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INTERNATIONAL

BUSINESS GUIDE 2018

MARKET REPORT 2018

ENTREPRENEURSHIP

MARKETING

EDUCATION

EXPERTS' VIEWS

COMPANY PROFILES



“This is great for surveyors ... they can **spend less time collecting data and more time using it**”

Iain Allen, Senior Manager of Geographic Information Systems, Barrick Gold



“senseFly’s eBee has given me **the best R.O.I.** of any surveying tool I own”

Prof. Tosa Ninkov Ph.D., Owner, GeoGIS Consultants



“We knew the drone would be great for data collection, but what else could we use this for? **And, boom, it’s saving us money every time we try something new!**”

Joe Drew, Director of Technical Services, Vista Sand

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Nick Kelly, Chief Land Surveyor, GRAHAM Construction

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“For a surveyor to get close to the same level of detail using terrestrial methods would probably take two to three weeks”

Aidan O’Connor, Managing Director, ASM Ireland





FEATURE PAGE 6

The Future Looks Bright for the Geospatial Business

GIM International Measures the Mood of the Industry

Company Profiles Page 14



TOP ARTICLES PAGE 10

Selection of the most read stories of the past year



FEATURE PAGE 19

General Management at Geo-ICT Companies and Data Acquisition Companies



FEATURE PAGE 24

The Importance of Continuous Education

How Fugro Academy Advances the Company's Business



FEATURE PAGE 29

How to Sell Just about Anything to Just about Anyone

Industry Marketing Secrets



Q&As PAGE 33

How Geospatial Industry Insiders View the Market

ADVERTISERS INDEX

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Education, Marketing and Insight

Instead of writing about the in-depth technology that is so characteristic of our industry, in our annual Business Guide we aim to give you some guidance on the other factors that influence company success. I have named three of them in the headline; education, marketing and insight into the current and future market are all key factors that determine whether your company will flourish or stagnate. The worldwide economic crisis has affected customer behaviour, leading to longer replacement cycles and longer lead times to actual purchase. Marketing therefore has to be tailored to this new behaviour, while also making use of new marketing communication opportunities including social media and other online channels. Markets and technologies are changing so rapidly that ongoing education is paramount for all employees. Preparing staff for other positions in the company is often another important goal of the continuous development of skills. Education must be on the agenda of every entrepreneur, always, because the modern employee is always learning. The *GIM International* Business Guide features articles not only on marketing and education, but also on that other very important issue: gaining insight into your market. Where is it heading, what are the trends, what do buyers intend to invest in? We've asked the people who really know the answers to these questions – in other words, our readers. Once again, we received an overwhelming response to our survey. The answers by more than 600 respondents form a great set of insights with which to kick off this new business year, enabling you to double-check, adjust (if necessary) and further strengthen your strategy! I wish you happy reading and hope that 2018 will be an excellent year for business!

Dirk Haarsma, director strategy & business development



The Right Ingredients



At *GIM International* we continuously strive to inform our readers about the latest news, trends and developments within the geospatial industry. And,

as we can safely conclude after having analysed the results of the readers' survey we conducted recently, you greatly appreciate our efforts. Knowing this not only encourages us to continue along this path, but also gives us new inspiration to work even harder to provide you with the very latest insights. For this special issue, we have picked a selection of articles that you valued the most during last year; this is also a good representation of the broad spectrum of themes encompassed by the geomatics sector and covered in *GIM International*. The introduction for each article can be found from page 10 onwards, and you can read the full story on our website – the number one portal for the geospatial community. Furthermore, this Business Guide contains articles on various aspects of running a business such as marketing, lifelong learning and management within geo-ICT companies. We've tried to prepare this edition with all the right ingredients, hoping it will give you lots of new ideas to fulfil your ambitions! And please let us know if we at *GIM International* can play any role in helping you to do so.

Wim van Wegen
content manager, GIM International

The Future Looks Bright for the Geospatial Business

In 2008, the seemingly endless growth of the geomatics industry was rudely interrupted by the global economic crisis and its enduring after-effects. But now, ten years later, the readers' survey conducted by *GIM International* reveals widespread optimism about the outlook of the mapping and surveying business. This renewed positivity represents many new opportunities for manufacturers of geospatial solutions and service providers. This article zooms in on these chances and provides insights into the needs, wants and demands of the widening customer base related to geomatics and all its verticals. Read on and let us brighten up your day!

Consultants, government officials, managers, researchers and technicians all make up the *GIM International* readership, and they are predominantly at decision-making level which makes this readers' survey even more relevant. The top five sectors they are involved in are land surveying, land management, building & construction, infrastructure and urban planning. Notably, the number of geospatial professionals active in agriculture and mining is growing significantly (see Figure

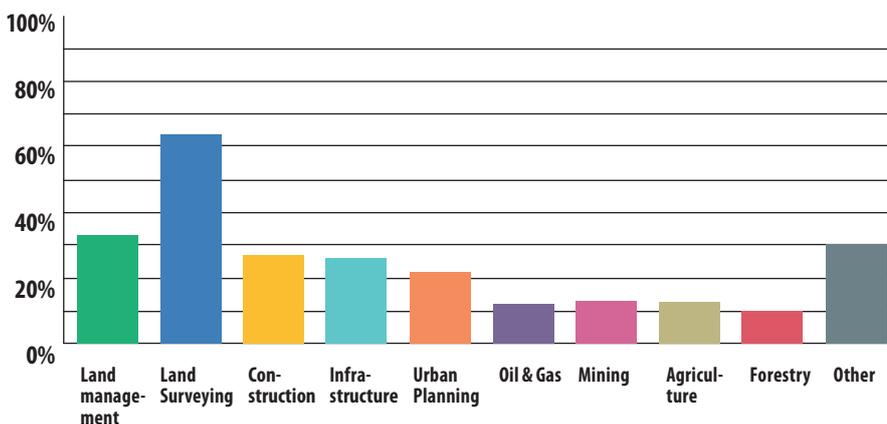
1 for an overview), which is a clear sign of the upward trend in the integration of geospatial technology in many verticals. Developments such as the unfolding precision-farming revolution offer plenty of new opportunities. The robotic technology that is set to transform agriculture is estimated to become a US \$45 billion industry¹ within the next two decades. The swelling world population not only places greater demands on the agro-food industry, but it also poses a challenge for the building

& construction and the infrastructure sectors, not to mention urban planning professionals.

PROSPECTS IN THE SURVEYING MARKET

But let's return to the optimism. In view of the fact that the financial crisis is behind us in many parts of the world, coupled with changing societal demands in the decades ahead, this optimism may seem perfectly logical. Indeed, the participants of the *GIM International* survey are in a very positive state of mind about the prospects in the surveying market in 2018 (see Figure 2). In fact, the number of professionals with a negative view of the current state of the market can almost be counted on the fingers of one hand.

So the mood is clearly upbeat, but where exactly are all those growth opportunities? The open-ended question in the survey generated lots of different answers on this topic, but a shortlist of the most frequently mentioned words paints an interesting picture of the most promising markets. Drones (or UAVs) are way out in front at the top of the list, and the rest of the top five is made up of construction/infrastructure, BIM, surveying



▲ Figure 1: Overview of the different sectors geospatial professionals are involved in.

(thank goodness!) and laser scanning (Lidar). Other high-potential industries include energy and mining. Another noteworthy outcome is the combination of Lidar and UAVs, which together are seen as a suitable tool for deployment in a varied range of applications such as forestry, building & construction, infrastructure and more.

GEOSPATIAL INVESTMENT READINESS

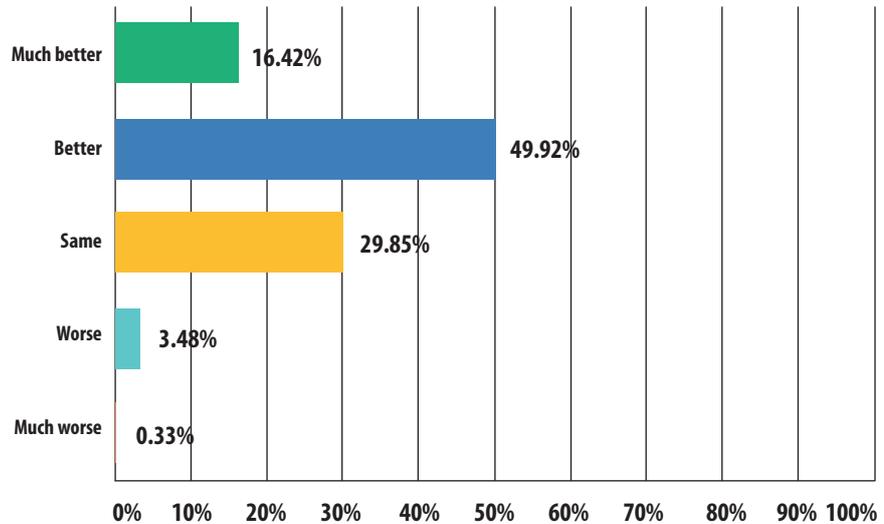
We could spend hours discussing the limitless possibilities for mapping and surveying applications, and it is great news that there seem to be so many chances, but who is actually willing to spend money on such solutions? In other words, where should manufacturers be focusing their attention? Which market segments should they concentrate on? What is the state of the geospatial investment readiness (GIR)? Almost 70% of the respondents indicate that their organisation plans to invest in new systems in 2018. This very high GIR will surely make every company involved in the geo industry sit up and take notice. But which types of systems are the respondents about to purchase, exactly?

The top three comprises UASs (or drones), GNSS receivers and GIS software, with more than 40% of the respondents planning to invest in at least one of those three systems. Between 20% and 30% intend to acquire photogrammetry software, point cloud processing software, total stations, terrestrial laser scanners, mobile mapping systems and/or UAS-Lidar. The latter is also covered below as one of the technologies regarded as having the most impact on the profession today, and the likely trends over the next five years.

A DIFFERENT REALITY

In spite of the initially enthusiastic predictions, technological advancements such as augmented reality (AR) and virtual reality (VR) have still not really taken off, and the same goes for blockchain. So which developments are currently perceived as the biggest influencers? The top three by a clear margin are robotics/autonomous vehicles (including drones), IT and apps/mobile devices, followed by artificial intelligence (AI) and the Internet of Things (IoT). While it is perhaps to be expected that drones are named as the technology with the most impact right now, they are mentioned surprisingly frequently in conjunction with Lidar (Figure 3). It seems safe to say that UAS-Lidar is about to deliver on its promise.

WHAT ARE YOUR EXPECTATIONS OF THE PROSPECTS IN THE SURVEYING MARKET IN 2018 COMPARED WITH THE LAST 3 YEARS?



▲ Figure 2: The expectations about the prospects in the surveying market are optimistic.



▲ Figure 3: Drones are named as the technology with the most impact right now, equipped with sensors suited to a great variety of applications.

Another finding that can be distilled from the participants' input is the changing nature of the surveying role. Their work is shifting away from 'boots on the ground' (Figure 4), as increasing automation and the growing influence of robotics require surveyors to increasingly develop their 'soft skills' to survive; they are becoming mediators, advisors and consultants rather than 'just' operators of technology. To cite one of the respondents: "With the enabling technology from robotics and AI, strong standardisation, certification and quality assurance which leverage geomatics as a technology rather than an independent profession, geomatics might become an integral part of services and solutions while it is losing its base as an independent discipline." There has been much debate on the future of the mapping and surveying professional, and the definition of a surveyor's tasks is changing, but given the seemingly insatiable need to capture our reality, the future of the geomatics professional does not appear to be under threat. It may be a different reality than a decade ago, but it is one that will be

catapulted by all the technological innovations that are happening.

EXPECTED INVESTMENTS

After glimpsing the future, now let's move back to the present. What can manufacturers and developers of geospatial solutions expect this year? After reviewing the comments, it is easy to draw the first conclusion: while most companies have been very reluctant to invest in new hardware and software over recent years, they now realise they cannot wait much longer. Many respondents also indicate the need to invest in more technologically advanced instruments to improve the accuracy, effectiveness and efficiency they can deliver. Improving efficiency is a top priority for many companies, and renewing and modernising their equipment is high on the list too.

Reality capture has made its entrance in many industries, ranging from agriculture to construction and from mining to transport – just think of geomatics' impressive contribution to autonomous driving. As a

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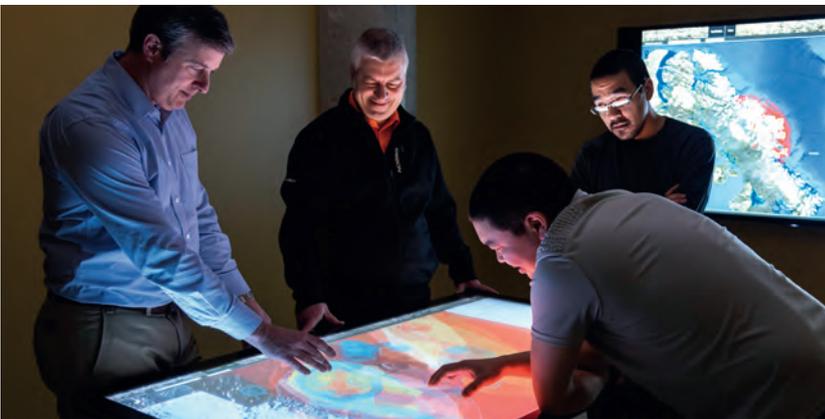
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▲ Figure 4: The work of surveyors is shifting away from 'boots on the ground'.



▲ Figure 5: Learning is a vital pillar and a lifelong process and does not finish when you graduate as a surveyor or engineer.

result, the horizon is broadening for the equipment manufacturers and software suppliers, and this is underpinned by the outcomes of the readers' survey. Planned investments, each with their own purpose, are coming from many directions. Again, it is striking how many respondents express their intention to purchase a UAS, and a relatively large number also show an interest in combining UAS and Lidar. Also worth mentioning is the interest in purchasing a laser scanner, while total stations and mobile mapping systems are high on the list too. In terms of software, image processing software and GIS solutions are the key targets of upcoming investment.

It should be noted that a considerable share of the survey participants state that money is a serious issue in the decision whether to purchase new equipment or not. Especially universities and various organisations (both governmental and non-governmental) indicate that they rely on subsidies or gifts.

Respondents from developing countries in particular express the need for low-cost solutions, e.g. for land administration and cadastral mapping purposes.

INFORMATION AND EDUCATION

Apart from helping us to get a good picture of 'what's hot and what's not' in the geospatial industry, the readers' survey also gave us at *GIM International* an opportunity to find out which topics we should cover more, what kind of content our readers would like to see and what will help them to stay even more up to date on the latest industry trends and developments. GIS, 3D modelling and UAS/drones were the winners of this poll, but many other subjects were named as well, including geospatial intelligence, mobile mapping, land administration, BIM, smart cities and point clouds. There is a clear link between the systems people indicate they will invest in, the developments they predict in the geospatial field in the years ahead, and also the topics they want to see covered by *GIM International*.

Our editorial team have been slightly surprised by the number of people who indicated a desire for more content on bathymetry and seabed surveying. Therefore, we'd like to take this opportunity to mention our sister publication *Hydro International* [www.hydro-international.com] which covers all major topics in the hydrographic business such as marine surveys, electronic charting, sensor technology, oceanography and much more.

While keeping you up to date with the latest advancements in the geomatics business is one of our priorities, education is another important function of *GIM International* (Figure 5). Our editorial board acknowledges that learning is a vital pillar and a lifelong process and does not finish when you graduate as a surveyor or engineer. Several comments were made regarding the need to make geomatics more attractive and to encourage high school students to become professional surveyors. As *GIM International*, we have addressed this issue in the past and will continue to do so in the future.

Geomatics includes many ingredients, which can sometimes make it hard for us to determine the right focus. The respondents' feedback on this matter, however, is very motivating for everyone involved with the creation of content for our publication. "Keep the diversity" and "There is always a good mix in the magazine; focusing too much on one or several topics may miss the wider picture" were just some of the remarks. These encouraging words are a fittingly optimistic conclusion to our analysis of the readers' survey. ◀

¹ Dr Khasha Ghaffarzadeh, *Agricultural Robots and Drones 2018-2038: Technologies, Markets and Players*

ABOUT THE AUTHOR



Wim van Wegen is content manager of *GIM International*. In his role, he is responsible for the online and print publications of one of the world's leading geomatics trade media brands. He is also a contributor of columns and feature articles, and often interviews renowned experts in the geospatial industry. Van Wegen has a bachelor degree in European studies from the NHL University of Applied Sciences in Leeuwarden, The Netherlands.

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Video: www.intergeo-tv.com/2018/01/18/wim-van-wegen

In-depth Geomatics Articles for You!

As the world's leading geomatics media brand, it is *GIM International's* mission to keep you up to date on the latest trends and developments in the industry. We've selected the most read articles on land surveying, GIS, photogrammetry, remote sensing, Lidar, GNSS, land administration, 3D city modelling and other geomatics-related activities for you. Simply open the short URL in your browser and read the full story!

UAV-based Mobile Mapping: Potential, Challenges and Outlook



Multi-rotor UAV system.

Accurate representation and 3D reconstruction of the environment using both active and passive remote sensing systems has become essential for non-traditional mapping applications. Due to the excessive cost as well as the required level of technical expertise, the needs of these applications cannot be satisfied by traditional

mapping, which is based on dedicated data acquisition systems designed for mapping purposes (e.g. manned airborne and terrestrial mobile mapping systems). Recent advances in hardware and software development have made it possible to conduct accurate 3D mapping without using costly and high-end data acquisition systems. Low-cost digital cameras, laser scanners and navigation systems can provide accurate mapping if they are properly integrated at the hardware and software levels.

► <http://bit.ly/2DHEvwp>

Growing Use of Oblique Imagery by Municipalities

For municipalities, aerial imagery is a vital support for geospatial and thematic information extraction and planning processes. Until recently, only orthophotos

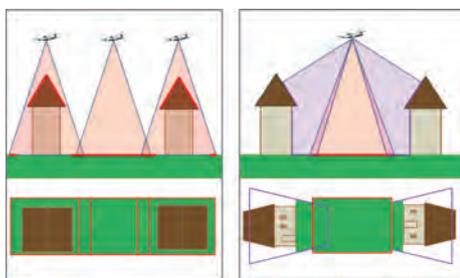


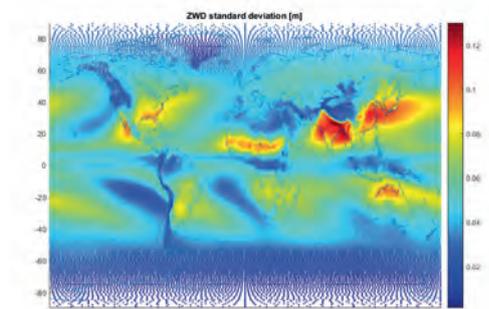
Image acquisition from nadir and oblique cameras.

produced by nadir aerial images were used for this, but the development of oblique-image cameras is opening up new possibilities. Cases in 3D cartography, urban damage assessment and urban planning demonstrate the high value of these images and derived geospatial products.

► <http://bit.ly/2vqbn1S>

Precise Point Positioning from Combined GNSS

Currently there are four global navigation satellite systems (GNSSs) available: GPS, Glonass, BeiDou and Galileo. The satellites of



12-year variation of the 'Zenith Wet Delay' tropospheric error.

these systems are used for positioning and the accuracy is greatly improved if precise satellite orbit, clock and uncalibrated phase delay (UPD) corrections are available when using the precise point positioning (PPP) technique. Fugro operates a worldwide network of reference stations capable of tracking GPS, Glonass, BeiDou and Galileo systems and this network is used to calculate precise satellite orbit and clock corrections of all four constellations in real time for maritime applications. The corrections are broadcast to users by eight geostationary L-band satellites providing worldwide coverage. This article describes the recent developments and the resulting accuracy of PPP with integer ambiguity Resolutions (IAR).

► <http://bit.ly/2rPUnLW>

Mobile Laser Scanning Point Clouds



Point cloud of an urban scene.

The demand for 3D maps of cities and road networks is steadily increasing and mobile mapping systems are often the preferred geodata acquisition method for capturing such scenes. Manual processing of point clouds is labour-intensive and thus time-consuming and expensive. This article focuses

on the state of the art of automatic classification and 3D mapping of road objects from point clouds acquired by mobile mapping systems and considers the feasibility of exploiting scene knowledge to increase the robustness of classification.

► <http://bit.ly/2rlqGwi>

Scan-to-BIM in the Pre-design Phase



Point cloud of a cemetery and building in Copenhagen.

Today's high demand for energy-efficient buildings has triggered the need for gathering documentation on existing construction conditions. This information is then used to design buildings with high consideration to the site conditions, or to allow the renovation of old buildings that can

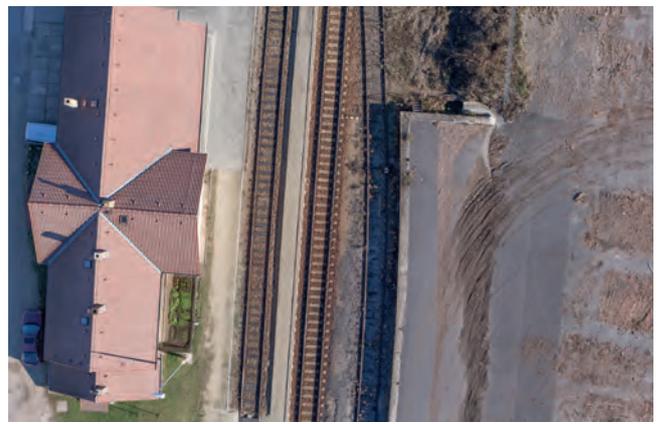
no longer meet the requirements for energy performance or comfortable living. The documentation required for this type of situation is often outdated or missing. To create an optimal design, the existing conditions need to be registered and analysed using advanced technological methods such as building information modelling (BIM) or 3D laser scanning. In a recent project in Copenhagen, Denmark, BIM and 3D laser scanning were applied together as an integrated process and methodology that brought multiple benefits in the pre-design stage.

► <http://bit.ly/2utEGtp>

UAS Photogrammetry and Railway Mapping

Today's photogrammetric software is able to create dense and precise digital surface models (DSMs), digital elevation models (DEMs) and orthoimages. But is the accuracy sufficient for highly demanding railway applications? A pilot project carried out in the Czech Republic demonstrates that unmanned aerial system (UAS) photogrammetry has great potential for collecting geodata meeting railway companies' high standards of precision. Parallel computing based on 16 personal computers (PCs) was used to process the 11,000-plus images in a reasonable time span.

► <http://bit.ly/2xP60Ap>

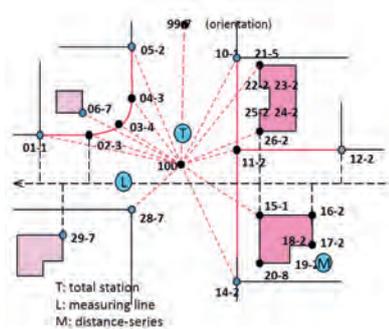


Railway station along the test trajectory.

Geomatics and Surveying in Support of Land Administration

Today's geospatial technology means that land administration systems can increasingly be implemented for the benefit of all. It is now possible to conceive approaches to capturing the unrecorded geometry of boundaries for the billions of unrecognised land interests or spatial units. In addition, new approaches are becoming apparent for the maintenance of collected data. Examples from the field show that we're well on the way to responding to the challenge. From a geomatics and geoscience perspective, many tools are already available to support development, but further steps are needed to operationalise them at scale. Read on for an article investigating a few of the emerging options.

► <http://bit.ly/2nly6jz>



Results from a conventional cadastral survey.

BIM: the New GIS for the Industry

As anyone who frequently visits trade shows and conferences in the geospatial industry or reads relevant geomatics literature already knows, building information modelling (BIM) is a hot topic. But just how special is BIM? And which new opportunities does the technology bring? Mohsen Kalantari, an expert from the University of Melbourne, Australia, and chair of the International Association of Geodesy's BIM-GIS working group, shares his thoughts in this interview.

► <http://bit.ly/2FnGtm4>



Mohsen Kalantari.

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Crane Camera Site Surveying: An Alternative to UAVs?



3D point cloud from the building site.

The construction industry is fully embracing the concept of BIM, as it provides an efficient way to manage complex projects. A prerequisite for BIM to be used successfully, however, is that the very detailed schedule and build sequences defined by BIM are strictly adhered to. Regular and accurate site surveys are crucial to achieve this. Although

unmanned aerial vehicles (UAVs) are suitable for collecting such site data, they have various limitations. A crane-based camera mapping system offers an alternative and enables the automated capturing of on-site data, both at minimal cost and without interfering with the site. Read on for article explaining how a crane camera solution enables project managers to resolve some of the most complex and lingering challenges in construction.

► <http://bit.ly/2EkNoxp>

Surveying in the Mining Sector

Geospatial data forms the foundation of mining. The rapidly evolving innovations in the geomatics sector are bringing previously unforeseen opportunities that will provide a major boost, both to mining surveyors and the mining industry as a whole. Read

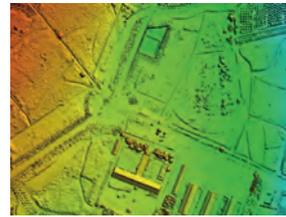


Surveying an open pit mine.

on for an article which starts with some history – after all, we should never forget where we came from. It then goes on to present a general outline of surveying in the mining industry, with a focus on the survey equipment and the technologies that are being used today.

► <http://bit.ly/2kivtNF>

Photogrammetric UAV Software



Photogrammetric software featuring DSM and DTM solutions.

The incredible diffusion of unmanned aerial vehicles (UAVs) has pushed many companies and research groups to implement dedicated software for the processing of data acquired by these devices. The number and the completeness of these software solutions have constantly increased with the aim to satisfy a growing and heterogeneous market. Depending on the scope of the UAV acquisitions, the experience and technical skills of the operator as well as the available budget, there are several affordable solutions already available on the market. The holistic software probably does not exist, but some features and options should be considered when approaching these instruments in order to find the optimal solution for one's needs.

► <http://bit.ly/2GtOxoL>

Spectral Imaging Cameras: A Review of Key Specifications

Going beyond the three visible bands and limited spectral range available in conventional digital cameras opens up a wealth of new possibilities for identification, mapping and measurement of surface and material properties. The application of spectral imaging is



The development of spectral imaging technology is progressing rapidly.

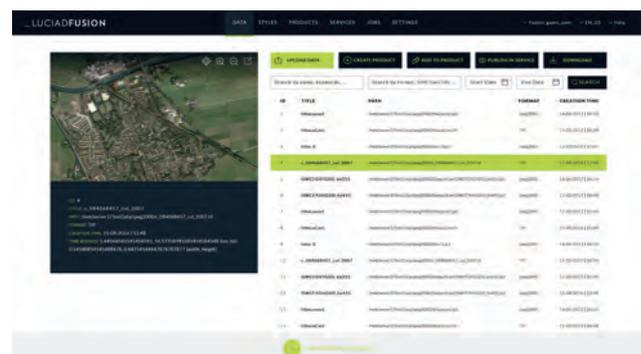
currently seeing increased interest across multiple disciplines and application areas including quality control in industrial applications, agriculture, geological and environmental or urban mapping, to name but a few. The market is rapidly expanding and comprises of an increasing range of vendors and camera models. Consequently, surveying and mapping professionals new to this field may struggle to gain an overview of the main considerations when assessing the pros and cons of available equipment suitable for their own applications. This article attempts to shed light on the main specifications to consider when choosing a spectral camera.

► <http://bit.ly/2zSpXZv>

Effective Use of Geospatial Big Data

The heart of any geospatial analysis system, regardless of its location or configuration, is increasingly becoming the server. All face a similar challenge, whether the system is in the 'cloud', a secure data centre or on a single machine running in an office. This challenge is primarily the ability to deal with the ever-increasing quantities and variety of data the world now produces at an unprecedented rate. For mission-critical systems, purposely designed software is required, tested in the most demanding environments. Try doing it cheaper and you only end up wasting money.

► <http://bit.ly/2z9QWfF>



Big data management.

CHC Navigation

CHC Navigation designs, manufactures and markets a wide range of competitive and reliable GNSS receivers and provides complete positioning solutions for surveying, construction, GIS and marine applications in more than 100 countries.

CHC is today one of the fastest-growing manufacturers and providers of GNSS products and solutions, developing a significant international presence and employing more than 800 professionals around the world. CHC has already supplied thousands of GNSS receivers worldwide

combining high performance and advanced features. 'Make Your Work More Efficient' is CHC's slogan, demonstrating its clear understanding of the reasons why customers choose the company. In order to help customers save more time, human resources and material resources, CHC always concentrates on their needs and provides them with products that facilitate their management of time, budget and workload.

COMMITTING TO QUALITY

Quality issues are at the forefront of CHC's philosophy. CHC has attained ISO 9001

certification from the International Standards Organization. It applies to all aspects of CHC's entire development process and workflow, covering all steps from the initial design to the final delivery.

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CHC's products are widely used in the Americas, Europe, Middle East, Africa and Asia-Pacific. CHC's international partner networks bring dedicated and professional support to end users no matter where they are located in the world.



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ComNav Technology

ComNav Technology develops and manufactures GNSS OEM boards and receivers for applications demanding high-precision positioning. Its technology is already being used in a wide range of applications such as surveying, construction, machine control, agriculture, intelligent transportation, precise timing, deformation monitoring and unmanned systems. With a team dedicated to GNSS technology, ComNav Technology strives to supply reliable and competitive products to customers worldwide. ComNav Technology is listed on the China National Equities Exchange and

Quotations (NEEQ), Securities: ComNav Technology (Compass Navigation), stock code: 833972.



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FOIF

Founded in the beautiful city of Suzhou in 1958, over the past 60 years FOIF has evolved into a high-tech company with multiple solutions from the earlier optical field. During these years, FOIF has constantly promoted technical reform while maintaining its competitive ability. In 2017 FOIF became one of the top 50 enterprises in China's geomatics industry. Advanced equipment guarantees good products, and high-quality products ensure FOIF's good reputation. Every production detail draws not only on the FOIF staff's professional technology expertise but

also on the company's focus on precise manufacturing, which enables the company's continuous development. FOIF is capable of complete R&D and manufacturing for total stations. Starting from the combination of theodolite and diastimeter, evolving into the total station with reflectorless distance measuring, upgrading to current high-precision robotic total station, FOIF always insists on precise manufacturing and makes quality its priority. As a result, the company has become the manufacturing base for numerous brands at home and abroad.

Since 1999, FOIF's GNSS products have been upgraded from original single-star, single-frequency static receivers to the current multi-constellation RTK products supporting GPS, Glonass, Beidou and Galileo, and have evolved from complex separate connection equipment into all-in-one A30 receivers, high-integration smart A60 or A90 receivers and high-end A100 or A200 CORS stations. Persistent technical innovation has always kept the company at the forefront of the geomatics field. FOIF supplies convenient and advanced surveying equipment to facilitate ever-



more precise and accurate surveying achievements. FOIF aims to reach deep into the industry of precision measuring instrument, make more brilliant and remarkable achievements, and build an internationally competitive advanced manufacturing base with good prospects.

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Geo-allen

Geo-allen Co. Ltd. was founded in 2002, in Suzhou, Jiangsu Province, 80km away from Shanghai, China. Suzhou is a beautiful city, nicknamed 'Heaven on Earth', with more than 2,500 years of history. Over the past years, Geo-allen has grown to be a world-famous company with an R&D team, a trading department, manufacturing workshops and an after-sales-service team. With the DNV's ISO9001 certificate and more than 15 years of development, Geo-allen is gaining more and more recognition in the field. Geo-allen's market covers almost the entire

world, including West & East Europe, North & South America, Asia, Africa and Oceania. By strictly adhering to its policies of best service/best quality/best prices, Geo-allen has gained a high reputation among its customers.

Geo-allen never stops expanding and developing. Its products now include UAVs, GNSS devices, total stations, theodolites, auto levels, laser instruments and all kinds of accessories. Its R&D department is highly capable of designing and producing new products, based on either customers' special

inquiries or the company's own ideas, in a very short period of time. Geo-allen holds several approved patents for products that it has designed, and is in the process of applying for more.

With its goal of Punctuality, Quality, Rigour and Service (P/Q/R/S), Geo-allen has a vision of an even more beautiful future. Geo-allen is looking forward to becoming more involved in the development of the Belt and Road initiative and is sure of an even brighter new year in 2018 with all its friends around the world.



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Hi-Target

Hi-Target (Hi-Target Surveying Instrument Co. Ltd) is a professional high-precision surveying instrument and solution provider based in China. Its areas of business include GPS/GNSS, total stations, GIS mapping, hydrographic surveying, UAVs, 3D laser

system instrumentation, BDS high-precision applications, precision agriculture and machine control, indoor localisation solutions and more.

As a market-leading brand, Hi-Target invests heavily in research and development. It has

collaborated with more than 100 universities in technological surveying research.

As the first Chinese company in the GNSS industry to be listed, Hi-Target adheres to its corporate mission: 'To create value for customers and wealth for shareholders while



at the same time remaining a conscientious contributor to humanity'.

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Juniper Systems

Juniper Systems designs and manufactures the highest-quality rugged data collectors and sub-metre GNSS receivers on the market today. As a company that functions almost entirely under one roof in the USA, Juniper Systems is proud to offer resell partners and end users an unbeatable line of reliable data collection products and personal customer care.

Favoured among geospatial professionals as the most affordable and reliable sub-metre GNSS receiver, the Geode works as an all-in-one receiver for use in extreme

environments. Users can easily pair the Geode GPS Receiver with the device of their choosing via Bluetooth and begin collecting precision data. And with its all-day battery life, users can work continuously without the worry of a dead battery.

The company's robust line of ultra-rugged handheld computers include the Mesa 2 Rugged Tablet, Archer 2, and Allegro 2, arming users with their ideal data collection device. Juniper Systems also offers a Cedar line comprising the CT7G Rugged Tablet and CT5 Rugged Smartphone. All Juniper

handheld computers provide improved GPS accuracy, an IP68 rating against water and dust, and an all-day battery life.

With a range of partnership opportunities, Juniper Systems offers complete customisation on all products. The team works closely with resellers to fully understand customer needs and determine the best solution for each unique situation. The company is proud of its growing number of successful partnerships and looks forward to new partnership opportunities.



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Leica Geosystems

Revolutionising the world of measurement and survey for nearly 200 years, Leica Geosystems creates complete solutions for professionals across the planet. Known for premium products and innovative solution development, professionals in a diverse mix of industries – such as surveying and

engineering, safety and security, building and construction, and power and plant – trust Leica Geosystems to capture, analyse and present smart geospatial data. With the highest-quality instruments, sophisticated software and trusted services, Leica Geosystems delivers value every day to those

shaping the future of our world. Leica Geosystems is part of Hexagon (Nasdaq Stockholm: HEXA B; hexagon.com), a leading global provider of information technologies that drive quality and productivity improvements across geospatial and industrial enterprise applications.



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MicroSurvey

MicroSurvey has been creating software solutions for land surveyors, accident reconstructionists, forensic specialists, engineers and construction professionals for over 30 years. The company's software solutions are helping provide industry professionals with the tools they need, in over 120 countries around the world. Recognised worldwide as the best least squares adjustment software on the market, STAR*NET sets the standard as the easiest, most widely used and respected least squares software with the most

understandable results. MicroSurvey FieldGenius is the most powerful graphics-based surveying data collection software available. Multi-brand instrument drivers ensure support for the latest hardware from the most popular global manufacturers of GPS and total stations. Code-free line work, easy pickup and stakeout workflows allow you to do more work in less time. Multiple platform support allows users to take advantage of the latest high-power, high-definition display devices and tablets.

MicroSurvey CAD offers a complete, cost-effective desktop survey and design program designed for surveyors. Perform standard surveying calculations, create high-quality 2D and 3D deliverables quicker and easier than those using more complex, non-survey-centric applications. You can even work with point clouds, Lidar and photogrammetric data. For those who run their business in an AutoCAD environment or prefer Autodesk-powered products, MicroSurvey offers the same powerful features found in MicroSurvey



CAD in two robust solutions: MicroSurvey inCAD, a plug-in you run in your existing AutoCAD, or embeddedCAD that is wrapped with the Autodesk engine. Powered by Autodesk Technology, embeddedCAD is a stand-alone powerhouse.

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Oakar Services

Since 1998, Oakar Services has been at the forefront in the distribution of integrated geospatial products, developing spatial information management systems, and offering training and capacity development programmes. As a geospatial consulting firm, it leverages technology to provide comprehensive geospatial solutions and products that respond to the needs of clients in the public, private, academic and

non-profit-making sectors. Oakar Services' rich expertise in spatial data capture, analysis and modelling using superior geospatial solutions has been manifested in deliverables that are critical to decision-making in the key areas of public service delivery, land management, natural resource management, utility and infrastructure management, as well as in education and research.

Oakar Services' team of versatile, highly trained and skilled professionals are committed to delivering reliable and innovative geospatial solutions to customers in Eastern Africa. At the core of the service offering and business practice is the provision of trusted solutions that realise tangible impact and application in a given industry. Through its solutions, the company aims to contribute to the modernisation of



Eastern Africa by empowering industries to respond to the rapidly evolving business landscape.

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Racurs

Racurs has a 25-year history of success in the Russian and worldwide geoinformatics market. Since its creation in 1993, the company has developed innovative digital mapping software for processing aerial, spaceborne and terrestrial imagery, known as PHOTOMOD. Today PHOTOMOD is the most popular digital photogrammetric software in Russia and is also used in 80 countries all over the world. An international dealer network helps to market, sell and support the Racurs products. Racurs' main business activities are:

- PHOTOMOD development and further

integration into Russian and international markets.

- Photogrammetric production services using both airborne and satellite imagery.
- R&D in the field of RSD processing software, methods and algorithms.
- Remote-sensing data distribution in Russia and the CIS countries.

The PHOTOMOD software family comprises a wide range of products for the photogrammetric processing of remote sensing data. This state-of-the-art software allows the extraction of geometrically

accurate spatial information from almost all commercially available types of imagery, whether obtained by film or digital cameras, UAS, high-resolution satellite scanners or synthetic aperture radars.

Racurs has been an ISPRS Sustaining Member since 1998 and a Special Committee I2AC Member since 2016. Racurs organises the well-known International Scientific and Technical Conference 'From Imagery to Digital Reality: ERS & Photogrammetry'. Every year, this conference brings together the



best specialists of the field from dozens of countries and provides them excellent opportunities for professional communication and discussion.

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RIEGL

RIEGL has been producing Lidar systems commercially since 1978, focusing on pulsed time-of-flight laser radar technology in multiple wavelengths. RIEGL's core 'smart waveform' technologies provide pure digital Lidar signal processing, unique methodologies for resolving range ambiguities, multiple targets per laser shots, optimum measurement distribution, calibrated amplitudes and reflectance estimates, and the seamless integration and calibration of systems. The broad RIEGL portfolio comprises laser scanners and laser scanning systems for

terrestrial, industrial, mobile, bathymetric, airborne and UAV-based applications. Innovative software complements the sophisticated hardware, resulting in powerful solutions for nearly all imaginable fields in surveying.

RIEGL stands for continuing 'innovation in 3D':

- In terrestrial scanning, the VZ-2000i offers ranging up to 2,500m. Like the VZ-400i, this system can execute tasks, e.g. registration and georeferencing in the background parallel to high-speed data acquisition.
- In mobile scanning, RIEGL presents the

new dual scanner mobile mapping system, the VMX-2HA. The system now provides a high-speed 10GigE link for acquisition of 2 million measurements/sec and 9x12Mpx camera images.

- In airborne scanning, the new VQ-780i high-performance airborne laser scanner allows highly efficient data acquisition at low, mid and high altitudes, covering a variety of different airborne laser scanning applications from high density to wide area mapping.
- In unmanned scanning, RIEGL has added the miniVUX-1DL, an application-optimised version of the RIEGL miniVUX-1,



to its portfolio. Its special downward-looking design perfectly meets the needs of corridor mapping tasks such as power line and pipeline surveillance, infrastructure inspection, and highway or railway monitoring.

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SBG Systems

SBG Systems is a leading supplier of MEMS-based inertial motion sensing solutions. The company provides a wide range of inertial solutions, from miniature to high accuracy. SBG inertial navigation sensors deliver roll/pitch, heading, GNSS position and heave data (marine application).

Combined with cutting-edge calibration techniques and advanced embedded algorithms, SBG Systems' products are ideal solutions for industrial and research projects such as surveying applications, unmanned vehicle control, antenna tracking, camera stabilisation and data georeferencing.

The company offers three product lines, each at different levels of accuracy and size:

- The Ellipse 2 Series: Ellipse is a product line of miniature inertial sensors reaching amazing performance for the size/weight/power consumption.
- The Ekinox 2 Series: Ekinox is a product line of advanced inertial systems showing a smart balance of size, accuracy and price.
- The Apogee Series: Apogee is a product line of high-accuracy inertial navigation systems, designed for demanding surveying applications.

In 2017, SBG Systems took a major step in the surveying industry by unveiling Qinertia, its new in-house post-processing software. After the survey, this full-feature software gives access to offline RTK corrections and processes inertial and GNSS raw data to further enhance accuracy and secure the survey.



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senseFly

senseFly's field-proven, end-to-end drone solutions simplify the collection and analysis of geospatial data, allowing surveying and GIS professionals and their clients to make better decisions, faster.

Founded in 2009 by Swiss robotics researchers, senseFly has quickly grown to become the industry leader in mapping drones. Its solutions have flown more than 520,000 flights to date globally, mapping a region of more than 65 million acres in the process.

Thousands of geospatial professionals today employ the company's eBee range of large-coverage, fixed-wing drones across a myriad of surveying applications, from cadastral work and urban planning projects to quarry and mine surveys, as-built surveys, land management studies and more. Their senseFly equipment is all backed by the very highest level of professional support, typically provided by senseFly's expert network of local service partners.

Professionals choose senseFly for several reasons. The company's products are simple

to use: hand-launched, with automated flight, image capture and landing and no piloting skills required. senseFly systems are safe, with the lowest take-off weights in their category and shock-absorbent construction. Plus, senseFly offers a camera payload to suit every project – from high-resolution RGB sensors to thermal and multispectral sensors.

Above all, senseFly solutions are designed from the ground up to meet industry needs. They are supplied with the company's acclaimed professional-grade eMotion



ground station software, are seamlessly compatible with industry-leading Pix4D photogrammetry software, and the new eBee Plus includes flexible, on-demand RTK/PPK functionality for survey-grade accuracy without the need for ground control points.

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SOUTH

As a dedicated Chinese manufacturer, South Group, based at Guangzhou Geo-information Park, has evolved over the past 30 years into a dynamic force in the geoinformation industry, with an annual output capacity of 50,000 total stations and 45,000 GNSS receivers. The company enjoys a seamless sales network nationwide and hundreds of overseas distributor connections, which excels in terms of global sales turnover. Thanks to its keen pursuit of R&D excellence, service and customer satisfaction, South Group is a renowned player on the global stage.

Based on the earlier success of survey equipment, especially in terms of total stations and GNSS, South Group is now switching its attention to more integrated solutions for the ever-evolving market to support its further growth as a major survey equipment manufacturer and geoinformation solutions provider. As the industry moves into the informatised mapping era featuring dynamic storage, big data and large-scale projects, the conventional ground measurement tools (e.g. total stations, GNSS receivers, etc.) require some new partners to supplement the daily

needs and improve the work efficiency. Therefore, South is entering a new chapter of UAV aerial photogrammetry, 3D Lidar mobile laser scanning, machine control systems, automatic deformation monitoring systems, high-precision location-based services, GIS applications and so on. It's time for the company to extend its business scope by delivering more and more products and solutions with a good cost-performance ratio worldwide. Interested parties should visit the website or send an email for more information.



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Teledyne Optech

With over 40 years of experience, Teledyne Optech is dedicated to developing and refining advanced Lidar survey instruments. Teledyne Optech strives to democratise Lidar with fast, accurate and cost-effective solutions for airborne mapping, airborne Lidar bathymetry, mobile mapping and terrestrial laser scanning. And now Teledyne Optech also has access to the deep remote-sensing expertise of the entire Teledyne Technologies family. Teledyne Optech's airborne Lidar systems are complete sensing solutions with integrated cameras and an end-to-end LMS

workflow for Lidar/camera processing and third-party output. Requiring no operator, the highly automated Optech Eclipse reduces capital and operating costs, while the 1Mhz Optech Galaxy T1000 uses SwathTRAK technology to survey variable-elevation terrain economically. Finally, the multispectral Optech Titan improves target identification and enables simultaneous topo/bathy collection. For surveying the crucial near-shore marine environment, the CZMIL Nova airborne Lidar bathymeter maps water depths even in turbid conditions, and fuses Lidar, RGB

and hyperspectral data into unprecedented deliverables. The CZMIL is already in use by multiple government agencies, and smaller groups can now deploy it via the CZMIL project programme. The Lynx family of mobile survey solutions uses its industry-leading scanner speed to deliver usable point spacing, even at highway speeds, and leverages the same automated LMS workflow used for airborne operations. Meanwhile, the Optech Maverick is so light that users can wear it on a backpack, opening up new applications for mobile Lidar. The Optech Polaris terrestrial laser scanner



makes high-quality Lidar surveying affordable for the average surveyor, with a user-friendly workflow and long-range performance at an unprecedented price.

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Tersus GNSS

Tersus is a leading GNSS RTK technology provider whose engineers have been pioneers in the design of GNSS products to better cater to the need of high-precision positioning. The company's offerings cover GNSS real-time kinematic (RTK) & post-processed kinematic (PPK) OEM boards and receivers, as well as integrated solutions such as NeoRTK, MatrixRTK, GNSS-aided inertial navigation systems, and autosteer for tractors.

Designed for easy and rapid integration, Tersus GNSS solutions offer centimetre-level accurate positioning capability and flexible interfaces for a variety of applications: unmanned aerial vehicle (UAVs), surveying, mapping, construction engineering, deformation monitoring and precision agriculture, etc.

The Tersus GNSS portfolio includes:

- BX306/306Z/316/316R/316D GNSS OEM boards
- TX204G/TX306 GNSS portal receivers
- GNSS kits with receivers, antennas and related accessories
- INS-T-306, GNSS-aided inertial navigation system
- NeoRTK GNSS receiver (base & rover kits)
- MatrixRTK, CORS system
- AG960/980 autosteer systems



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Zoller + Fröhlich

Zoller + Fröhlich offers a new generation of laser scanners which allows beginners and professionals to reach new levels in their projects.

The Z+F IMAGER 5016 is 30% smaller and 30% lighter than the Z+F IMAGER 5010X. The ergonomic streamline design features a passive cooling system, IP54 rating and two handles for better grip while carrying and during setup. This makes it much easier to mount the scanner on high tripods and conduct overhead applications, for example. Due to innovative developments, the

maximum range of the Z+F IMAGER 5016 has been extended to up to 360m (1,180ft), thus establishing new opportunities and applications. The maximum measurement rate of more than 1 million points/second guarantees highly accurate results even with long distances. Due to 50% less range noise, the scanner can now scan two times faster than before without compromising quality and accuracy of the resulting point cloud.

The new Z+F IMAGER 5016 series includes all powerful features of the 5010 series like an integrated high-definition HDR camera

which comes with internal LED spots to shed light into the dark environments for perfect colour imagery. It also features the unique Z+F scan positioning system, which allows real-time registration of scan data right in the field to guarantee a complete and successful project. Even though the system has an implemented GPS receiver, the scan positioning system also works indoors, independent of satellite coverage. The scanner is classified as 'eye-safe' according to laser class 1 and can therefore be used in public areas without any restrictions.



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General Management at Geo-ICT Companies and Data Acquisition Companies

There is much generic literature on general management but not specifically about management at geo-ICT companies or data acquisition companies, which is why the author has written this article. It covers the various aspects of general management at geo-ICT companies and data acquisition companies, and addresses the priorities that need to be chosen. This article is intended for current or future 'ultimate responsible persons' (URPs) within geo-ICT companies and data acquisition companies, and their advisors, including within geo-related units in the non-profit sector. The URP can differ from one company to another, although one can usually indicate this intuitively (director-major shareholder, managing partner, general manager, managing director, director, departmental manager, etc.).

When considering a geo-ICT company or data acquisition company, it is important to determine whether general management is about entrepreneurship or about management. Entrepreneurship is externally oriented, is focused on the 'what' (effectiveness) and is market oriented, whereas management is internally oriented, is focused on the 'how' (efficiency) and is oriented towards business management.

In the following aspects of general management, the emphasis is mainly on (external) entrepreneurship:

- Mission and vision
- Marketing (product-market combinations)
- Sales (product-marketing combinations/PMCs)
- Research & development / business development (new PMCs)
- Maintenance (PMCs)
- Acquisitions

In the following aspects of general management, the emphasis is mainly on (internal) management:

- Strategy
- Housing
- Finance
- Production of geo-ICT software or geodata
- Human resources
- Organisation



▲ An Ultimate Responsible Person can differ between companies.

- Quality assurance regarding geo-ICT software or geodata
- Risk management regarding geo-ICT software or geodata
- Communication with shareholders and works council

The above distribution of aspects of general management to entrepreneurship (external) and management (internal) is somewhat arbitrary; many aspects contain both an entrepreneurial and a management component. Therefore, it is important that the URP of a geo-ICT company or data acquisition company has the characteristics of both an entrepreneur and a manager. In general, however, it is more important for the URP to be structurally involved with external (entrepreneurial) aspects than with internal (management) aspects. Wrong external decisions usually result in more severe damage to the company's image, cost more money and are more difficult to reverse than wrong internal decisions. In practice, therefore, the URP will often take most of the external aspects for his/her account and will often delegate most of the internal aspects to a deputy.

IN ADVANCE

It is advisable for the URP to do as much thinking as possible in advance, both when using own staff and when hiring specialists from outside. Doing as much as possible in advance has several advantages: it increases the URP's control and boosts the cultural unity, as well as saving costs in the case of hiring an external expert.

In a situational management approach, the employee is managed according to the situation (to be classified in one of the four items: directing, guiding, supporting, delegating). This approach is relevant in geo-ICT companies and data acquisition companies too; employees must be managed depending on the situation rather than on the person.

GENERAL MANAGEMENT PRIORITIES

Of course, it is not possible for the URP at a geo-ICT company or data acquisition company to continuously focus on all aspects of general management. Therefore he /she will have to set priorities. To begin with, some aspects of general management only need occasional attention.

For example, once the mission, vision and strategy have been established – often after an intensive and time-consuming process – it will usually be sufficient to check and maintain them just once or twice a year (at fixed times) for several years afterwards. Similarly, when it comes to housing, in the case of rented business premises this issue only demands attention towards the end of a rental period, and if the property is owned it usually requires even less frequent attention. It is wise to terminate the contract immediately at the start of the rental period to avoid having to remember the notice period. But for the short period of time that the issue of housing requires attention (whether for rent or purchase), it makes intensive demands on a manager's time! During this process, it is important to estimate the right number of square metres needed because the company will be renting/buying for the long term.

Conversely, finance is an issue that needs the URP's constant attention. After all, ultimately the URP is always responsible for making sufficient profits. Furthermore, the URP must have some affinity (and his/her deputy must have great affinity) with the production of geosoftware and geodata. Firstly, that affinity will enable the URP to stay alert to a potential conflict of interests between the production department and other areas of the company. Secondly, it will help the URP to keep or get critical projects on track. This is good for risk management and gives the URP internal and external authority, contributing to a high-quality image for the company in the market. Thirdly, the URP must be able to decide what has to be executed within the company and what can be structurally outsourced.

It is important that so much is executed within the company itself, that sufficient competences remain in place to translate client wishes into production and to guide the outsourcing, including the important aspect of quality assurance. Fourthly, it is important to have a realistic picture of the costs/hours of production. Much work is outsourced to low-cost countries by geo-ICT companies and data acquisition companies. Thanks to increasing automation, the share of manual production is decreasing, making labour costs less significant. Having said that, outsourcing decisions are not made based on production aspects alone. Another important aspect is whether the activities concern the core business or not.

EXTERNAL VIEW

It is very important that the URP approaches his/her company with an external view in order to see the opportunities and threats for the company in the market (external) and strengths and weaknesses within the company (internal). By having a feeling for these elements of the SWOT analysis, the URP has an even stronger sense of the company's mission, vision, strategy and positioning. The URP also has an understanding of the choice of products and services in the market (PMCs) and/or clusters thereof which must be in line with the SWOT analysis, the mission, vision, strategy and positioning of the company. The aim is to logically subdivide the company's activities into PMCs/clusters of PMCs that are as unique as possible, since the choice of PMCs determines the current and future market position of the geo-ICT or data acquisition company.

MARKETING

The PMCs then have to be marketed and sold. Technical people sometimes associate marketing with nothing more than presence at trade shows. However, marketing revolves around creating coherence and alignment between all aspects so that the geo-ICT or data acquisition products or services can be sold at the maximum price. Some people do not realise that marketing is different from sales; in fact, marketing is the preparatory work for sales! The influence of marketing should already be felt in the choices regarding development. The company should strive to develop new services or products that can be positioned with as little competition as possible. This is called the 'blue ocean' strategy, in contrast to the 'red



▲ Situational management.

ocean' in which there are too many fish (i.e. too much competition) and they attack each other, turning the water red.

Another advantage of early contact between the Marketing and Development departments is that this is good for the balance between the technology push (technological development) and market pull (marketing on basis of market needs). The geo-ICT and data acquisition sectors are both driven by continuous technological advancements, but there must be a (latent) need from the market!

IMPORTANCE OF PMC DECISIONS

It is important to choose the PMCs, and to cluster similar PMCs, to optimally meet the following requirements:

- The PMCs must remain unchanged for at least two or three years to facilitate financial monitoring
- Similar PMCs should be grouped together to form a stable cluster from which PMCs are produced and/or sold. Such a cluster needs to be healthy and managed by a cluster manager. People and other resources have to be allocated for a reasonable time (two to three years) with budgets for development, sales, software production, maintenance, etc.
- Everything that the cluster manager cannot influence must be financed from outside the cluster (general overheads, part of the costs for housing, human resources management, office automation costs, etc.)

The URP must be closely involved in the selection of PMCs and their marketing, sales and development. Such decisions should not be delegated. However, PMCs have far-reaching significance beyond these aspects. In fact, it is good to base all operations on the PMCs. These can be monitored very well financially and analysed using a BCG Matrix as question marks, stars, cash-cows or dogs. This indicates whether activities (development, marketing, sales, maintenance) have to be developed, consolidated, reduced or stopped for the respective PMC. As mentioned above, from a commercial point of view the PMCs should be positioned as uniquely as possible in order to minimise competition. Unique positioning is not only determined by the product (or service) itself, as technical people still often think, but also by the other 'P's in the marketing mix: price, place, promotion and personnel. One danger of the PMC approach is that one can be inclined to focus only on



▲ Automation has made it possible to capture large quantities of geodata.

the existing PMCs, paying too little attention to new PMCs. Therefore it is good to make someone responsible for the development of new PMCs (i.e. business development) in addition to the employees responsible for existing PMCs.

For those geo-ICT companies and data-acquisition companies that work for government authorities – and many of them do – it is extremely important to closely follow the policies and developments within government and to align their PMCs with them. Both in companies and in government, the trend is shifting from georegistration to geomonitoring and then to geoprediction. Automation has made it possible to capture large quantities of geodata, e.g. through laser scanning.

BUSINESS MODELS

Generally speaking, the market is much more likely to accept a new product/service (P) than a new sub-market (M). Therefore, companies are advised to favour the development of new products and services for existing clients. If a company wants to enter a new market segment, this may be a reason to buy (part of) another company including its clients. With regard to acquisitions, it is worth mentioning that the leading Dutch quality newspaper NRC recently reported that “almost every industry has to deal with companies with business models like the start-ups of Airbnb and Uber”. Why should this not be the case in our industry? Airbnb and Uber are built around the smart use of ICT, especially the use of apps. The size of the own workforce is minimal in these companies, and they frequently work with independent third-party professionals. There is one big difference with the geo-ICT and data acquisition sectors: in our industry, the necessary level of education

is much higher. In the geo-ICT and data acquisition industry, only a few companies fit into the Airbnb and Uber trend. Longer-standing companies in geo-ICT and data are focused on ensuring quality. While quality is definitely an issue, it has become less important because of a lack of knowledge regarding how quality should be measured (e.g. using the Baarda method of testing). As the importance of quality decreases, the relevance of the seemingly easier-to-measure price increases. When it comes to quality, the old adage ‘The devil is in the detail’ often applies, and the quality (or lack of it) often only becomes apparent at stress moments. Longer-standing companies are more likely to have a quality system in place than start-ups. Those companies with a quality system usually improve their quality over time as they implement lessons learned in the quality system for subsequent projects.

ACQUISITIONS

Although acquisition of (parts of) companies is a very complex topic that cannot be dealt with thoroughly here, it should be pointed out that acquisitions are not commonplace and, when they do occur, they are always strategic decisions involving the senior management. In purchasing another business, the acquiring company's aim will often be to acquire PMCs that it does not currently have itself but which are essential for a healthy future. We see evidence of this when start-ups in the geo-ICT and data acquisition sector are taken over by longer-standing companies.

The geo-ICT aspect is becoming increasingly important for data acquisition companies too. However, it can be very difficult for data acquisition companies to find a geo-ICT company that is a good cultural fit and hence could be a potential takeover target. Without

a cultural fit, the acquired employees will subsequently leave, resulting in the acquiring company buying a geo-ICT company – often at great expense – without a workforce, leaving little more than an empty shell! If there is a great risk of such a situation arising, data acquisition companies are recommended to build their own geo-ICT unit instead.

A company's culture is based largely on its approach to human resources and quality assurance. Therefore, it is important for the URP to make his or her mark in close consultation with the works council. This does not mean that the URP has to spend a lot of time on these issues; much of the workload can be absorbed by the human resources and quality assurance professionals, whether inside or outside the company. However, they need clear direction on policy from the URP. For example, in terms of quality assurance, the URP should proactively indicate how the company should position itself in terms of quality, i.e. high quality at a high price, or lower quality at a lower price.

RISK MANAGEMENT

Most geo-related projects involve high risks, so it is important to control and manage the risks, both before and during a project.

Risk management prior to the project:

- Adhere to the certification requirements relating to the main processes. Certification

forces a systematic approach to work and a structured approach to communication. However, certification does not solve all problems. There are plenty of examples of the wrong work being done, albeit according to the certificate.

- Encourage continuing professional development, given the rapid technological developments in geo-ICT and data acquisition.
- Beware not to over-specify the contract. This has the following negative effects:
 1. There is little room left for the (innovative) input of the geo-ICT and data acquisition companies;
 2. Assignments become too complex;
 3. The project can be attributed to a specific contractor.
- Functional procurement approach: this has the big advantage that contractors can bring their innovative abilities into the project.
- Set the lower limit: It is in the contractor's interest that the projects are not too small and have an easy part so that the contractor can recoup the knowledge costs.
- Set the upper limit: On the other hand, there is also an upper limit for the contractor, since the bigger the project is, the more risk it entails. If the upper limit is exceeded, the risks are unacceptably high.
- Include cancellation and amendment clauses: A cancellation clause enables

- a contractor to stop a project without excessive consequences, for reasons beyond the company's control. In practice, this will not happen easily, but only after the contractor has incurred considerable costs. In terms of amendment clauses, clients are generally unwilling to accept a clause that enables the contract to be changed on the contractor's initiative.
- Pay attention to fines and bonus clauses: These are mainly included at the client's request, and the two (fines and bonuses) go together. For a contractor, a fine on a project that is not running well is usually just the tip of the iceberg because the contractor will also have already incurred high costs.
- Identify the risks and formulate solutions in advance: The contractor should consider various project scenarios and indicate the perceived risks, including how to minimise them and which actions will be taken if the risks arise. The contractor must discuss this with the client.

Risk management during the project:

- Arrange a trial delivery: A geo-ICT or data acquisition project usually involves large amounts of data, and it is essential that all types of project data appear in the trial delivery. The trial delivery is also a good way to match the expectations of the client and the contractor. Fast trial delivery is essential to prevent or eliminate many misunderstandings.



▲ Most geo-related projects involve high risks, so it is important to control and manage the risks, both before and during a project.

MORE INFORMATION

- Risico-management bij geodetische en Geo-ICT projecten, Jos Anneveld and Ronald Vroom, *Geo-Info 2017-1*; Marketing en sales bij Geo-ICT en data acquisitie bedrijven, Jos Anneveld, *Geo-Info 2017-1*, pp 24; Algemeen management bij Geo-ICT bedrijven en data acquisitie bedrijven, deel 1, Jos Anneveld, *Geo-Info 2017-3* and Algemeen management bij Geo-ICT bedrijven en data acquisitie bedrijven, deel 2, Jos Anneveld, to be published in *Geo-Info*.
- Elliott Aronson, Timothy Wilson & Robin Akert, 2011, *Social Psychology* (7th Edition), Amsterdam: Pearson Education, Benelux.
- Wikipedia, strength-weakness analysis
- Wikipedia, BCG Matrix.

- Formulate critical projects that the contractor strictly monitors from above: While describing a project as 'critical' ensures it receives extra attention, there is also a risk of creating unnecessary bureaucracy. A loss-making project should definitely be labelled 'critical', but of course other criteria can be chosen too. For critical projects, improvement points should be formulated and it is a good idea to monitor progress weekly.
- Build in enough contact moments between contractor and client: A geo-ICT or data acquisition project to develop a product or service requires input from both parties. It is important that the contractor and the client have enough contact moments, starting from the very beginning of a project. Not all contact moments must be face to face; for example, the client and the contractor can keep a digital log, allowing them to specify the project in detail.
- Set a realistic deadline: Healthy time pressure is important in a geo-ICT or a data acquisition project, as in any other project. However, excessive time pressure leads to errors. Meanwhile, too little time

pressure allows attention to fade and that can also cause errors. A quick trial delivery of a small part involving all the essential elements of the project helps to create healthy time pressure, and production is greatly increased when the trial delivery has expired. In the final phase of the project, production is much lower and a large part of the team can be removed from the project.

- Communicate with shareholders and the works council: Since the above-mentioned issues should be broadly summarised for the shareholders and the works council, this communication must always be coordinated by the URP. It is also extremely important that the URP is the first point of contact in case of initiatives by shareholders or works councils.

CONCLUDING REMARKS

General management of a geo-ICT company or data acquisition company involves many aspects. The ultimate responsible person (URP) must therefore set priorities. Some areas require only occasional attention, whereas other aspects must be handled by the URP or

may be delegated by him/her within or outside the company. In the case of delegation, it is important that the URP thinks about the issues in as much detail as possible in advance in order to determine the policy and, in the case of delegation outside the company, to save costs. ◀

ABOUT THE AUTHOR

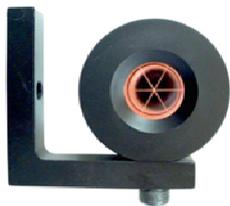
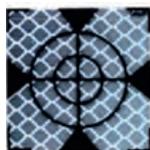


During his career, Jos Anneveld has gained extensive experience in formulating missions, visions and strategies for organisations and departments, and in implementing policy in line with these visions. In doing so, Jos has always aimed to achieve cohesion between positioning, marketing, sales, execution, technological development, organisation, personnel and finance. Jos is familiar with various public authorities, energy, water and telecom companies, contractors, and oil and gas companies. His area of expertise lies in setting up long-term international collaboration between government bodies, knowledge institutes and the private sector, with a special interest in solving complex problems at strategic, organisational and project level.

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The Importance of Continuous Education

It is now well over ten years since Fugro Academy opened its doors within Fugro as a focal point for learning and development for the company's 10,000-plus employees, who specialise in providing geoinformation and asset integrity services to a global client base. So, what is Fugro Academy and how does it contribute to the ongoing education and professional development of the largely technical workforce? Andrew McNeill, global talent development manager at Fugro, explains more.

Fugro Academy was established in late 2006. Around that time, Fugro was working in a very buoyant market, particularly for services related to oil and gas, and faced significant competition in recruitment of staff. However, even with a successful recruitment campaign in place for geomatics professionals, it can take some time for newly hired staff – usually graduates – to go through the training and development programmes needed for them to become efficient members of the teams deployed on projects.

The organisation at that time was also highly decentralised with many local offices, and so achieving certain efficiencies and economies of scale was not always possible. At Fugro,

we also needed to increase standardisation in processes and systems so that staff could be deployed more flexibly across projects and meet the expectations of international clients. Against this backdrop and series of objectives, we set about putting the resources and infrastructure in place that provided the basis for Fugro Academy, upon which we have continued to build in the 11 years since initial launch across the organisation.

BRICKS AND MORTAR OR CLICKS AND MORTAR?

One of our first considerations was in what form Fugro Academy should exist. Traditionally many corporate training

departments or academies have a physical presence, and staff from across the organisation travel to a central location for training events. This comes at a cost, however, and a previous attempt to gain support for a training school in this format at Fugro had floundered. We therefore decided to establish Fugro Academy as a virtual training school. We would have no permanent physical presence, but instead use existing facilities in our various offices. This had two immediate cost benefits. Firstly, there was no need to invest in further offices, classrooms and physical buildings to create the school. Secondly, it allowed us to reduce the travel time and costs for many delegates as the courses would be run locally at their offices, with the trainer travelling and delivering the course instead.

We recruited trainers from within our existing workforce, seeing this as an opportunity in itself for employees to further their careers within Fugro. All of our trainers are experienced technical professionals with years of operational and business experience. This knowledge and experience is invaluable, and so it was important to retain and share this within the organisation. Our trainers were also already used to business travel as part of their original roles, so were comfortable with the idea of travelling to deliver a training course.

ONLINE ACADEMY

Fugro Academy is not just a virtual school by the nature of our classroom-based course



▲ Extract from a Health & Safety e-learning course.

delivery. We also saw the potential and opportunity for online learning ('e-learning') for a global organisation like Fugro. Part of our initial development was the selection and implementation of a learning management system (LMS) to provide a virtual centre for Fugro Academy activities. The LMS would allow all training, whether classroom, e-learning or other, to be recorded and tracked for all employees. The use of e-learning allowed busy professionals to fit training and development around their own work schedules rather than having to fit their work around training class schedules. But an LMS in a new training school is like a library with no books: just empty shelves. We needed to find courses that were relevant to our audience. Since many of our technical services are based upon Fugro's proprietary software and systems, these courses had to be created. Therefore, we also invested in e-learning course-authoring software and trained our trainers and other subject matter experts (SMEs) to create e-learning courses. This enabled us to not only capture knowledge from our professional experts, but also to share it across the organisation – regardless of time and distance – to others within Fugro whose skills and knowledge could be developed via these courses. It also made certain training more cost-effective,



▲ Extract from a Compliance e-learning course.

as we no longer needed a minimum course length or classroom size for a course to run efficiently.

As time went on, we saw the need to develop more advanced and higher-quality e-learning courses, so we created an e-learning authoring team to work alongside the trainers and SMEs to help design and author courses. We also made use of advanced 2D and 3D multimedia and animation techniques to better illustrate the courses and make them more engaging for learners. Course development initially focused on technical topics but, as with other aspects of Fugro Academy's capability, this has since

expanded to cover other topics like health and safety, project management, compliance, finance and human resources, to name but a few.

BROADER RANGE OF TRAINING

From day one of Fugro Academy opening its virtual doors, we planned to offer a broad range of courses, not just technical ones. Staff joining as graduates inevitably need further training to supplement and extend what they have learned at college or university, to put it into the context of the company and the industry they are employed in. Whilst much focus is initially



▲ On-the-job training.

placed on technical training to help technical professionals develop the knowledge and skills they need in their day-to-day work with software, equipment and processes, a much broader skill base is required over time. From the ranks of these technical professionals come the future leaders and managers who take responsibility for the business and moving it forward. Hence, as their career develops, their development needs change. Finance, project management, leadership, management, sales, marketing as well as soft skills all become areas where specific development is required so that these experienced professionals can take on higher and broader levels of responsibility,

including the management of people. Fugro Academy provides courses and development programmes across this broader range of competencies to ensure we support the entire business as it requires. However, unlike for many of our technical courses which are internally produced, we work with external partners on the design and delivery of these business skills programmes. In truth, many of these skills are generic across a wide range of businesses. But value can be added to the individual and the organisation when the content is tailored to include Fugro-related examples and context, so we always adopt this approach rather than taking a pure 'off-the-shelf' option.

BOATS AND MORTAR

Although our initial plan did not include the dedicated training centres we had seen in other organisations, after operating our virtual delivery model for a number of years we started to see that having our own facilities would be an advantage to the business. Therefore, in Plymouth, UK, we opened the first of two dedicated Fugro Academy Training Centres in 2015. The second followed one year later in Abu Dhabi, UAE. Our original virtual concept still holds validity for many trainer-led courses where the delivery requires either limited or readily available tools and equipment such as software and computers. But when you need specific equipment such as acoustic positioning systems, multibeam echosounders or remotely operated vehicles and also want to put the training into practice in a real-life environment, you need dedicated resources. It was with this in mind, as well as some longer courses we were planning, that we invested in our first training centre in Plymouth. We now have several trainers based there as well as two inshore survey boats which we use for practical training. These boats can be configured with standard equipment configurations that replicate the systems installed on our large, ocean-going survey vessels, thereby making the training highly applicable to real field operations. This investment allows our staff to gain confidence and experience using real systems away from the pressures and expectations of live projects and clients. They are able to make mistakes and learn from them, but without putting a commercial project, or our reputation, at risk by relying solely on on-the-job training.



▲ Surveyors and engineers learning about acoustic positioning at Fugro Academy's training centre in Plymouth.



▲ An ROV pilot learning about hydraulics at Fugro Academy's training centre in Abu Dhabi.

LEARNING IS A JOURNEY, NOT A SHORT COURSE

One of the areas we have focused on for our professional staff in the last few years is leadership and management development, particularly for first-level leaders: people stepping up to manage a team or department having previously been a member of it. In technical organisations like Fugro, the managers have usually come from a similar background to the people they are managing. However, they need to learn new skills and behaviours to successfully make the transition from team member to team leader and to continue to develop their professional career path. Being a great technical expert does not necessarily mean someone will become a great manager or team leader; different skills



▲ *Developing the next generation: delegates on a management programme.*

may need to be developed, and time must be invested to do so.

To enable this, we created our junior management development programme to support this group of staff. Unlike some earlier management courses we had run, we designed this programme recognising that the skills and behaviours needed could not be developed in a five-day short course. Instead, we adopted a 'learning journey' approach whereby delegates on the programme participate in a number of different learning activities spread over the course of eight or nine months. A few are classroom-based, but others are virtual, some e-learning and some simply peer-to-peer discussions. The purpose of these virtual sessions and discussions, along with associated preparation and follow-up, is to allow participants to practise what they have learned back in the workplace and then to discuss how this went, what they have learned and what they would do differently next time. By repeating this process and making it a learning journey, delegates gain experience and confidence in applying their newly acquired skills, resulting in better performance and behavioural change for the longer term.

ASSESSMENT

As with any expenditure, there is often the question of whether we have achieved a return on investment (ROI). This can apply to training, as it does to any other business activity. It is probably the one question training professionals fear most, as it can be

difficult to separate the training effect from many other factors – inside and outside the organisation – that affect performance and results. Nevertheless, it has to be attempted

THE 'LEARNING JOURNEY' APPROACH HELPS DELEGATES GAIN EXPERIENCE AND CONFIDENCE IN APPLYING THEIR NEWLY ACQUIRED SKILLS

in some shape or form. For technical skills, like software or equipment operation, you can quickly determine this by testing workplace performance or conducting a competence assessment. For some of the leadership skills we have been teaching our professionals, it's not so easy, particularly over the short term. And over the long term, the other factors may also have greater significance.

For our leadership programmes in particular, we were keen to demonstrate the value they represented to the business. Therefore, during the design phase, we planned how we would evaluate the success of the programme. This would be done six months after the formal end and would be conducted using a 360-degree survey technique whereby delegates, their managers, peers and reports all provide assessments of before and after behaviours on key measures. This assessment is repeated for each cohort going through the programme, so over time we build up a larger, more robust dataset.

Early indications show good results from the programme, with survey respondents showing over 25% improvement in behaviours such as communication, delegation and decision-making. In terms of wider effects of team performance, respondents have indicated 80% improvement in engagement and collaboration. And last but not least, managers of delegates have reported an increase of 75% in capable leaders and an 84% improvement in leadership quality as a result of the programme. These results show that the programme is benefiting not just the individual participants, but also their teams and the business overall. The programme has also gained formal recognition, winning HR Network Scotland's Learning and Development Award of the Year 2017.

CONCLUSION

The initial and then ongoing development of staff is a key activity for any organisation. Initially this may focus on ensuring staff have the necessary technical skills to equip them for the jobs they are currently employed in. However, as many of these same people eventually take on leadership roles, it is equally important to prepare them for

these roles through suitable development opportunities. Through Fugro Academy, we have been working on both aspects of this development for our technical professionals and we subsequently offer a wide range of programmes that are helping develop our next generation of leaders. ◀

ABOUT THE AUTHOR



Andrew McNeill is the global talent development manager for Fugro and manages the Fugro Academy. He has worked for Fugro for 20 years, initially as chief surveyor for the Aberdeen office and then as chief surveyor for the Offshore Survey Division. He jointly established Fugro Academy in 2006, and took on full-time management of it in 2009. Since 2013, he has also been a member of Fugro's Global HR team.

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INDUSTRY MARKETING SECRETS

How to Sell Just about Anything to Just about Anyone

At some time in their lives, everyone has experienced a situation in which someone starts telling them a story that seems to be leading somewhere really interesting, and then all of a sudden they get to the end and there's just no point or punchline. In this article, the author explains how she often gets a similar feeling when talking to geospatial engineers and developers, or as she calls them "the real boffins of the industry". Here, based on her extensive experience in selling and marketing innovative laser survey equipment worldwide, she shares her insider secrets for how to market your innovations successfully.

Geospatial engineers and developers are obviously extremely smart and it's amazing what features and technologies they come up with. But very often you're left thinking, that's great in theory but what are you going to do with it in the real world? What specific problem will it solve? In other words, what is it about this idea that will persuade people to give you their money?

Not that the geospatial engineers are just inventing stuff willy-nilly without having a clue what it might be used for. Most engineers come up with an awesome idea, be it the latest laser scanning technology or point cloud processing software, because they understand that their potential client has a problem that needs solving. But all too often, somewhere along the way, this goes haywire.

In the inevitable process of further tweaking to develop a cool new feature or refining the laser scanner until it's absolutely perfect, they forget about the customer and their needs. The result is a product that the engineer is tremendously proud of, but which doesn't work for the market – perhaps because all that obsessive R&D work has pushed the price way too high, or because the focus has shifted and the product no longer addresses the clients' problems.

BRIDGING THE GAP

Whatever the reason, if you're in sales then you're the one tasked with bridging the gap between what the engineer is super-excited about having created, and what your client actually wants – or, in many cases, between the potential of the new technology your team has created, and your market's understanding of what that means for them.

Sounds familiar? Well, don't despair. After all, this is the whole point of marketing, right? It's not about shiny ads, it's about understanding your customer base and catering to their needs – solving problems, educating, attracting and retaining! Armed with a number of tricks of the trade, it's possible to take your innovations to market successfully.





TEST IN THE MARKET FIRST, TWEAK LATER

I began my career at my father’s laser manufacturing firm, MDL, selling and marketing innovative laser survey equipment to offshore and mining markets, all over the world. We specialised in borehole-deployable laser scanning, and we were the undisputed kings of the sector. Why? Because we excelled at devising solutions that the market wasn’t yet ready for – not because they didn’t need them, but because they didn’t know they needed them yet. Furthermore, my father was obsessed with being the first to market, every time, and that meant taking a lot of risks. His general rule was to get it

out in the market, let customers test it ‘to destruction’ and then tweak it later.

In those days, of course, marketing was heavily ‘outbound’; we went out to find the customer through advertising and exhibitions. Fast-forward to today and things are very different in the marketing world. Without going into depth about what makes an ‘innovative’ product launch, today’s marketing is more like a big jigsaw puzzle, with online and offline elements all playing different yet equally crucial roles – and a big part of this is inbound marketing. As Brian Halligan, founder of HubSpot and the person who coined the phrase ‘inbound

marketing’, says: “Marketing is about attracting, converting and delighting the customer through activities that attract the market to you!”

THE MARKETING BASICS

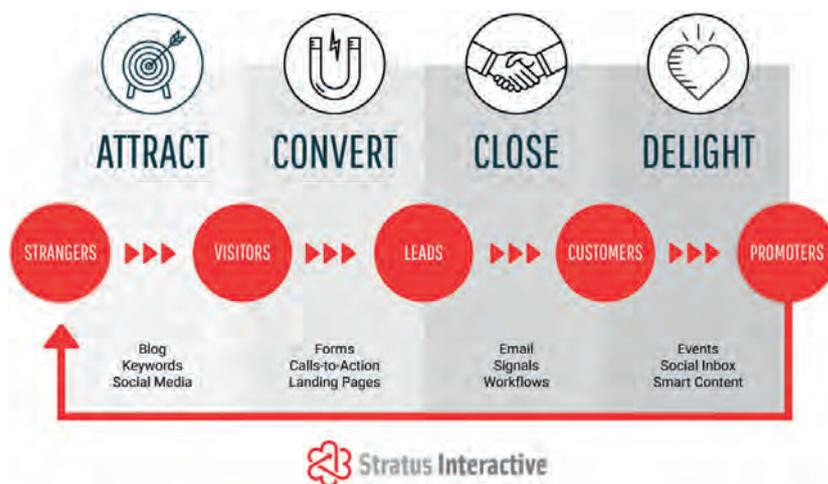
First of all, it’s important to think about the type of business you run and what your purpose is. Whether you’re a laser scanning manufacturer, reseller of survey equipment, designer of point cloud processing software or whatever else, remember that it boils down to this: you don’t just provide a feature or technology or a service; instead, you provide solutions to specific problems for the geospatial industry. It sounds obvious, right? But miss this vital point and you can wave goodbye to your profits (and certainly to a successful marketing campaign).

WHO?

There are countless manufacturers of laser scanning equipment around the globe, all pitching their scanners to similar markets... but 99% of them are doing a mediocre job! I know it sounds harsh, but I can count on one hand the number of companies I’ve met in this sector who really seem to understand and visualise exactly who their customer is.

HOW?

Imagine you’re a producer of point cloud processing software and your focus is on the transportation corridor marketplace. You



focus on engineers and surveyors that own laser scanners, such as within departments of transportation (DOTs) and civil engineering/surveying companies, as well as on laser scanning manufacturers/dealers. There may be hundreds of software companies out there that are selling the same stuff as you (or, at least, that the market perceives as being the same software). Before you jump in and pour marketing budget over the problem, you need to clearly define who are you, who you're for and how you set yourself apart from your competitors. The key is to gain a thorough understanding of your business strategy.

WHY?

Let's jump back to where we started with all this: what is the point of your company? In the above example, you probably started with a pretty decent, customer-focused remit. For example: "Our customers' laser scanners generate terabytes of data! How can we add value by helping them make sense of it all? How do we translate that noise into knowledge?" That's actually a great start... providing you stay focused on that goal. But in reality, there's a big chance that your engineering team will soon start obsessing over finer details that don't actually help you reach that goal, or will get hung up on creating tons of nice-to-have features that don't genuinely add value. That's the big danger here: the tendency to work so hard on trying to make the software so perfect it ends up never going anywhere, or has so many bells and whistles added to it that it's way too complicated for the user to work with. Because no matter how clever your product is, if your target market can't use it, it's doomed to fail. Instead, you need to focus on truly solving the problem at hand; treat everything else as a bonus, not a core feature.

UNDERSTANDING YOUR ROAD MAP

To keep your eye on the prize, you need to define your business goals, establish the direction you're going in, and map this out step by step. Firstly, establish a game plan for the future – and set your sights high. You should be aiming to be the 'go-to company' to solve that problem for your specific target market! Secondly, how are you going to get there? Successful marketing is all about having a clearly defined plan. Coming up with an amazing feature or technology isn't enough. You need to know how you're going to go about solving the problem, what makes you different, how you're going to



▲ Once you've defined your strategy, market segments and types of buyers are you ready to open up your marketing communication toolbox!

communicate this to your market... and who is this mystical customer, anyway? So many manufacturers never get a distinct picture of their customer – and then they wonder why their marketing efforts aren't pulling in leads.

3 KEY POINTS

In conclusion, here are three key points to take away:

1. Focus: Choose one or two markets that you know well, and define the market segments (specific groups of people/companies with common needs). This is vital for getting your marketing communications strategy right! It will help you be smart and precise about where you spend your money, mitigating risk and boosting profits.
2. Resources: Figure out what resources you need to reach your target groups in terms of people and hard cash. What do you need to take your product to market, and which channels will you use to communicate to your audience that your business is what they need?
3. Communicate: Only once you've defined your strategy, market segments and types of buyers are you ready to open up your marketing communication toolbox! Don't fall into the trap of kidding yourself that things are always changing so you don't need a plan. Defining who you are selling to is an

essential place to start, even if you have to adapt this later.

In other words, marketing is all about understanding your purpose, what gets you out of bed in the morning, who your customers are, and how you can solve their problems. To be honest, that's not just marketing – that's the core of all business. Everything else, I'm afraid, might be fun... but it's not the stuff that will make you money! ◀

ABOUT THE AUTHOR



Elaine Ball is the creator of Elaine Ball Ltd, a global business and marketing evangelist for the geospatial industry. She has dedicated 20 years to international marketing and business development for the technical industry. She has a background in the manufacture of laser surveying equipment sold to multiple industries, including mining, oil & gas, aviation, transportation, forestry and surveying. Elaine has noticed a lack of specialised technical sales and marketing expertise within the geospatial industry and surrounding vertical markets, and is on a mission to raise the standards within the geospatial industry and to encourage and excite the next generation of surveyors.

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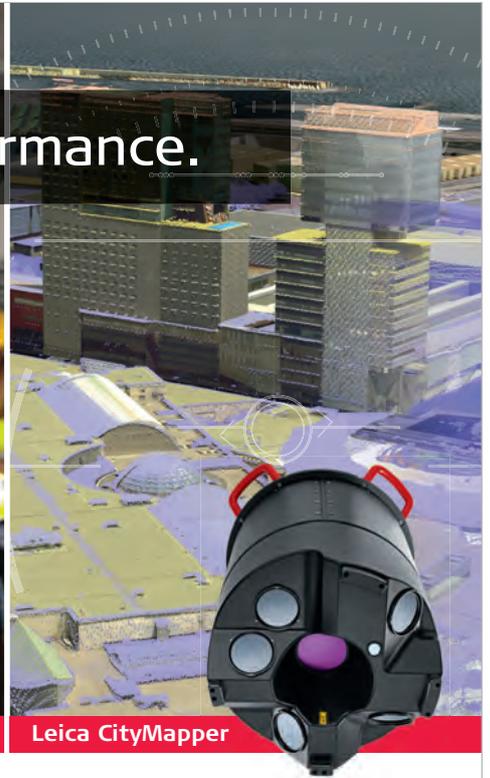
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How Geospatial Industry Insiders View the Market

To gain real insight into today's geospatial business landscape, *GIM International* decided to ask some of the sector's most influential companies. This series of Q&As captures the current state of the industry from various perspectives, such as which technological and societal developments will have the most impact on the geomatics market, which market segments are the most promising and which areas offer the most substantial growth. The questions also explore the trend towards open data and open-source software.

Q&A with...

Aidan Mercer, Bentley Systems

Which technological developments will affect your product/service portfolio the most in the coming years?

One of the most exciting developments at Bentley are Microsoft Azure-based cloud services that enable our users to achieve better project delivery and asset performance. This is known as our CONNECT Edition portfolio. This next generation of software is helping firms in 'going digital' – this is the ability for data residing in applications to interact with data in other applications in a fully digital environment, one we may describe as 'connected'. The benefits are unbounded, e.g. performance improvements, scalability, efficiency gains, accessibility and more. The ability for our users to access on-premise or cloud-based services gives them choices and flexibility as well as exciting new features like '365 Services' and a range of CONNECT Edition applications.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

The world's population is growing by a staggering 200,000 people every day. By 2025, the global population is expected to reach over eight billion people and by 2040 this number could hit nine billion. Experts predict such rapid growth will increase the population to a massive 11 billion people by the turn of the century. Urban expansion is driving new ways of working and a heavy reliance on technology. We've made

great progress with our reality modelling applications, in particular ContextCapture CONNECT Edition, which rapidly captures existing site conditions through digital photographs or laser scanning data. This is helping urban planners develop space for new housing, develop new roadways, expand water capacity and understand how to deal with future growth, to name but a few use cases, because of its ability to capture assets or entire cities. It is slowly becoming the must-have technology and we are excited about the contribution it provides to society.

Which market segments are the most promising for your products/services?

Bentley covers all infrastructure asset types with a concerted focus on advancing infrastructure projects. One major focus for us in 2018 and the coming years will be 'digital cities'. This, I believe, is an evolution of smart cities by applying the emerging technological advancements that can deliver significant value, like the Internet of Things (IoT) or machine learning. When applied to cities, with all the data they create, the value or outcomes could be hugely significant.

In which parts of the world do you envisage substantial growth in users of your products/services?

At our annual Year in Infrastructure Conference held in Singapore in October 2017, we recognised the best projects from around the world at the Be Inspired Awards. Of the 23 categories, ten of the winners

were from China. These projects were selected by independent jurors, and it goes to show the quality of infrastructure projects in the region and the innovative use of Bentley software on these projects. Also, the burgeoning use of ContextCapture on all types of infrastructure projects is enabling a new way of working, inclusive of engineering workflows that are bringing real excitement to the market.



Open data is becoming increasingly available all over the world. How will this trend affect your business?

Open data is very important. We have many users that are publishing data, like cities and local authorities. Bentley has been committed

Aidan Mercer

Aidan Mercer joined Bentley in 2010 and is currently industry marketing director for AEC. He has held various roles in geospatial and utilities marketing with Bentley and previously held various marketing roles in similar high-tech organisations. Mercer's global responsibilities include reality modelling and smart city initiatives. Aidan graduated with a bachelor's degree in history and holds a master's degree in marketing from the University of Gloucestershire as well as various CIM marketing qualifications. Aidan has written extensively on global topics such as BIM and 'going digital' as he aligns the company message to audiences around the world.

to open standards for many years, particularly on the geocoordination of applications. An example would be a GIS database, like CityGML, which has been developed as the Open Geospatial Consortium (OGC) standard describing such things as 3D urban objects as an application schema and which comprises different thematic areas. Although the model is in XML format, it is geometrically compatible with Oracle Spatial for RDBMS. Such standards provide the framework for semantic and geometric relationships and have the

functionality of representing differing levels of detail required for complex infrastructure projects. These standards can also ensure the same object is represented in different levels of detail simultaneously, and integration with BIM, for example, is very important. Bentley has been a corporate sponsor of OGC for many years and continues to see value in open data.

We certainly see the value in open source and actively encourage third parties to contribute to aspects of our software. For example, our IModelHub 2.0 Platform has an API that allows third parties to create bridges within the cloud services of the offering as we address change management for certain aspects of a project making it very powerful and adaptable. You must harness the tremendous potential and expertise in the ecosystem so that projects can benefit, and we see real value in this.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Q&A with...

Chase Fly, Delair



Which technological developments will affect your product/service portfolio the most in the coming years?

Key technological developments that will impact Delair solutions in the coming years include deep learning, Internet of Things (IoT),

telecommunications and cloud technology. Delair provides hardware and software products that form complete aerial data acquisition and analysis solutions which deliver business intelligence. Deep learning algorithms enable Delair to continuously improve the quality and quantity of data analytics which are applied to aerial imagery, such as change detection. Delair's UAVs (drones) are being equipped with advanced telecommunications systems that include cellular connectivity and onboard data processing capabilities in order to extend the range of drones to support beyond visual line

of sight (BVLOS) flights and open the door to IoT applications.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

Drones, and more importantly the huge data generated by drones, will enable companies to digitise their physical assets, which will provide exciting new insights into what happens in the world around us. Combining these exciting new insights and huge datasets with big data analysis and machine learning techniques will also open new opportunities in the area of predictive solutions. This is likely to lead to a future where physical objects and infrastructure is built to last longer and could also enable a wealth of new business models around servicing physical objects. Delair's UAVs lend themselves well to large-area mapping projects and flying BVLOS, and a 3G/4G communication link is used as one solution for this. The expansion of cellular data network coverage in rural and unpopulated areas throughout the world, where companies frequently have assets they want to map, will enhance the value of the technology Delair is building into its drones.

Which market segments are the most promising for your products/services?

The geospatial, construction, infrastructure, agriculture and environmental markets are the most promising. Delair offers drone platforms designed to provide user-friendly workflows that focus on producing high-quality survey-grade maps and data products. These market segments all have applications that benefit from aerial imagery and Lidar

data that can be transformed into actionable business intelligence, which is Delair's core business.

In which parts of the world do you envisage substantial growth in users of your products/services?

Delair has a worldwide distribution network of local dealers who actively market and sell Delair drone solutions. Drone technology adoption is growing all around the world, but regions which are demonstrating rapid uptake include China, Latin America and the United States, where Delair representation is strong and the future looks bright.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

The availability of aerial imagery from satellites available through open data sources will provide landscape-scale imagery which may supplement the high-resolution imagery collected and analysed by Delair customers with drones. Delair solutions also consume satellite imagery as a potential source that will benefit from the open data trend. The push for open data could also be a huge driver for adoption of the Delair solutions, since the providers of open data will need solutions that provide efficient means of acquiring, storing, processing and publishing imagery and geographical data.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Many of Delair's clients use open-source software (OSS) such as QGIS or other

Chase Fly

Chase Fly specialises in applied technologies including GNSS, GIS and unmanned aircraft systems (UAS). He has worked in the geospatial industry for ten years and has a degree in geography. At Delair, Chase is the geospatial product manager, working with the engineering, sales and marketing teams to ensure that new and existing drone solutions are providing meaningful solutions for real-world applications. Chase holds a private pilot licence and a Part 107 Remote Pilot Certificate in the USA and has operated drones commercially for mapping applications.

geospatial applications. These applications often enhance the ability of these clients to view or further analyse aerial imagery collected with Delair drones or even processed by Delair's software platform.

This is viewed primarily as an opportunity for Delair to offer a drone data acquisition and processing solution that can ultimately feed deliverables into OSS that clients leverage in their everyday activities. Delair software tools

are accessible to developers and business specialists through a series of interfaces and APIs. They are encouraged to port their modules on the platform, to access a new base of users and promote their know-how.

Q&A with...

Clint Brown, Esri

Which technological developments will affect your product/service portfolio the most in the coming years?

Cloud computing is enabling an instrumented world where computing can be harnessed to analyse and respond to virtually any issue. We envision that GIS will be recognised as a key enabling information technology for most big IT initiatives in the coming years – essentially integrating location intelligence into large to massive enterprise and cloud-based systems and hybrid systems. GIS provides a comprehensive approach for working with virtually all information sources. Further, the data in each individual organisational GIS is being brought together virtually to create a comprehensive GIS of the world in the cloud. Each of us are creating and maintaining our own layers, and because all GIS layers register onto the Earth, we are also contributing to and assembling a larger societal GIS for our planet – our individual GIS systems of record are being integrated, extended and deployed as systems for insight as well as communal systems for engagement.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

GIS has evolved into an essential information technology and will be at the centre of major advances in computing. Geospatial systems and expertise will be essential for our planet's future. In the past decade, GIS has been expanding far beyond the professional GIS community. With the advent of apps, people everywhere began to use online maps – the foundation for shared GIS. Almost overnight, everyone began to recognise the power of GIS as an enabling information platform for improved understanding, decision-making, efficiency, communication and collaboration. GIS provides a geospatial framework to integrate and interpret results. Over the past few decades, the mass adoption of the internet has led to a glut of information that we have come to know as big data. GIS

provides a geographic context to make sense of it all – while also providing the capability and the context to analyse that data in real time.

Which market segments are the most promising for your products/services?

The most interesting and exciting growth is in initiative-oriented and community-based systems. Communities are being formed around geographic locations as well as around common initiatives such as education, health care, environmental stewardship, smart cities, etc. Meanwhile, GIS is being applied in virtually every field of human endeavour, from helping businesses identify new customers to enabling our responses to natural disasters. The reach and influence of GIS is also expanding globally. GIS brings all digital content together and enables us to make interpretations to more deeply understand and to comprehend what is happening in a spatial context. For example, GIS maps help us to integrate IoT data feeds that will lead to deeper interpretation and understanding. GIS maps provide a framework for communication and understanding. Story maps have become a major revolution for GIS practitioners engaging with their communities. Over 400,000 story maps were shared publicly in 2017 across virtually every discipline, delivering critical messages and results in a very easy-to-understand way.

In which parts of the world do you envisage substantial growth in users of your products/services?

New social tools in the cloud and on apps have enabled broad global access and adoption of GIS. This is a key global implementation pattern that we see taking place daily and is expanding the comprehensive use of GIS everywhere. We see broad GIS growth everywhere globally with mature systems being implemented now in North America and Europe, and these systems will continue to expand and

mature in the next few years. Meanwhile, we see an expected lag in global adoption of web GIS and apps in other parts of the world. Something new in the near future is the capability for web GIS and mobile apps to be adopted and implemented much more rapidly than past information technologies. This is driven by cloud computing and apps on smartphones and other devices.



Open data is becoming increasingly available all over the world. How will this trend affect your business?

Open data will fuel the growth and relevance of GIS everywhere. Recently, computing has become more collaborative and social. With cloud computing and the mobile/app revolution, the GIS community has expanded to include almost anyone on the planet. The data in every individual organisation's GIS is being brought together virtually to create a comprehensive GIS for the world, made accessible on the web. Today, nearly

Clint Brown

Clint joined Esri in 1983. Since then he has been a key participant in Esri's product development for over 30 years (including ArcInfo, PC ArcInfo, ArcView, ArcIMS, ArcGIS and much more). Clint continues to team with Esri's development leads to grow the product – initially from about a dozen organisations in the early days to over 350,000 organisations today. Clint also works on GIS implementation and concepts, writing extensively about GIS, contributing content to several books, white papers and presentations on GIS. Among the initiatives Clint's teams develop and release are: the ArcGIS Living Atlas of the World, Esri Story Maps and Esri Press publications. He remains passionate about developing and capturing new and evolving approaches and methods for GIS. Clint has published extensively on GIS throughout his career, from *Understanding GIS* to *The ArcGIS Book*, and *The ArcGIS Imagery Book*, as well as numerous articles and publications.

everyone can take GIS with them everywhere they go on their tablets and smartphones. Now everyone can access each other's geographic information as URLs on the web. Their results are being shared using maps and apps on the web and smartphones. The ArcGIS Living Atlas of the World reflects these data-sharing trends, enabling users to build on each other's good work and to share their most creative ideas with others.

Will the tendency of increasing use of open-source software be a threat or an

opportunity for your business?

This is definitely an opportunity. The ideas, concepts and motivations behind open-source programming provide the hope that we can work together and collaborate. Of course, our view is that both commercial systems and open-source systems can be used together to orchestrate the best available solutions for real users with real problems to be addressed. The guiding principles of 'open' and communities have always been fundamental motivators throughout the geospatial community. GIS continues

to expand and grow rapidly, limited only by our imagination and commitment to implement meaningful solutions for the world. The demand for apps and opportunities for developers to create new kinds of engagements for our users is unprecedented. Sharing of interactive, amazing, functional online maps has enabled GIS access by virtually everyone. The more opportunity there is for individuals and organisations to access this technology, the better and more comprehensive our global GIS solutions will become.

Q&A with...

Oliver Bürkler, FARO



Which technological developments will affect your product/service portfolio the most in the coming years?

Looking at our customers and the technology they are applying, increasing digitalisation and automation of the construction industry

is affecting our portfolio the most. The more design and construction processes will be digitised, the more our customers will benefit from our products which are aiming at connecting the realms of physical construction and digital construction. Looking at FARO's product portfolio for the construction and BIM industry, the progress of digital technologies like cloud computing, 5G or virtual reality will lead to better customer experience, better and more valuable answers in less time. Ultimately, our customers will be able to make better decisions, avoid waste and rework costs throughout the whole building life cycle.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

With FARO's Construction, BIM-CIM business line supporting the AEC industry, any development which grows the construction market will influence our market. Trends like

urbanisation, scarcity of training staff and internet of things, to name but a few, are all areas where we can help our customers to transform and grow their business.

Which market segments are the most promising for your products/services?

Our main focus, our field of expertise where we strive to deliver the best value to our customers, is the AEC or construction industry.

In which parts of the world do you envisage substantial growth in users of your products/services?

The construction industry and related businesses are growing on a global scale. Therefore we see potential to gain new users for our solutions in all parts of the world.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

Our solutions are supporting the easy and intuitive sharing of as-built information to allow our customers to collaborate with all involved parties throughout the building life cycle. In that respect, the idea of open data is supporting our vision. Meanwhile, data security, protection of data privacy and intellectual property are very important to our clients. Our cloud-based data sharing solutions take care of this by offering the best possible security and encryption levels as

well as by giving the customer full control to manage the access to their information.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Having more and better software which is accessible to users at very low or even no cost will broaden the application of digital technologies in the AEC industry. We see this as an opportunity for our customers to make their businesses more profitable. Accordingly, FARO is supporting the access for software developers by providing programming interfaces to the digital as-built data created by our solutions.

Oliver Bürkler

Oliver Bürkler is senior product manager for 3D documentation software & innovation with FARO Europe. He earned his master's in precision engineering and business administration & engineering at the University of Applied Science in Munich, Germany. As part of the FARO 3D laser scanner product manager team, Bürkler is focusing on the development of FARO's 3D documentation software and new innovations, as well as managing the relationships with the company's third-party development partners.

Q&A with...

Jürgen Dold, Leica Geosystems

Which technological developments will affect your product/service portfolio the most in the coming years?

Edge computing is quickly becoming a guiding development for our solutions. From laser scanning to machine control, we are working to make processing the reality captured data happen more in real time and in the field, to dramatically increase efficiencies. Although we've been on this path of giving users the ability to do more in the field for some years, I am convinced that our customers will recognise the advantage of edge computing in the future.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

As population around the globe increases, we know contractors will need to be more efficient on construction sites. As more people move into cities, we know city planners will need to create smarter cities. And as more land is used for urban needs, we know farmers will need to be more productive with crop yields. Our focus is to provide 'smart digital realities' by capturing all variables in real time fused with advanced analytics and powerful visualisations. The smart digital reality is what enables the digital transformation of somewhat less than efficient systems in order to address these critical challenges.

Which market segments are the most promising for your products/services?

While we remain dedicated to increasing efficiency and quality in surveying and engineering, we are also expanding into the architecture, engineering and construction (AEC) sector. With the release of the Leica BLK360 imaging laser scanner, we aim to empower everyone to plan and execute projects with higher quality. We are democratising laser

scanning through simplicity-driven design to professionals who may have regarded the barriers of entry as too high in the past due to affordability and learning curves. We continue to work toward this goal by taking traditionally exclusive technologies and making them more inclusive. We're now seeing our solutions being picked up in many new segments such as real estate and interior design and in the arts & entertainment sector, and we're very excited to see where this goes. We certainly see a use case where these professionals can create digital realities to immerse their clients in properties during the buying decision or design phases so that perception and reality fuse.

In which parts of the world do you envisage substantial growth in users of your products/services?

That's an interesting question as the past few years have been influenced by macroeconomic and geopolitical events. Most recently we have seen growth in almost all our regions, and we have active business in more than 150 countries. With our broad portfolio of solutions and selected services, we are experiencing growth in many areas, especially driven by continuous innovation.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

In some instances, such as airborne data that is subsidised by the government, then of course we support an open data model. When it comes to professional-grade data, though, you need to know when and where it was collected to fully trust the data, and then there are costs involved. For us, we have taken a page from the shared economy playbook, and we are applying this to our business model. Take our HxGN Content Program, for example. By sharing resources to collect high-quality, professional-grade

airborne data, our network of airborne sensor customers have come together to make this resource accessible and affordable for all. We support shared data over open data, solely for the quality there is to gain.

**Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?**

We're an optimistic organisation, so we find the opportunities in any change. There is always much to learn in terms of trends and customer needs when it comes to open-source software (OSS). We do see some synergies between the OSS concept and our strategy around a shared economy, so to that end we embrace it.

Jürgen Dold

With close to 30 years of experience in the geospatial industry, Dr Jürgen Dold serves as the president of Leica Geosystems and Hexagon Geosystems. He directs the organisation's global strategy in measurement technology, leading 5,000 professionals in more than 40 countries. Previous to this role, Dold served in many positions within the organisation, from product manager to division president. He also served as academic counsel and assistant professor at the Institute for Photogrammetry and Image Processing at TU Braunschweig, Germany, where he oversaw research and development for various projects, including an expedition across the Greenland ice sheet. Dold holds a MSc in engineering from the University of Bonn. He serves on the boards of ETH Zurich and SWISSMEM and is a member of the ISPRS Foundation Trustees.

Q&A with...

Victor Adrov, Racurs



Which technological developments will affect your product/service portfolio the most in the coming years?

Racurs' main business activities are PHOTOMOD development and photogrammetric production services, so evolution of remote

sensing technologies – both aerial and spaceborne – and computing facilities have the most influence on our business. We rise to this challenge with a high level of automation and distributed processing for main photogrammetric operations. Furthermore, cloud technologies seem promising, which is why we offer our solutions in several cloud services.

Victor Adrov

Dr Victor Adrov graduated from Moscow Institute of Physics and Technology in 1980. He obtained a PhD in engineering in 1987. Dr Adrov co-founded Racurs and has been CEO since its foundation in 1993. Before Racurs, Dr Adrov worked as head of laboratory at the Scientific Council of Cybernetics of the Russian Academy of Science. He is also a member of the Steering Committee of Russian Society of Geodesy, Cartography and Land Management, a member of the International Industrial Advisory Committee of ISPRS and various other societies.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

Nowadays, methods and technologies of spatial data acquisition as well as new business models like software as a service (SaaS) are becoming increasingly available for non-professionals. For instance, the growing UAS market generates many start-ups which offer aerial survey and UAS data processing. Such businesses need user-friendly and inexpensive solutions, so the target for software developers is to decrease prices and increase possibilities. These efforts, for sure, expand the market opportunities.

Which market segments are the most promising for your products/services?

The present time is characterised by developments related to virtual and augmented reality technologies, projection of smart cities, BIM and autonomous vehicles, but photogrammetry is still tasked with providing topographic support for territorial development and land management.

In which parts of the world do you envisage substantial growth in users of your products/services?

We are optimistic about the 'Asian tiger' countries such as China, Korea, India, etc. Besides huge domestic GIS market, these countries are highly active in the international outsourcing market. The GIS markets in developing countries also offers perspectives for our software, which is characterised by an optimal productivity/price ratio, a high level of automation for main

photogrammetric operations, and the ability to process any type of remote sensing data. These countries are still depending on effective spatial data acquisition solutions for land management. Our technologies are widely used in advanced markets too. PHOTOMOD software is used effectively for 3D modelling as well as for vector data creation (stereovectorisation), and point cloud generation. These applications are the fastest growing for the photogrammetry market. Last but not least, Russia is the number one market for us. We are proud that almost all leading companies in Russia use our software. Thus we see possibilities for our technologies to be used all over the world.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

Accurate and precise open data, both raster and vector, can be successfully used as underlying data during photogrammetric tasks. Any new source of verified open data essentially widens the application area of our software and is therefore positive for us.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Open-source software (OSS) includes useful algorithms and powerful libraries, but rarely complete solutions. It is a long road from OSS to successful business. OSS is a part of our programme development process. We regularly test OSS algorithms and methods to find something new. We use commercially available libraries like GDAL under X/MIT licence.

Q&A with...

Christian Sevcik, RIEGL



Which technological developments will affect your product/service portfolio the most in the coming years?

Some of the technological developments that will affect our product/service portfolio and business the most over the coming years are advances such

as automation, robotics, driverless vehicles,

the cloud, and the Internet of Things, to name but a few. While these may not affect our business with a direct impact, we do feel the effects of them in the industry and are watching them starting to shape how the industry works and new products that are being introduced to the market. We are seeing how these new pushes of technology are working their way into affecting new products and services that we may end up offering to the market, if they are needed.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

The societal development that will influence and shape our brand the most over the coming years is Lidar becoming more widely known and used throughout the world. As Lidar becomes more of a 'household name', so to speak, and people generally gain more knowledge of what it is, what it does, what it is capable of and how it affects their daily life, that will really give us a larger share and greater

visibility in the geomatics market and in the public eye.

Which market segments are the most promising for your products/services?

There are multiple market segments that show great promise for RIEGL such as precision agriculture, wide-area mapping, transportation, surveying, mining and bathymetry, to name but a few. One of the largest areas where we are currently seeing great promise and potential is in unmanned applications worldwide. The need in this market has grown exponentially over the last few years alone and there continues to be great demand at this point in time. Unmanned sensors and systems offer users more flexibility and possibilities to get into hard-to-reach or even dangerous areas, which has opened up new fields and applications.

In which parts of the world do you envisage substantial growth in users of your products/services?

There is a constant need and demand for our products throughout the world and I feel that this trend will continue. Highly accurate Lidar data is needed worldwide for a multitude of applications and businesses. We have seen growth in all of our market segments in every area of the world and we believe that we will continue to see this type of growth happen through North America, South America, Europe, Asia, Australia and even Africa. The

fact that we are seeing this type of substantial growth throughout the world shows immense promise and potential for our brand.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

The increasing availability of open data will affect our business in the sense that some of the users of our sensors and systems may participate in the movement. With our users being involved in a number of fields and applications, there certainly may be some who feel that acquired data should be freely available to everyone to view and use as they wish, and there will be some who cannot provide data due to customer and governmental regulations. As for affecting our business directly, we may end up with new users who are aiming to acquire data for this sole purpose. Generally speaking, open data initiatives are very welcome as they are vital to raise public awareness about Lidar.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

The increasing use of open-source software (OSS) can be seen as both a threat and an opportunity for us and our business. As we have our own proprietary software for our sensors and systems, we would optimally want our users to utilise the software that we have specifically developed, hence the aspect of a 'threat'. Using our software, along with our

hardware, guarantees the best results with our products. We see a lot of potential in some of the OSS being launched onto the market and a lot of fascinating applications, which could present some interesting opportunities to our business as well. Software processing is typically separated into two consecutive steps: firstly, the preparation of the Lidar data itself, hence the production of the point cloud, and secondly the processing of the point clouds to derive the information products. The first part requires a lot of hardware specifics, so open source is unlikely to prevail in this sector. Where we see the huge potential of OSS is in the second processing step, where the fundamental idea of open software – the wisdom of the crowd – emerges in very innovative approaches in open-source projects. On the whole, the increasing use of OSS is more of a benefit than a threat.

Christian Sevcik

Christian Sevcik holds a master's degree in surveying and geoinformatics from Graz University of Technology, Austria. His involvement in the Lidar industry dates back to 1999, when he was working at the Institute of Digital Image Processing within Joanneum Research in Graz. In 2003 he became project manager for photogrammetry and laser scanning at GeoDATA Informationstechnologie with a focus on terrestrial laser scanning. In 2011 he joined RIEGL Laser Measurement Systems in the role of manager for strategic software alliances.

Q&A with...

Jean-Christophe Zufferrey, senseFly

Which technological developments will affect your product/service portfolio the most in the coming years?

The development of drones for geospatial applications has made aerial imagery affordable and easy to obtain. As a result, data acquisition has been revolutionised and become much more efficient. Aside from further increasing the efficiency, coverage and accuracy of our products, new technologies like improved connectivity, machine learning and AI will allow us to improve data interpretation and analysis, and make processes like updating maps immediately actionable.

Which societal developments will influence your share of the geomatics market the most

in the coming years? How and why?

As developers of new technology, we expect our share of the geomatics market to continue increasing in the coming years. This is driven by three trends. First, drones are becoming more and more common, driven by the widespread use of consumer drones, and therefore more widely accepted in commercial use cases. A lot of the scepticism that drone solutions were initially met with is now gone and adoption is rising drastically as efficiency increases and fast return on investment are widely proven. Second, developing economies are investing rapidly in new technologies. There, the younger population works in our favour, as the workforce is more eager to adopt new innovations like drone technology. Thirdly,

airspace regulators worldwide are bringing more clarity into the use of drones, which alleviates a barrier that has often kept potential customers from adopting drones in professional use cases.

Which market segments are the most promising for your products/services?

senseFly solutions are well established in the geospatial, agriculture and inspection segments, and that is where we expect to see continued healthy growth. Geospatial applications are the largest market for our flagship product, the eBee Plus, where flight



time, coverage, the centimetre-level precision RTK GPS and professional-grade sensors such as the senseFly S.O.D.A. make it unique. Our largest customers come from the mining and construction industries, as well as surveying companies and public institutions that use it for land management.

In which parts of the world do you envisage substantial growth in users of your products/services?

senseFly operates globally. We have more than 200 points of sale throughout the world and

service centres across all regions. In the past, adoption was driven by the most developed economies, in particular North America and Europe, but we now see our penetration increasing across virtually all regions. That is why we opened an office in China as well as in the Asia-Pacific region last year and continue to grow our distribution network.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

Open data is an enabler for the business we're in. senseFly solutions are built to provide highly precise geospatial data and 3D terrain models, which are becoming more and more relevant for many industries, including automotive, construction, transportation and mining, to name but a few. The availability of open data in the geospatial world accelerates the development of new solutions, and makes things like AI or autonomous navigation possible. Both the trend towards open data and the solutions it enables are creating a need for more high-accuracy data to be generated on demand in near real time, which creates more demand for our solutions.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Open-source software (OSS) has been in use for decades, and has played a major role in technological progress in three ways. First, it makes technology available to a broad audience and allows this audience to reuse it at virtually only the operating cost. This enables innovation, because rather than replicating what has already been developed, resources are spent building new web applications on top of the OSS. Second, just by being available, it is possible for companies to use and customise it, which creates value; we use a number of open-source tools and frameworks internally to boost our admin and R&D processes. Finally, open-source software sets the minimum standard in areas where commercial software is also available, and thus challenges the creators of commercial software to innovate and differentiate. So OSS is more than an opportunity; it is a business enabler.

Jean-Christophe Zufferey

Jean-Christophe Zufferey is the CEO and co-founder of senseFly. He is a pioneer in the field of small, bio-inspired, autonomous flying robots, holding a PhD in mobile robotics from the Swiss Federal Institute of Technology in Lausanne (EPFL) – where he has taught and managed numerous robotics projects – as well as an MSc in micro engineering, the thesis for which he completed at Carnegie Mellon University. A Swiss national, Jean-Christophe is also a licensed pilot with a passion for flying helicopters and fixed-wing aerobatics.

Q&A with...

Ian Stilgoe, Topcon Europe Positioning



Which technological developments will affect your product/service portfolio the most in the coming years?

Trends that are going mainstream in consumer technology, such as the Internet of Things (IOT), are impacting the way we work on site and in the office on construction projects. This pace of change is widening our user base and speeding up the adoption of automation and connectivity across the whole workflow – from the site to the office, and from excavating initial foundations to asset monitoring. This is helping our customers to work smarter – meaning real-time communication between all stakeholders involved on a project as well as less waste and less time-consuming processes. The fast pace of technological development has shaped the way we work with our customers. We have developed long-standing relationships with the likes of Autodesk, Bentley and Intel. We are

always open to working with the right partner to complement our hardware and software offering. This helps to ensure we have the best package of expertise and technology for the specific requirements of a project.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

According to Standard and Poors, there is a US \$36 trillion deficit between the amount we need to spend on infrastructure globally and the amount of capacity currently available within the industry. Increasing urbanisation, growing economies and aging post-war infrastructure in Europe mean there are huge demands to create and maintain infrastructure. We believe we're at the crunch point where as an industry we need to work collaboratively to be able to meet this shortfall between capacity and demand. It's a key focus for our business, as we work to create and help our clients implement technology to increase efficiency and maximise capacity.

Which market segments are the most promising for your products/services?

Precision farming has a reasonable adoption rate and the recovery of the market will positively influence our business. The area which will have the most significant impact in 2018 is the adoption of machine control and automated construction processes. This spans many market segments as construction companies of all sizes look to technology to increase efficiency within their business.

In which parts of the world do you envisage substantial growth in users of your products/services?

There's particular opportunity for market growth in areas such as India, Indonesia and China, as these countries are still constructing new infrastructure at an impressive rate. Although there's a lot of uncertainty in Europe, we've seen recovery and growth in the region as countries invest in updating and developing infrastructure such as rail networks and utilities.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

It is critical to have accurate and traceable data. In an era of supposedly 'fake news', the source and reliability of data is more important than ever. Open data is a useful addition to the decision-making process you may be involved in, but it should not be taken as absolute. Our kit is known for reliability and accuracy of data, but we also take the traceability needs of our users seriously. MAGNET Enterprise is one example of this. The software records all the field observations and shared project data, storing these in a secure cloud environment

which can provide the traceability from field source.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Open-source software (OSS) is seen as mostly an opportunity. Open source feeds creativity and there are a lot of useful ideas and products developed by nimble start-ups which develop into great platforms. Open-source routines can speed up pilot projects to test out new products and ideas. However, you always have to be careful if utilising OSS in any developments you want to commercialise. Many open-source agreements are not open source

for all applications and users. The age-old saying 'Check the small print' is vital for those companies wanting to integrate open source.

Ian Stilgoe

Ian Stilgoe, FCIInstCES, MRICS, joined Topcon in 2000, having started his career as a chartered engineering surveyor at Laing Civil Engineering playing a key role in major infrastructure and energy projects. Currently vice president of geopositioning at Topcon Europe Positioning, Ian's expertise in software and monitoring have helped to develop the Topcon market share across Europe, supporting customers with technology and expertise on a wide range of projects.

Q&A with...

Ron Bisio, Trimble

Which technological developments will affect your product/service portfolio the most in the coming years?

All of the key IT trends in the world today require precise data. Autonomous vehicles, mixed reality and sensor fusion are just a few of the data-driven technological advances shaping geospatial innovation. Autonomous vehicle development is elevating the geospatial industry's role in capturing roadside assets and accurate data. Emerging mixed-reality solutions are poised to transform the industry by making it easy to place and align digital assets in the physical environment so that road crews, for example, can dig with greater assurance they won't hit utilities. By merging multiple sensor types into unified data collection and analysis tools we can maximise their collective benefits while minimising their collective weaknesses. Innovation will also focus on collaborative environments such as Trimble Connect, which unifies data from different hardware and software solutions so multiple stakeholders can work together with disparate tools.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

Geospatial information is no longer solely the domain of professionals but is evolving for the broader population. Digitalisation, mobility and global connectivity are increasing the importance of geospatial data. Some of the world's top thinkers believe artificial intelligence (AI) will change everything in society by enabling machines to interpret

and respond to our environment more quickly than the human mind. One example of societal benefit comes from using AI to interpret data collected in real time from transportation infrastructure so roadside damage can be detected and corrected before it puts public safety at risk. Innovations in the professional market are leading to innovations in the consumer market as well, including autonomous vehicles, drones and virtual reality systems.

Which market segments are the most promising for your products/services?

Trimble is highly focused on vertical markets and has been developing dedicated franchises to meet emerging market opportunities for many years. We've seen widespread technological adoption in geospatial, civil construction and agriculture, and we anticipate continued growth in these areas. We have a team dedicated to the forensics market segment and expect promising growth as our services and global reach expand to that audience. Segments within Trimble with additional potential include transportation and logistics, as well as building construction – a segment that has surprisingly seen productivity stall in the last decade, despite the advances of almost every other market segment.

Open data is becoming increasingly available all over the world. How will this trend affect your business?

Open data is changing the experiences and workflows of our customers for the better by

increasing their efficiency and expanding their services, especially with the continuous need for updated geodetic information. We see significant gains in efficiency because our customers can quickly access topographic base maps, satellite

images, GIS census information, contour maps, land ownership records and other publicly available data online through our solutions, and integrate the information into their existing workflows. They can also expand their services by providing high-value deliverables, such as updated cadastral/ALTA drawings with updated topology and spatial relations and updated road and construction designs. Their confidence, authority and professional judgement sets them apart from other engineering professionals as they



Ron Bisio

Ron Bisio is vice president of geospatial at Trimble. He joined the company in 1996 and has held several marketing, sales and general management positions prior to taking over worldwide responsibility for Trimble Geospatial in 2015. He earned a master's degree in business administration from the University of Denver, a master's in regional planning from the University of Massachusetts and an undergraduate degree in geographic information systems & cartography from Salem State University in Massachusetts, USA.

provide accurate and reliable deliverables that will withstand the scrutiny of a land-related legal dispute or a forensic reconstruction case.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Trimble views open-source software as an

opportunity. We developed Trimble Catalyst, a software-defined GNSS receiver, to include a software development kit (SDK), which provides an open-source opportunity for developers to build integrated applications and professional workflows. Likewise, our Trimble Access platform enables developers to extend the utility of the software with specialised workflows to address any market

requirement. The trends are clear: more geospatial customers are open to solutions as services rather than only equipment, data silos are coming down, interoperability is preferred, and customers are wanting to blend different technology ecosystems. The real threat is avoiding a new technology frontier out of fear, when it holds great promise to expand technology utilisation.

Q&A with...

Tristan Allouis, YellowScan



Which technological developments will affect your product/service portfolio the most in the coming years?

The development of new solid-state Lidar sensors, when available with suited specs (which means enough range, spatial resolution and accuracy),

may allow the development of even lighter and cheaper UAV Lidar systems.

development of technologies such as VTOL UAVs and lighter long-range Lidar systems can largely simplify the use of UAV Lidar in civil engineering, utilities and corridor mapping.

In which parts of the world do you envisage substantial growth in users of your products/services?

That would be North America. The market is structured and we already see a great demand for our products there. We are actively searching for the talent that will join our team to become the general manager of our US branch.

Will the tendency of increasing use of open-source software be a threat or an opportunity for your business?

Open-source software is an opportunity for us. In a similar way to open data, it makes new tools available for customers that can help them develop their process efficiently. YellowScan developed itself thanks to open-source software such as QGIS or Cloud Compare software.

Which societal developments will influence your share of the geomatics market the most in the coming years? How and why?

People's perception about UAV technology is changing. We are actually moving to a better acceptance of UAVs flying in civil areas or beyond line of sight. This evolution may lead to more flexibility in the UAV regulations and, as a result, an increase in the number of projects using UAVs.

Which market segments are the most promising for your products/services?

By increasing the mission's productivity, the

Open data is becoming increasingly available all over the world. How will this trend affect your business?

Open Lidar data is generally available at regional or national scale. This is a very good opportunity for more and more people to learn how to use spatial information and adopt it in their process. Our sensors can deliver high spatial and temporal resolution which complement larger-scale data, allowing professionals to perform more precise work.

Tristan Allouis

Tristan Allouis has been leading the development of YellowScan systems since 2012. His areas of expertise include computer science, remote sensing, technology development and forestry. After completing his master's degree in engineering, information technology and electronics at École Supérieure d'Informatique Électronique Automatique (ESIEA), Tristan focused his research on forest mapping using Lidar data. He received his PhD from AgroParisTech.

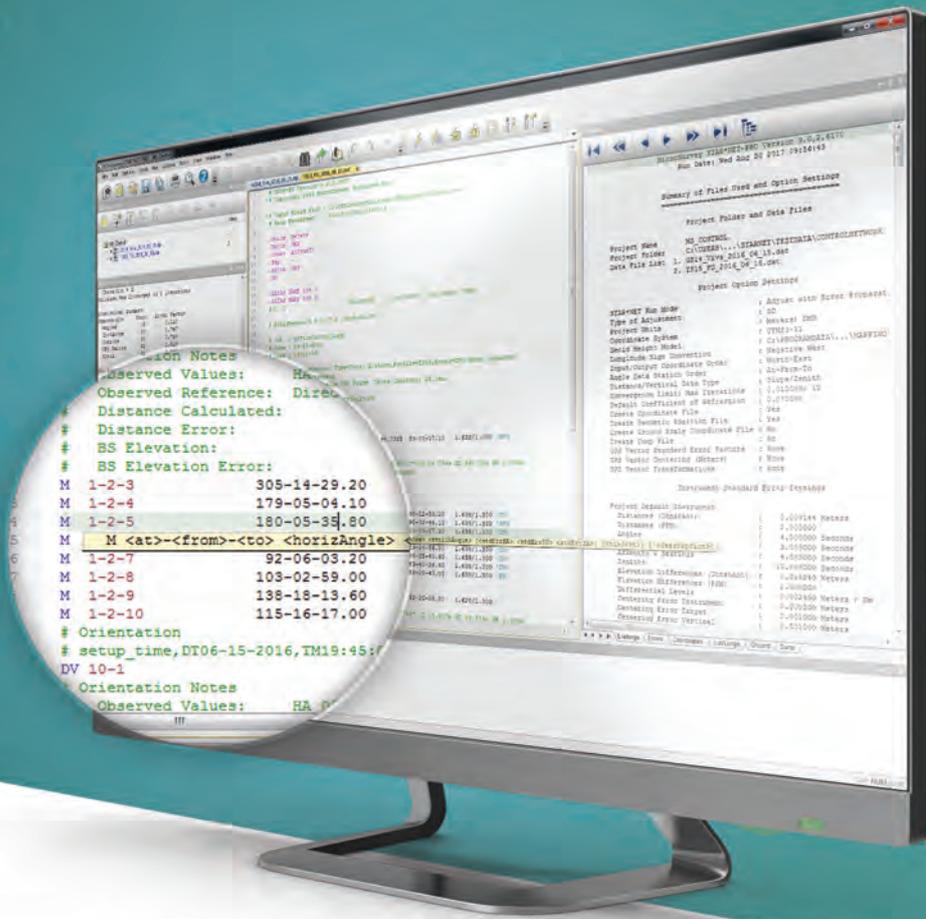
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• Advanced Find

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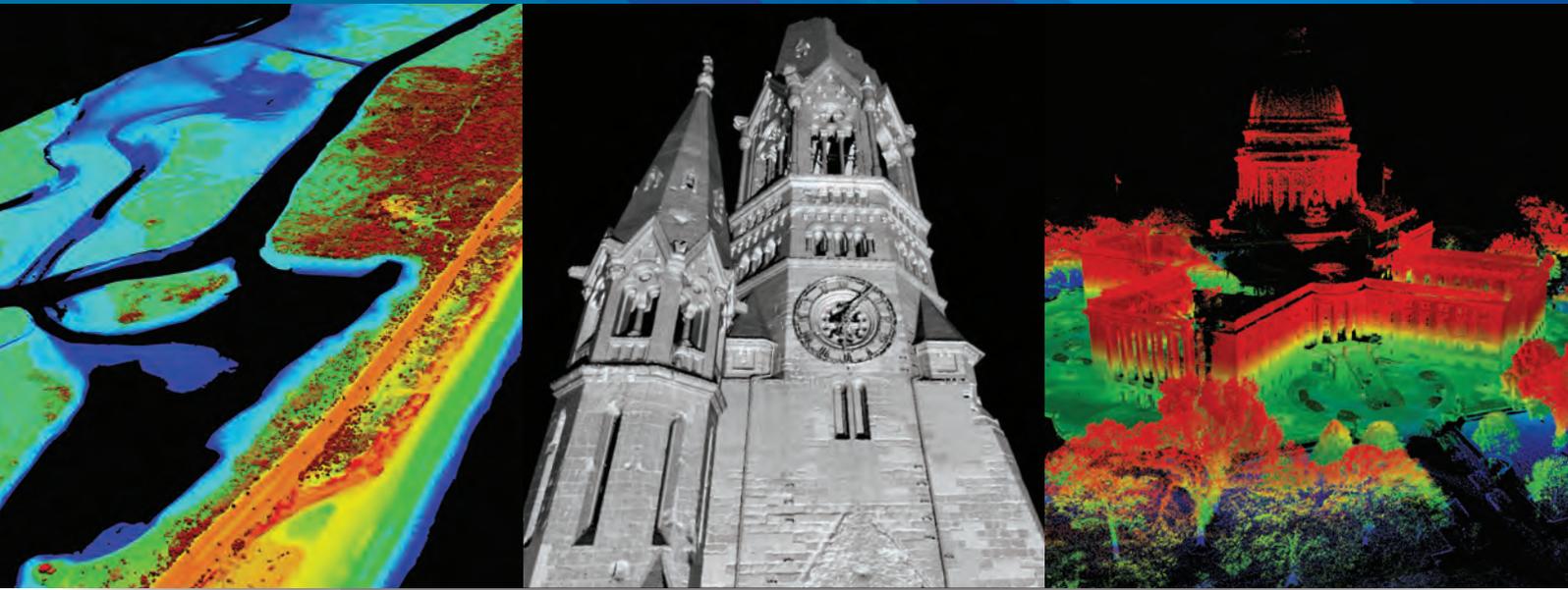
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