set by the CAA was something we were happy to do. This commitment along with our close relationship with RUSTA (Rheinmetall Unmanned Systems Training Academy) will also enable us to give industry leading training, support and advice to our customers ..." Leica now holds monthly Aibot X6 demonstration days at Hawk in Shropshire.



Left: iSTAR image within Arithmetica's Spherevision software.

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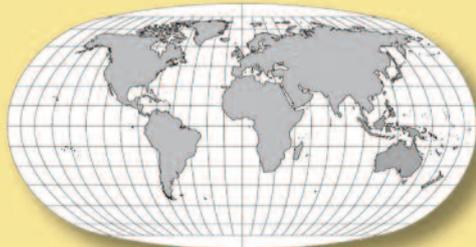
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