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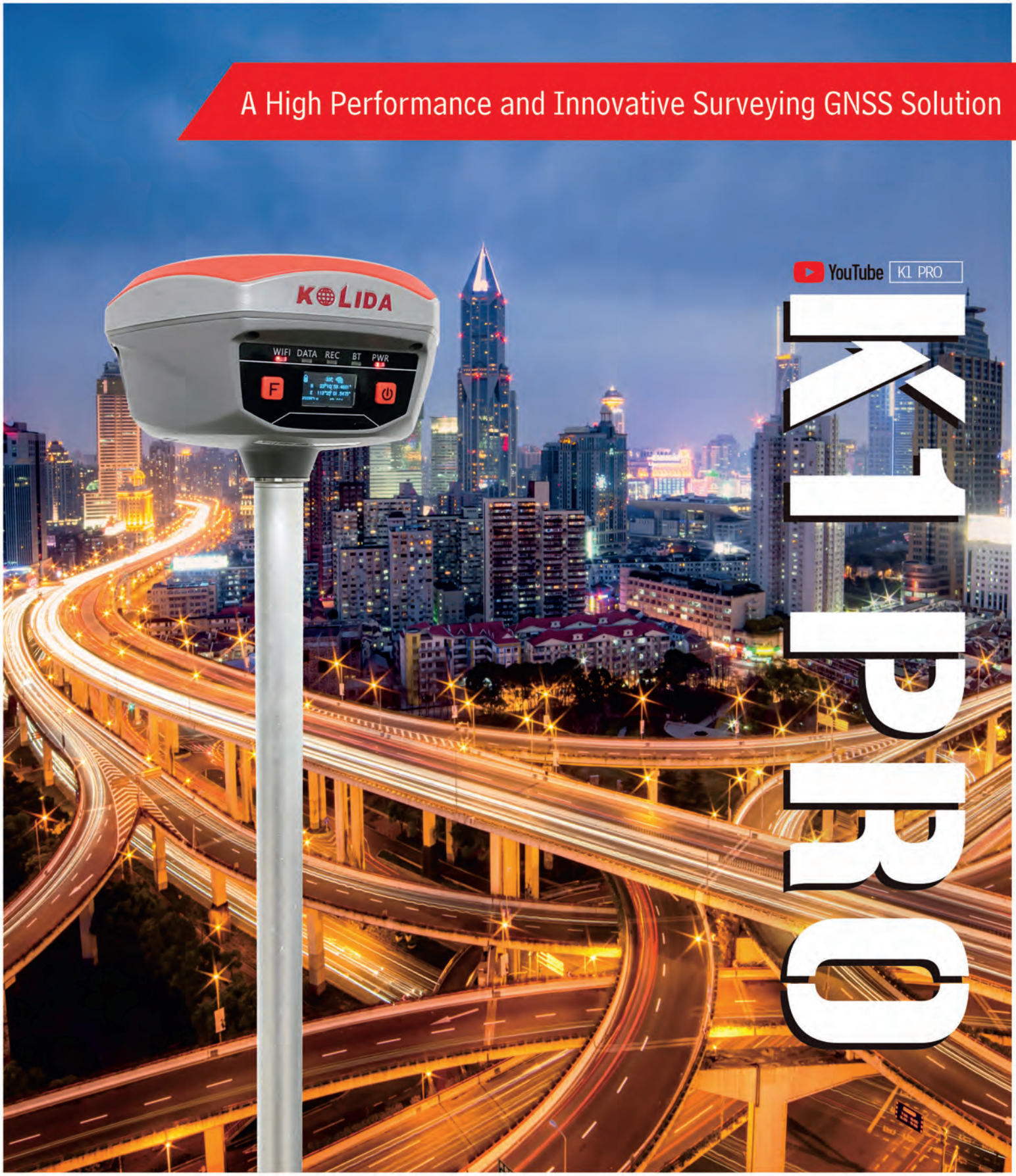
GETTING READY FOR DISASTER EVENTS WITH REMOTE SENSING



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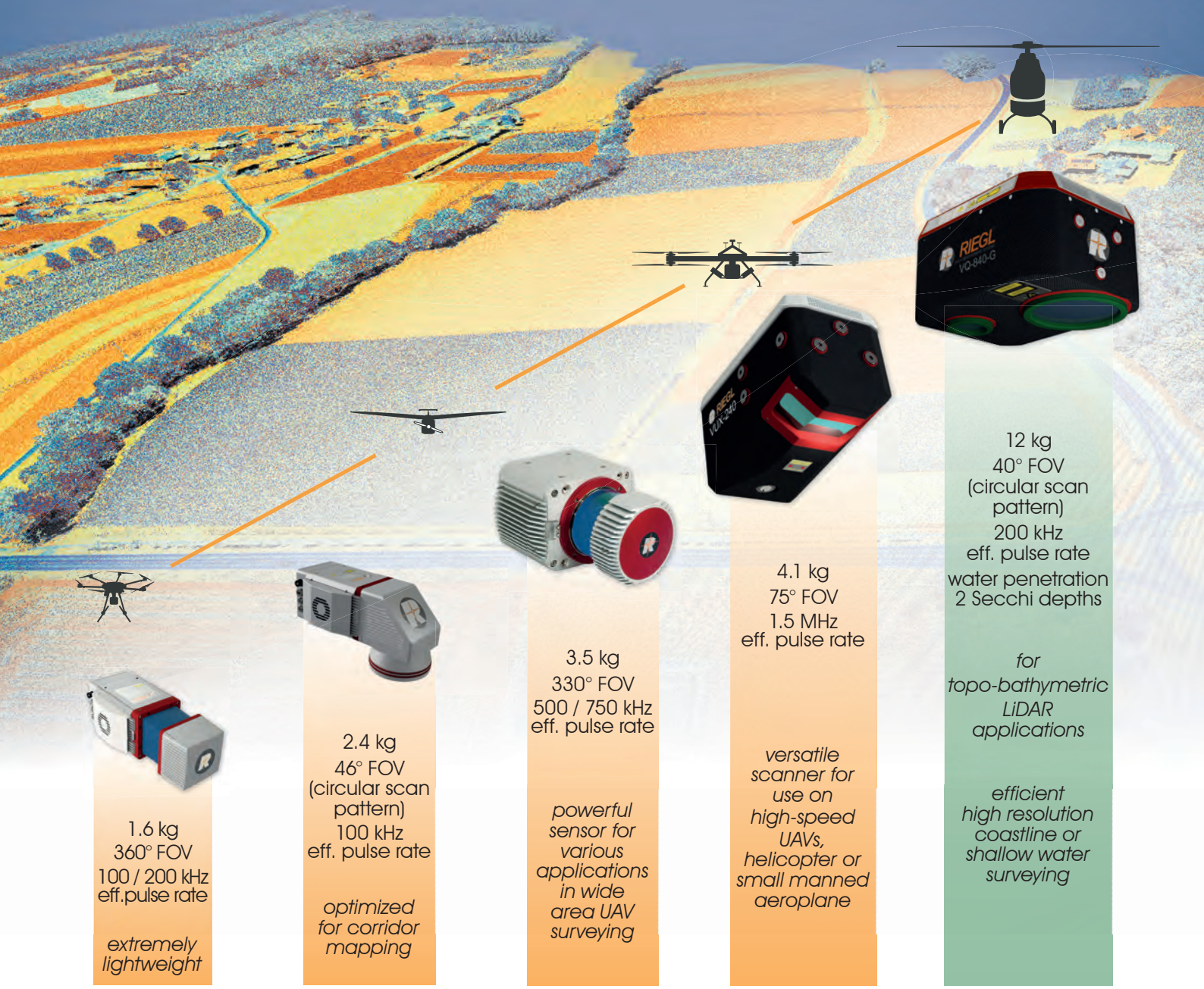

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Circling the Earth

What if circling the Earth were as easy as going on a bike ride? Just imagine: the extraordinary, stunning views from orbit would be accessible to everyone with the same amount of effort as cycling through the nearby countryside. But would the impact of the billions of earthlings be visible from above? And would it change people's attitudes towards our planet?

Astronauts – who are the only ones lucky enough to have seen the view with their own eyes – describe the journey into space as overwhelming and breathtaking. The Dutch astronaut André Kuipers openly admits that orbiting the Earth made him realize just how small and fragile this sphere we live on is. There is even a term for the consciousness-changing experience of observing Earth from a great distance: the 'overview effect'. As ordinary mortals, we have to use our imagination to experience a similar overview effect – but it's not impossible. We've recently had some very clear night skies here in the Netherlands, and I saw a crescent moon and a magnificently bright Venus rising above the western horizon after sunset. One night, I even witnessed the International Space Station (ISS) passing over several times, at roughly 500km above the surface of our planet. To be honest, I felt the same excitement as when my father took me and my brother to an observatory to see a lunar eclipse in our childhood. The ISS was not the only moving object visible to the naked eye during my skygazing; I also saw several tiny dots passing overhead. When I touched base with a renowned Dutch science journalist via Twitter, I learned that they were low-orbit Starlink satellites, recently launched by Elon Musk's SpaceX company as part of plans to offer broadband internet in remote areas across the globe.

Now that coronavirus has spread to countries all over the world, Earth looks different from above. Better, actually. Earth observation satellites that are mapping the atmosphere have recorded a massive reduction in air pollution. According to the European Space Agency (ESA), the Copernicus Sentinel-5P satellite has detected strongly declining NO2 emissions in many densely inhabited and industrialized areas. Everyday life has largely come to a standstill due to the COVID-19 pandemic – seemingly to the relief of Mother Nature, who is taking this opportunity to pause for breath.

Earth is vulnerable. Astronauts realize that when they experience the overview effect. Now it is time for us to realize it while keeping both feet firmly on the ground. Maybe the time has come to stop chasing our tails, and to protect our planet for the sake of future generations.

A final note to Elon Musk: providing internet access for all earthlings is a worthy goal, but could you please turn down the lights a little on your swarm of satellites? I still want to be able to see the stars and planets in our solar system, to feed my imagination as I gaze up at the night sky with a sense of childlike wonder. Thank you!

Wim van Wegen,
Content manager

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Pandemic

In these times of the coronavirus pandemic, most businesses are trying to carry on as best they can, if they can – and we are no exception. Many of our readers have been working from home, and perhaps you are one of them. Even if just for a few moments, I hope that this issue of *GIM International* can go some way towards taking your mind off all the gloomy news about the spread of the COVID-19 virus that is reaching us from around the globe. In this issue you will find an article about authoritative data, titled 'How the New EU Directive Will Change the Geospatial Data Market' (see page 10) by our contributing editor Frédérique Coumans. The article focuses on new rules coming from Brussels that will make it mandatory to provide open and free access to the most crucial, publicly funded geospatial and Earth observation data for use and re-use. This is aimed at enabling both the geomatics sector and society as a whole to benefit from such data. In my opinion, this article is very timely. Data is the lifeblood of modern society. The recorded information about where a person lives, their property and what they own can have fiscal or other legal consequences. Citizens need to be able to rely fully on data that can have a major impact on their daily lives; it should be unambiguous and precise, plus their privacy should be protected at all times. (As a side note: the current pandemic and its aftermath will lead to new perspectives on privacy and the possible – and acceptable – governmental use of data.) Last but certainly not least, companies in the geomatics industry stand to benefit from the new directive. The premise in Brussels is that opening up the data for new uses will create commercial advantages for existing and new entrepreneurs. That is definitely a good thing, especially in the light of the economic downturn everybody expects after the current health crisis. Perhaps the pandemic has meant you have had to cancel trips to attend events that have now been postponed or even cancelled. You have almost certainly faced restrictions on working at project sites and visiting clients for face-to-face meetings. By now, most of us will have discovered that working remotely is fine, but that physically going to work in a good-old office setting is not that bad either. Hopefully, a lot of companies will be able to sustain some kind of 'business as usual' and life will get back to normal as quickly as possible. In the meantime, I would strongly advise you to subscribe to our newsletters and to check our websites on a regular basis so that we can keep you up to date on how our industry is responding in the face of this crisis. Happy reading and stay safe!

Durk Haarsma,
director strategy & business development

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Geospatial Joint Venture to Help Plan Rollout of European 5G Network

▲ *The combination of Bluesky's data capture expertise with Land Info's proven technical approach and Hexagon's advanced sensors will inform decision-making and help accelerate the rollout of 5G across Europe.*

Land Info Worldwide has assembled a team of renowned geospatial companies to help plan the rollout of 5G networks across Europe. Land Info is already a leading provider of mapping solutions for 5G wireless in North America, using machine learning and artificial intelligence to meet the demanding mapping specifications of network design. It hopes that by working with aerial mapping company Bluesky International in the UK and Hexagon's HxGN Content Program team in continental Europe, it can extend this reach in the 5G industry internationally. "Our international team, comprising Bluesky and Hexagon, will give 5G wireless operators in Europe direct local access to the geospatial data and expertise they need to develop state-of-the-art telecommunications networks," said Land Info President Nick Hubing.

▶ **https://bit.ly/39NmZHa**

Towards a Digitized Citizen-oriented Armenian Cadastre

▲ *Yerevan, the capital of Armenia, with Mount Ararat in the background.*

Armenia is moving towards a more transparent, secure, unified and citizen-oriented cadastral system. To achieve this, digitizing cadastral archives is essential. Digital availability of cadastral information will enable better management of lands, documented rights and tenure security for all Armenians. The Cadastre Committee has requested Kadaster, The Netherlands' land registry and mapping agency, for support. In Armenia there is currently no unified approach to archiving cadastral and land registry records. The integrated cadastre on real estate has little ability to support management and assessment of lands and real estate, and the registration of the natural, economic and legal status of those lands. The Cadastre Committee (CC) plans to reform by introducing an advanced self-service and paperless system, based on electronic registration and information processes. This digital system will be one of the pillars of the new real-estate cadastre.

▶ **https://bit.ly/3aNPXH1**

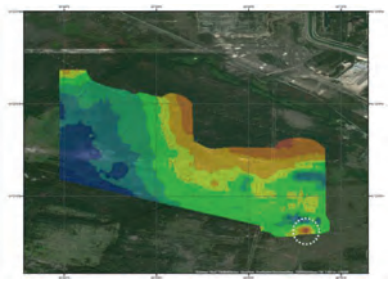
Blockchain – An Emerging Opportunity for Surveyors?

▲ *The RICS insight paper on blockchain.*

Every so often, a revolutionary digital breakthrough emerges. The most recent example is a technology allowing a decentralized, reliable and verifiable record of transactions, which is maintained across multiple computers using peer-to-peer networking and cryptography: blockchain. Blockchain technology can be used to store information about construction project management, building management, property management, utilities management and even data drawn from the ever-growing network of sensors that are part of the Internet of Things (IoT). The UK's Royal Institution of Chartered Surveyors (RICS) recently issued a relevant insight paper on this topic. Blockchain came to public prominence as the digital architecture underpinning Bitcoin and other cryptocurrencies that blossomed following the financial crash of 2008. It soon found potential applications in other fields, including a wide range of sectors in which RICS members and RICS-regulated firms operate. But where will the technology add value? What are its limitations and risks? And how likely are today's professional firms and other industry players to take advantage of the opportunity that blockchain represents?

▶ **https://bit.ly/38L7WN4**

Lidar Technology Reveals Chernobyl Radiation Hotspots



▲ *Map of the Red Forest showing areas of unexpectedly high radiation levels.*

It has been over three decades since reactor Number 4 at the Chernobyl Nuclear Power Plant in the Ukraine melted down, leading to the world's worst civilian nuclear disaster in history. Now, a team of multidisciplinary researchers have used Routescene's UAV Lidar technology to map radioactive hotspots in greater detail than ever before. Professor Tom Scott from the School of Physics at the University of Bristol, UK, led a group of researchers from the UK's National Centre for Nuclear Robotics (NCNR) to conduct surveys on multiple sites of interest within the Exclusion Zone which surrounds the damaged reactor. The surveyed sites included the village of Buriakivka, a settlement abandoned following contamination from the power plant accident, and the 'Red Forest', a natural woodland area located the closest to the reactor and hence the most heavily contaminated.

▶ **https://bit.ly/2W7pP66**

Satellite Imagery and AI to Improve Paddy Field Management in Indonesia

As part of their collaborative partnership to develop a national satellite data platform system for Indonesia, science education company PASCO and Indonesia's National Space Agency (LAPAN) are researching the use of satellite data to improve paddy field management. The solution also incorporates artificial intelligence (AI) technology from PASCO for extra efficiency. LAPAN is developing the regional data node (ReDaNo) system to provide Indonesian and other Southeast Asian governments with satellite data concerning natural hazards, sea-level rise and illegal maritime activity in near real time. Indonesia is particularly keen to use this system to improve the efficiency and accuracy of data concerning paddy field ownership and taxable land. Over 60% of Indonesian paddy fields are located in mountainous regions. This, combined with inland aquacultures, has made it difficult to manage paddy fields using traditional surveying techniques.

▶ **https://bit.ly/2W4A7Uj**

▲ *Paddy fields (left) and aquaculture (right) in Indonesia.*

The Importance of UAVs in Nepal's Land Sector

Nepal has recently taken promising steps in the area of land policy and related legislation. The new fit-for-purpose land administration policies and government initiatives embrace new ways of data collection for various land administration purposes. According to the National Agrarian Reform Program, every plot of land in Indonesia must be certified and registered by 2025 for example. However, using the standard land registration methodology, this target will not be reached. Using unmanned aerial vehicles (UAVs or 'drones') is an emerging option. In the land administration domain, UAVs have already been piloted and demonstrated in a range of OECD-member countries, as well as countries across eastern and southern Africa.

▶ **https://bit.ly/2QaCpxv**

▲ *UAVs offer particular benefits in areas with heavily undulating terrain.*

Velodyne Lidar Introduces Low-cost Small Lidar Sensor

▲ *The Velabit is aimed at democratizing Lidar with its small size and affordable price.*

Velodyne Lidar has introduced Velabit, the company's smallest sensor that brings new levels of versatility and affordability to 3D Lidar perception. The Velabit leverages Velodyne's innovative Lidar technology and manufacturing partnerships for cost optimization and high-volume production. The sensor contributes to Velodyne's mission to make high-quality 3D Lidar sensors readily accessible to everyone. The Velabit complements Velodyne's sensor portfolio. The sensor delivers the same technology and performance found on Velodyne's full suite of sensors. It is set to be the catalyst for creating endless possibilities for new applications in a variety of industries. The compact Velabit can be embedded almost anywhere within vehicles, robots, unmanned aerial vehicles (UAVs), infrastructure and more. It is designed to be easy to manufacture at mass production levels.

▶ **https://bit.ly/2wQWy4K**

Hexagon Buys COWI's Aerial Mapping Division

▲ *COWI and Hexagon have been working closely together on the HxGN Content Program since 2015.*

Hexagon, a global leader in sensor, software and autonomous solutions, has announced the signing of an agreement to acquire COWI's aerial mapping business. COWI, based in Denmark, is a leading international consulting group within engineering, economics and environmental sciences with a mapping business that serves as Europe's largest provider of airborne surveying and spatial data processing and a key partner of the HxGN Content Program. Bringing valuable expertise in capturing and selling Content as a Service (CaaS), COWI's mapping unit has been delivering HxGN Content Program services in Europe since 2015. With approximately 400 specialists worldwide, the business provides public administrators, government organizations, infrastructure project stakeholders, utility companies and global internet companies with access to the most relevant geospatial data during their planning processes. "The acquisition of COWI's mapping business is a logical next step to accelerate and strengthen the HxGN Content Program in Europe," says Hexagon President and CEO Ola Rollén.

▶ **https://bit.ly/2Q8bUJ6**

New Partnership to Accelerate Growth of Indoor 3D Modelling

▲ *Flyability's Elios indoor drone.*

Flyability and Pix4D recently announced a partnership agreement to offer bundled Flyability and Pix4D products. The bundle will be sold in the form of a photogrammetry add-on that can be purchased on top of Elios 2 drone packages. This offer is aimed at facilitating access to a coherent and complete product offering for those who want to tackle indoor 3D modelling using photogrammetry. Flyability is a Swiss company building solutions for the inspection and exploration of indoor, inaccessible and confined spaces. By allowing drones to be used safely inside buildings, it enables industrial companies and inspection professionals to reduce downtime, inspection costs and risks to workers. The design of Flyability's Elios 2 makes it an excellent tool to build 3D models of indoor spaces using photogrammetry. The photogrammetry processing engine of Pix4Dmapper is one of the industry-leading photogrammetry software solutions. It is known for its good reputation when it comes to processing non-georeferenced images – a feature that is much needed when building 3D models of GPS-denied environments.

▸ **https://bit.ly/2xonrxh**

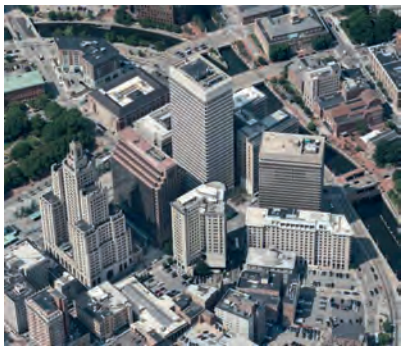
senseFly Receives Financial Boost from Parrot

▲ *senseFly eBee X.*

Through its parent organization Parrot, senseFly has recapitalized its balance sheet and funding, guaranteeing a healthy operational outlook as it continues its growth path as the global leader in fixed-wing drones. The financial backing comes at a particularly meaningful time for senseFly – an Ecole Polytechnique Fédérale de Lausanne (EPFL) spin-off – which celebrates its tenth anniversary this year. Since its inception, senseFly has flown over one million flights, mapped an estimated 500,000 square kilometres and generated over USD$100 million in revenue. This important milestone sees senseFly's status shift from a promising start-up that pushed the boundaries of remote mapping to a leading manufacturer of professional fixed-wing drones, used by some of the world's largest organizations, including Trimble and Microsoft.

▸ **https://bit.ly/2vQTiqh**

Vexcel Imaging to Acquire Image Resources from Verisk



▲ *The acquisition will create a prominent and highly relevant geospatial data library.*

Vexcel Imaging, a company specialized in aerial imagery data, large-format aerial cameras and photogrammetry software, has signed a definitive agreement to acquire the imagery sourcing group from Verisk's Geomni business. The acquisition will combine Geomni's imagery surveying and content-related teams and assets into Vexcel. Verisk, an innovative data analytics provider, will be a minority owner in Vexcel with full access to all aerial imagery libraries. The combination of Geomni's fleet of fixed-wing aircraft and aerial operations, mapping business and oblique aerial image library, together with Vexcel's sensor business and data programme will create a prominent and highly relevant geospatial data library. Geomni's analytics team and assets will remain part of Verisk and continue to focus on first-class advanced analytics. The team will work closely with Vexcel on a strategic road map and joint projects.

▸ **https://bit.ly/38MtjOi**

Tygron Enters Esri Partner Network

The Dutch Esri Partner Network is expanding with Tygron as a Silver Partner. The collaboration between Tygron – the company behind the Tygron Geodesign Platform – and Esri Nederland (the Dutch branch of the GIS software company) facilitates governments, engineers, planners and designers in straightforward cooperation and in providing better solutions to complex spatial tasks. The impact on space is an increasing concern. Residential construction, climate adaptation and the energy transition require space, while regulations impose great demands on the solutions. Complex tasks such as these require the knowledge and ability to experiment with solutions and to continuously outline the effects of the plans. The collaboration between Tygron and Esri Nederland provides a firm basis for this.

▸ **https://bit.ly/2TGuKtO**

▲ *The Tygron Geodesign Platform.*

AUTHORITATIVE DATA IN THE SPOTLIGHT

How the New EU Directive Will Change the Geospatial Data Market

The Europe Union (EU) is adding a new dimension to the digital data-distribution policies of mapping agencies, cadastres and land registries. In two years' time, a new EU directive will make it compulsory to provide open and free access to the most crucial, publicly funded geospatial and Earth observation data for use and re-use. EuroGeographics and EuroSDR, the two most renowned pan-European organizations in these matters, have reacted positively, assuming there will be sufficient national funding. After all, both society and the geomatics sector stand to benefit from increased use of 'authoritative' geospatial data.

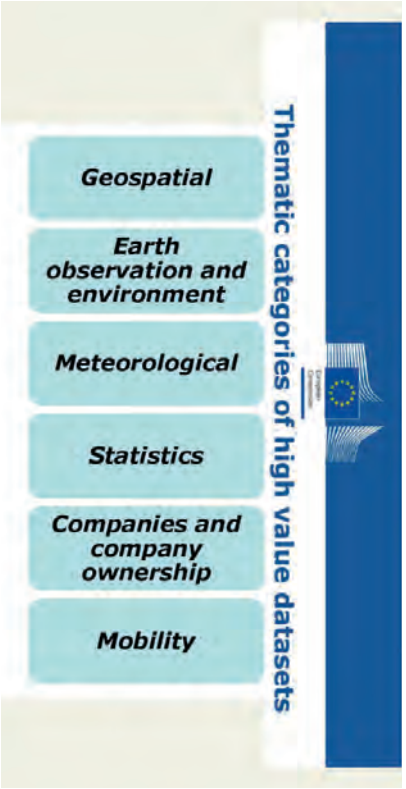
▲ *Mick Cory (r) and Joep Crompvoets: "Competition is a race to the bottom, so partnerships and collaboration are the only healthy way." (Image courtesy: VBB, Jeroen van Berkel).*

Published by the EU last summer, the Directive on Open Data and the Re-use of Public-sector Information (the 'Open Data Directive') sets out an updated set of rules on the re-use of public-sector information. It relates to any content, whatever its medium, when produced by any public-sector body or with public funding (not subject to third-party copyright). The charge for non-high-value datasets must be limited to marginal costs related to the initial provision of the 'documents'. It also specifies 'high-value' datasets which should be made available for free in machine-readable formats, via APIs and (where relevant) as bulk downloads. There are six categories of high-value datasets: Geospatial; Earth observation and environment; Meteorological, Statistics; Companies & company ownership; and Mobility. This year, a list of specific datasets within these themes will be adopted by way of an Implementing Act, issued by the European Commission (EC). "The thematic categories listed could inter alia cover postcodes, national and local maps, energy consumption and satellite images, in situ data from instruments and weather forecasts, demographic and economic indicators, business registers and registration identifiers, road signs and inland waterways," states the EC.

According to Andrus Ansip, the former EC vice-president for the digital single market, "Data is increasingly the lifeblood of today's economy. The total direct economic value of public-sector information and data from public undertakings is expected to increase from €52 billion [US$60 billion] in 2018 to €194 billion [US$222 billion] by 2030 (these figures are based on the EU including the UK, Ed.). With these new rules in place, we will ensure that we can make the most of this growth." EU Member States have until July 2021 to incorporate the directive into law. In case of a substantial impact on the budget of the public bodies involved, the provision of free access may be delayed by up to two years.

AUTHORITATIVE DATA

The high-value geospatial datasets are mostly in the hands of national mapping agencies, cadastres and land registries. In Europe, two important organizations that act in their interests are the policy-oriented EuroGeographics and the research-oriented EuroSDR (see box). The secretary-generals of both organizations strongly agree with the European Commission that geospatial datasets can speed up the emergence of a wide variety of value-added information products and services, including ones based on artificial intelligence. "Therefore data accessibility is a key priority, because we believe our members' authoritative data should be used as much as possible," state Mick Cory (EuroGeographics) and Joep Crompvoets (EuroSDR). They emphasize that the economic perspective is one thing, but that the public interest is also important. The accuracy of the official data regarding what you own, where you live, property, administrative/democratic/state boundaries, 4D topography, land use and so on can have important fiscal or legal consequences. Crompvoets: "The real value of this data is not what you can earn with it. Instead, the value is fundamentally societal: legal certainty to consolidate that we live in nations where the rule of law means something. You can totally disagree with the outcome of taxes and legally binding decisions, but you need to be able to trust the underlying, identifying data as correct – as you can with authoritative data." Cory: "It is a matter of certainty about your rights as a citizen. To give an example: there is nothing more fundamental than property rights, and therefore the need for a state authority to make clear what your rights are. The geodata that private companies deliver is fit for many purposes, but you want to be sure that the organization telling you what you own has a legal mandate to do so by providing precise, unambiguous information. Furthermore, you want to be sure that your privacy is protected!"



▲ *Geospatial high-value datasets must be made available for free in machine-readable formats, via APIs and (where relevant) as bulk downloads.*

'YOU CAN TOTALLY DISAGREE WITH THE OUTCOME BUT YOU NEED TO BE ABLE TO TRUST THE UNDERLYING, IDENTIFYING DATA AS CORRECT – AS YOU CAN WITH AUTHORITATIVE DATA'

TRUST

The quality of authoritative data is not yet perfect in every country, but extensive (and expensive) quality validation mechanisms are already a core business of EuroGeographics' members. A report published in 2019 titled 'Authoritative Data in a European Context' was a joint project of EuroSDR, EuroGeographics and the University of Leuven in Belgium. The report was based on a thorough survey followed by roundtable discussions with executives at national mapping, cadastral and land registration agencies in 38 countries on the European continent. The participants believe that trust in the (known) quality of their datasets is critical. Accuracy, frequent updates, transparency and availability on a continuous basis are the characteristics that keep their data authoritative. Because the overall result is only as strong as the weakest link, they are certain that these reference datasets will grow in importance now that more and more processes are being automated. They foresee more jobs, thriving businesses and higher tax revenues because of many more innovative information services in which private data is combined with public data – and that is precisely the EC's intention in enacting the Open Data Directive. Those

automated processes should depend on authoritative datasets, such as addresses, cadastral and administrative boundaries, and other data. The data producers see a growing group of users who also consciously prefer to shift the responsibilities and potential liability for data quality onto recognized authorities.

All this does not mean that private actors produce low-quality data. "Google is excellent for navigation and suchlike. Open Street Map is also invaluable for countries where they don't have sufficient infrastructure to produce authoritative data," remarks Joep Crompvoets. "It all depends on what the data are being used for. If the outcome of an information process could have serious consequences for the 'target' person or company, you are glad to be able to use authoritative data." That choise is made easy if that data is free of charge or at least affordably priced.

FUNDING

But someone has to pay. "If you have sustainable funding to keep members' data collection activities going and ensure data quality and up-to-dateness, of course the data can be made available for free. It is a matter of a state's financial policy," says Mick Cory. He knows that in many countries that will mean a struggle with the Finance Department. As this is an EU directive which lays down the results that must be achieved (e.g. free high-value datasets), the EC cannot enforce decisions in the Member States regarding authorities and business models. Instead, each Member State is at liberty to decide how to transpose directives into national laws. The European Commission is now in consultation with the Member States on the issues of which specific datasets are 'high value', which public authorities can use taxpayers money to maintain these, what their business model is for releasing the information, and how the release of data will impact on the national economy. Furthermore, one possible exception to the free availability has to be taken into account: the requirement shall not apply to public undertakings if there is a risk of distorting competition. The EC wants to reach a decision this summer. "If the impact on the national economy is greater than the impact on the organization's business model, that is sufficient justification to release the data," summarizes Cory.

IN MANY COUNTRIES, PROVIDING DATA FOR FREE WILL MEAN A STRUGGLE WITH THE FINANCE DEPARTMENT

GEOMATICS SECTOR STANDS TO BENEFIT

The geomatics private sector (active in surveying, mapping, remote sensing, cartography, GIS, GNSS, photogrammetry, UAV and Lidar) will profit from the new developments. Firstly, there will be many high-quality datasets that are easy to re-use as building blocks for new offerings. The premise is: make it open and there will be new uses. When the USA's President Clinton opened up the codes for GPS, there was a boom in new applications in the navigation industry. Secondly, there will likely be more need for third parties to participate in work processes of public authorities. The 'Authoritative Data in a European Context' report outlines three different roles. For core authoritative datasets – the ones used for decisions that have important legal and fiscal consequences – governments must stay in charge of the total governance. A private company could collect the data, of course, but that must be validated by the public authority. That could also be the case with other authoritative datasets, but then as a choice. The datasets could be governed by other public organizations or the private sector. For all other datasets, the public authorities are one of the stakeholders in a co-creating

▲ *The geomatics private sector will profit from the new developments. There will be many free high-quality datasets that are easy to re-use as building blocks for new offerings. (Image courtesy: thinkWhere).*

ecosystem. "Competition is a race to the bottom, so partnerships and collaboration are the only healthy way," believe both secretary-generals. Another benefit for the geomatics sector is that, if the centrally financed budget is confirmed, professional standards in surveying qualities can be maintained. "Otherwise the very nature of the profession becomes undermined," says Cory, a professional surveyor himself. "I would say we all share that attitude, wherever we are working in this sector." Joep Crompvoets agrees: "A company in the geomatics industry wants their data products to be used as much as possible, not only because of the profit, but also to contribute to the greater good. If a surveyor's work supports authoritative decisions, there will be tighter standards to comply with and more education and training will be required… so professionals will make more money than when geospatial data collection can be done by just anyone." ◀

MICK CORY AND EUROGEOGRAPHICS

Mick Cory is the secretary-general and executive director of EuroGeographics, the international membership association of 62 national mapping, cadastre and land registry authorities from 46 countries across the European continent. He has worked internationally and for all three Ordnance Surveys of Great Britain, Ireland and Northern Ireland, where he coordinated technical and change programmes. As chief executive of Ordnance Survey of Northern Ireland, he led the development of the NI geographic information strategy. Cory holds a bachelor's degree in surveying science and a master's degree in land and geographic information systems.

JOEP CROMPVOETS AND EUROSDR

EuroSDR (established 1953) is a pan-European research platform on the implementation of technology developments which optimize the provision of reference information in a spatial data infrastructure context. It has 18 country members (national mapping and cadastral agencies and academic institutes) and seven associated members (mostly private companies). Joep Crompvoets is secretary-general. At KU Leuven's Public Governance Institute he is professor of information management in the public sector and consultant in the domains of GIS, spatial data infrastructures, e-governance and public-sector innovation.

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For our 'Ask the Specialist' features, we invite readers to send us their burning questions about geospatial surveying. We pass the questions on to relevant industry experts who provide comprehensive and detailed answers to point geospatial professionals in the right direction. This time around, the focus is on UAVs.

3D VISUALIZATION TOOLS

How will the integration of 3D visualization tools in UAVs further revolutionize the way geospatial technology can inspect, survey and map?

When 3D visualization tools are used to process and visualize captured data in combination with the benefits of fast, simple and cost-effective utilization of unmanned aerial vehicles (UAVs or 'drones'), it makes 3D geospatial mapping and monitoring much more accessible and deployable almost everywhere. There is a growing demand for a single software solution that can achieve the desired output. Ideally it should be able to schedule a UAV mission, process and visualize the captured data into a variety of formats and also allow for further data analysis and visualization as the desired output – such as point cloud processing tools, vegetation filtering, DTM creation, volume measuring, orthophotos or another types of image analysis, e.g. for agriculture, etc.

In the future, the added value for professional UAV operators lies in the creation of a versatile tool that will simply generate geospatial data from captured data regardless of the UAV manufacturer, as well as process and visualize it in a wide selection of data formats that the customer works with, whether in the cloud or on local equipment. The visualization and analysis of 3D data is especially gaining popularity. Important features include working with point clouds, cloud filtering, and creating detailed 3D models for building information modelling (BIM) more easily than in several software solutions and – in view of the need for constant conversion between formats for those software solutions – without loss of quality of the scanned data.

Companies that are already using drones for mapping and other geospatial applications want to be not only providers of source data, but above all providers of various analytical and advanced end-to-end applications and ready-to-use output. This will be increasingly important in the future, as the market becomes ever-more competitive.

Jakub Karas
CTO UpVision
President, Czech Unmanned Aerial Alliance

OPTIMIZING BVLOS

What will be the impact of beyond visual line of sight (BVLOS) on the application of drones in the geospatial surveying profession?

BVLOS operations have progressed in leaps and bounds in recent years, thanks to ongoing trials, demos and data collection that have been key in facilitating progress. As an industry, we're constantly learning and gathering more highly geoaccurate data and insight as to how we can optimize BVLOS in UAV operations.

This process of learning has also enabled unmanned aerial vehicle (UAV or 'drone') technology itself to become more advanced. This has seen fixed-wing drones become better equipped for BVLOS operations, offering better batteries and motors and afe airframes that have been verified through rigorous impact testing. As a result, many drones now have the endurance to enable users to safely fly further and map larger areas, broadening the potential for more complex BVLOS applications and offering cost, time and operational efficiencies. This is true across the globe, where operators in more countries are seeing BVLOS becoming increasingly accessible. Last year, for instance, the national civil aviation authority of Brazil (ANAC) approved BVLOS flights to be carried out for the first time in the country's history, marking a pivotal point in Brazil's commercial drone industry.

It's clear that the more data and knowledge we have, the closer we get to establishing a robust framework and defining risk models for shaping safe, fit-for-purpose BVLOS operations. This will be key in facilitating greater public acceptance and scalability to expand the opportunities available for geospatial professionals growing their drone fleet. The next step, as we see it, is reaching a position where humans can take on a management role, rather than a piloting one, in autonomous BVLOS flight. They will be supported by more sophisticated detect and avoid systems and communication technologies to ensure safer, smoother integration with other air traffic. The drone sector has already evolved significantly in the last decade, but capturing the opportunities BVLOS presents will enable fixed-wing drone technology to truly flourish. Collecting even more data, through a continued commitment to trials and partnerships with authorizing bodies, will be integral to this and the building of regulations that support safe BVLOS operations.

The regulatory outlook is already positive; European regulations, as well as laws implemented by Transport Canada and the USA's Federal Aviation Administration (FAA), look set to move towards better accommodating BVLOS flight. I'm confident that this acceptance will be an important enabler for BVLOS operations and geospatial professionals the world over.

Pierre-Alain Marchand
R&D Regulatory Compliance Manager, senseFly

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DRONES IN LAND ADMINISTRATION

What Are the Main Issues to Consider before Using UAVs for Land Administration Projects?

The almost ubiquitous unmanned aerial vehicle (UAV or 'drone) has been a key technology inspiring new thinking and disrupting land administration practice over the last decade. The flexibility and affordability of UAVs make them an efficient bridge between more expensive and time-consuming (but highly accurate) field surveys, and classical aerial or satellite photogrammetry. UAVs deliver tailored orthoimages from which spatial data – including visible parcel boundaries, building outlines and coordinates – can be derived. Many geospatial technology companies now offer high-tech UAV-based solutions, and many new hardware and software providers have also entered the market. Thanks to falling prices of UAVs, many land surveyors are now either experimenting with UAVs or already using them on a daily basis. So, what are the key questions that need answering before deciding to adopt a UAV in your next land administration project?

LOCAL LAWS AND REGULATIONS

First up, knowledge of local laws and regulations is crucial. There are two different sets of laws to consider: i) laws relating to cadastral surveying, and ii) laws relating to the use of UAVs. Surveyors already know the first set well. Those laws are long standing and tell us, amongst other things, what needs to be surveyed, who can do the surveying, what the data quality and procedural requirements are, what features can be used to demarcate boundaries, and the legal status of the cadastral plans and maps. If the local laws allow the use of physical boundaries that are visible in imagery, then UAVs can be a solution. Likewise, if the laws are not prescriptive about the surveying tools and methods, or are performance based, then UAVs remain an option.

Meanwhile, laws relating to the use of UAVs, both for hobby and professional users, have been developing rapidly. A key challenge in developing regulations is finding the right balance between the demands of different actors. Government institutions and regulatory bodies, even though often supportive of technical advancement, are aimed at ensuring public safety and security. The R&D sector strives for innovation. Commercial companies aim to sell products. Surveyors from any of these sectors wishing to use UAVs therefore need to be acutely aware of, and keep up to date with, local UAV regulations, and also be aware of the local actors and administering authorities (e.g. civil aviation authorities). Where there are country-wide legal bans on UAV flights, surveys might be impossible in the short term. Other contexts will require permission on a case-by-case basis, as authorities take into account the local situation. More mature contexts will call for the registration and identification of UAVs, and licensing of pilots (and/or of the operating organization). Careful preparation of flight planning will be needed. This will also include ensuring the proper selection of the flying height, image overlap issues, and the necessary ground sampling distance. The more mature approaches make it easier for surveyors to plan and complete flights, and also support more accurate results.

PROJECT CHARACTERISTICS

Secondly, the land administration project characteristics need to be assessed against the capabilities of UAVs. Like all other surveying tools, UAVs will be highly suited to some applications, but not all. If the project scale is national or regional, then satellite imagery or conventional aerial imagery will probably be more appropriate. If the work involves only a few parcels and demands high accuracy, then ground-based survey methods, using GNSS, are likely still a great option. Fixed-wing UAVs are highly suited to community, village, corridor or even municipality-scale mapping tasks. They are increasingly becoming like conventional aircraft; they can perform longer flights, but still require basic motion for their aerial mission and wider space for take-off and landing. Rotary-blade UAVs are generally suitable for smaller, more complex areas, having the ability to remain stationary in the air, and are therefore great for 3D modelling of cadastral volumes, buildings and infrastructure. Either way, UAVs are likely the quickest way to obtain near-real-time imagery at a low cost and the desired quality. If these characteristics are inherent and important in the project, UAVs might be the way to go. UAV technologies are always advancing – flying parameters and duration, sensor characteristics and positioning approaches are always improving – so keep an eye on that too.

FINANCING, PARTNERSHIPS AND CAPACITY

Thirdly, if UAVs still seem promising at this point, it's time to move on to concerns about financing, partnerships and staff capacity. UAV solutions vary greatly in price; surveyors should therefore decide which options are optimally 'fit for purpose' – both for the job at hand and future jobs. UAV insurance and training costs also deserve consideration. And it is worth thinking about whether the UAV work should actually be done in-house at all. Could you form partnerships or reach outsourcing arrangements with specialist UAV companies instead? If an in-house capacity is needed, who will be trained and how will the upskilling occur? Many surveying and geodesy education providers already offer UAV training courses.


Rohan Bennett, Swinburne Business School, Australia
Mila Koeva, University of Twente, The Netherlands

FURTHER READING

Koeva, M., Stöcker, C., Crommelinck, S., Ho, S., Chipofya, M., Sahib, J., ... & Crompvoets, J. (2020). Innovative Remote Sensing Methodologies for Kenyan Land Tenure Mapping. *Remote Sensing*, 12(2), 273.

Stöcker, C., Bennett, R., Nex, F., Gerke, M., & Zevenbergen, J. (2017). Review of the current state of UAV regulations. *Remote Sensing*, 9(5), 459.

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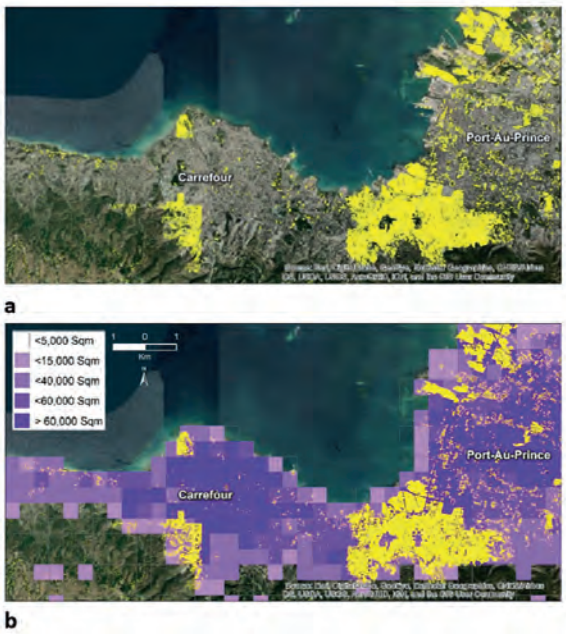
PREDICTING OPENSTREETMAP COMPLETENESS IN RISK AREAS

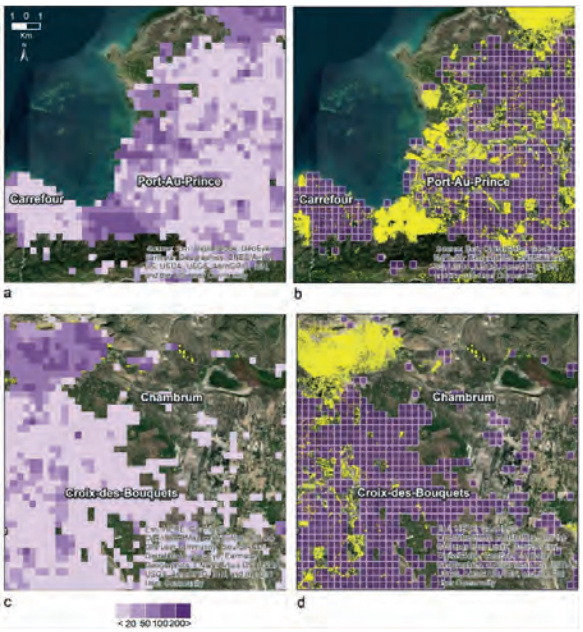
Getting Ready for Disaster Events with Remote Sensing

In view of the increased frequency and severity of natural disasters, timely information related to the distribution of vulnerable populations and critical infrastructure is key for effective disaster relief. OpenStreetMap shows great potential to support humanitarian mapping tasks and has provided vital information in many past major disasters. Publicly available remotely sensed measurements can be utilized to identify areas that have not yet been fully mapped and help guide and prioritize future mapping efforts in preparation for future disasters.

On the afternoon of 12 January 2010, the island of Haiti suffered its most devastating natural disaster ever: a magnitude-7.0 earthquake. An estimated 250,000 people lost their lives, 300,000 people were injured and close to 1.5 million people were forcibly displaced. Six years later, in October 2016, Hurricane Matthew struck southwestern Haiti, leaving a further 900 people dead and 28,000 homes damaged. In fact, Haiti has been hit by ten hurricanes and other tropical storms since 1998, with every landfall causing widespread loss of life and flooding. More than 96% of its population is exposed to various types of natural hazards, particularly



▲ *Existing OSM building footprints (shown in a) versus predicted area of OSM building footprints in a grid cell (shown in b) (Carrefour, Haiti). Areas shown in dark purple are predicted to include a large area of building footprints.*



▲ *The ratio between the actual and the predicted area of OSM building footprint in a grid cell (shown in a & c). Grid cells exhibiting the lowest ratio (shown in b & d) represent locations where the actual area of OSM building footprints is much lower than the predicted area.*

hurricanes, coastal and riverine floods, and earthquakes.

DEVASTATING CONSEQUENCES OF NATURAL DISASTERS

Haiti is not alone. Over the last few decades, many countries have been challenged by the devastating consequences of natural disasters which pose a significant threat to human health and safety, property, critical infrastructure and homeland security. Every year, natural disasters impact close to 160 million people worldwide, causing destruction of the physical, biological and social environments, impacting food security and causing global losses that amount to over US$100 billion. The Overseas Development Institute (ODI) estimates that, by 2030, up to 325 million extremely poor people will live in the 49 most hazard-prone countries, the majority of them in South Asia and sub-Saharan Africa.

When a disaster strikes, first responders are the first to react. They support search, rescue and evacuation efforts, aiming to meet the immediate and pressing needs of vulnerable communities for shelter, food, water and medical treatment. Timely information about the location, availability and functionality of critical infrastructure such as hospitals, shelters, water and sanitation facilities, roads and public transportation, as well as about where people live and the location of potentially isolated communities, is critical for effective disaster relief aimed at saving lives. Accurate, complete and accessible geospatial information is the foundation of a successful disaster relief effort.

VOLUNTEERED GEOGRAPHIC INFORMATION

Until recently, governmental agencies and the commercial sector were the two primary sources of geospatial data for disaster management purposes. In the past decade, however, citizens have been increasingly recognized as a valuable source of such information too. Volunteered geographic information (VGI), or geographic information collected by individuals often on a voluntary basis, has been playing a growing role in the support of humanitarian relief. This trend was even recognized by *Time* magazine in 2006, when 'You' were chosen as the magazine's Person of the Year.

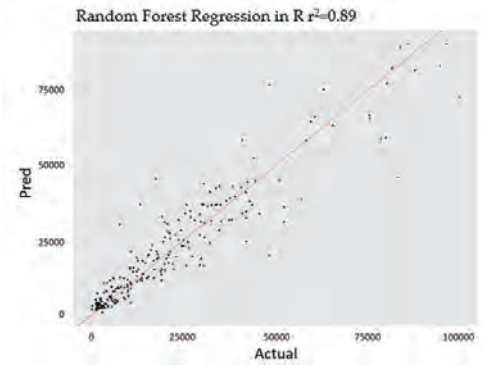
When the 2010 earthquake struck Haiti, accurate and timely information on the distribution of critical infrastructure was exactly what the disaster response community was looking for. But existing data, including from Google Maps, did not offer comprehensive coverage of the necessary features. In the days following the earthquake, many organizations released high-resolution satellite imagery under open licensing schemes, catalysing a worldwide effort to map Haiti and support the recovery operations. Over 450 OpenStreetMap volunteers from around 29 countries used the imagery to digitize roads, buildings and other features, creating the most detailed map of Haiti in existence in just a few weeks. Created in 2004 by Steve Coast, OpenStreetMap (OSM) is a collaborative project aiming to "create a free editable map of the world". As of today, there are more than 5.5 million OSM users and one million contributors who generate more than three million changes every day, as well as specialized groups such as Humanitarian OpenStreetMap Team (HOT-OSM) that conduct activities aimed at enriching OSM data to support emergency relief operations.

OSM COVERAGE

According to a recent study, the world's user-generated OSM road map is more than 80% complete. However, OSM's coverage of features varies significantly between – and often within – countries. For example, its coverage of remote areas is often lower than coverage of highly populated urban areas, and the coverage of developed countries tends to be lower than that of developing countries. A complete and accurate OSM map, especially in countries vulnerable to disasters events, is essential for the support of timely and effective search and rescue operations during and immediately after disasters.

In 2019, the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), the GFDRR Innovation Lab, together with a research team at New Light Technologies Inc., evaluated the potential use of satellite data and other types of remotely sensed derived products as predictors of OSM coverage. The objective of the project was to leverage different types of remote sensing measurements, together with machine learning approaches, in order to identify geographical areas where OSM coverage of building footprints is incomplete. A robust methodology to identify areas that are not yet fully mapped by OSM and that are at risk of environmental and natural hazards would allow prioritization of mapping efforts and preparation for future disasters.

Haiti was chosen as a case study for this project because, despite some densely mapped zones of Port-au-Prince, large portions of the country remain unmapped.



▲ *Comparison between the actual and the predicted area of OSM building coverage in a grid cell.*

This is potentially the result of the episodic engagement of community mapping volunteers and the definition of mapping 'tasks' on a neighbourhood scale through OSM editing tools. To predict the completeness of OSM building footprints in Haiti, the research team first created a tessellated grid of cells, each cell 0.25km^2 in size, spanning the entire country. The completeness of OSM building footprints in close to 1,600 cells was visually assessed against high-resolution satellite imagery as a base layer. Half of these cells, which were relatively fully covered (i.e. more than 75% of the buildings in a cell were estimated to be mapped), were used as a training set in order to evaluate the predictive power of different remotely sensed indicators.

Several remotely sensed indicators were assessed as potential predictors of OSM completeness, including intensity of light emitted at night (based on VIIRS measurements), spectral indices (NDVI, NDBI, SAVI, UI) derived from Sentinel-2 satellites, surface texture (based on Sentinel-1 SAR measurements), elevation and slope. Additional remote sensing classification schemes representing the distribution of forest and built-up land cover were also assessed as predictors.

PREDICTING BUILDING FOOTPRINT VARIATION

The analysis showed that the combinatorial effect of nine of the variables together explains up to 82% of the variation in OSM building footprints in Haiti. This is much higher than the predictive power of each variable independently. The team found that Random Forest regression predicts up to 89% of the variation in OSM building footprints in a cell, suggesting the potential utilization of remotely sensed measurement indicators of OSM building footprints. The trained Random Forest regression model was then used to predict the

coverage of OSM building footprints over the entire country. This allowed the team to identify cells that are predicted to be covered but that are actually not mapped yet – areas that would require extensive mapping efforts to ensure complete coverage to, for example, support disaster management in the future.

Evaluation of this method in a case study of two additional small island states (Dominica and St. Lucia) produced similar results, with a prediction of up to 94% of the variation in OSM building footprints in those states.

To summarize, with the increase in the frequency and severity of disaster events – especially in developing countries – it is essential to ensure the availability, accessibility and accuracy of geographical information to support disaster management operations. Although VGI platforms, specifically OpenStreetMap (OSM), show great potential to support humanitarian mapping tasks, significant areas – including countries vulnerable to natural disasters – remain unmapped. This study showed that the increasing availability of free and open-source remotely sensed data can be utilized to identify locations where built-up features still need to be mapped. Overlaying the model's predictions with hazard-risk data could allow not only the disaster management community, but also the OSM community to prepare for future disaster events and ensure that essential geospatial information is available to support the response and recovery efforts during and following major disasters. ◀

FURTHER READING

- Global Facility for Disaster Reduction and Recovery (GFDRR) | www.gfdrr.org/en/gfdrr-labs
- The world's user-generated road map is more than 80% complete | https://bit.ly/30fVGkP
- Overseas Development Institute | https://bit.ly/2tc91i8

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GLOBAL AUGMENTATION SERVICES SUPPORT DRIVERLESS VEHICLES

GNSS Positioning at Centimetre Level for Dynamic Applications

Mobile mapping, automated machine guidance and other dynamic applications employ global navigation satellite system (GNSS) receivers for positioning. To obtain centimetre-level positioning accuracies, augmentation services are needed which correct for atmospheric signal disturbances, clock errors and satellite orbit deviations. A major limitation of many solutions is that accuracy comes at the expense of long convergence times, which impedes the application in high-precision dynamic applications. This article outlines a solution based on global augmentation services.

Precise positioning at centimetre level cannot be achieved using GNSS signals alone. In addition, augmentation systems are needed. They consist of a network of base stations that continuously collect data to produce corrections on satellite orbit, satellite clock and atmospheric delay, and submit them to GNSS receivers. These corrections are indispensable in obtaining 3D positioning coordinates at centimetre level. These augmentation services are often offered commercially on a subscription basis. GNSS positioning at centimetre level can be conducted by many augmentation methods, including real-time kinematic (RTK), network RTK (NRTK), precise point positioning (PPP) and PPP-RTK. RTK exploits a network of base stations from which corrections are computed and transmitted to the subscribers.

DYNAMIC APPLICATIONS

For dynamic applications, the corrections must be instantaneously (in near real time) available at the GNSS receiver. Phase-based PPP is a well-appreciated solution among land surveyors, but one of the limitations to its use on moving platforms is that it can take half an hour or more to obtain stable and reliable 3D coordinates. That means dynamic applications require short convergence times. They also require augmentation services and transmission of the correction data at low bandwidth (Table 1). The large data volumes that RTK and NRTK require limit the communication through ground stations and thus the size of the service area. The need for instantaneous processing of the corrections requires a global network and transmission of the corrections through communication

	RTK	Network RTK			Phase-based PPP	Code-based PPP	PPP-RTK
	RS	FKP	MAC	VRS/PRS			
Errors Corrected	Orbit error, Clock error, Bias, Ionospheric delay, Tropospheric delay				Orbit error, Clock error, Bias, Iono/Tropospheric delay (PPP-RTK)		
Approach	Observation State Representation (OSR)				State Space Representation (SSR)		
Accuracy	cm				< dm	~3dm	< dm
Mean convergence time	< 5s				20min	< 1s	< 5s - 1min
Largest service area	Local	Regional			Global	Global	Global
Double frequency	Yes				Yes	No	Yes
Required bandwidth	Medium	Medium	High	Medium	Low	Low	Low to Medium
CORS network density requirement [km]	20 - 50	70 - 100	70 - 100	70 - 100	1,000+	1,000+	100+

RS: Reference Station; FKP: Flächen-Korrektur-Parameter (Area Correction Parameters); MAC: Master Auxiliary Concept; VRS: Virtual Reference Station; PRS: Pseudo Reference Station; CORS: Continually Operating Reference Station .

▲ *Table 1: Augmentation technologies. (Source: PPP-RTK market and technology report, European GNSS Agency, 2019)*

Name	Provider	Service area	Service release
CLAS	Japanese government	Almost the whole of Japan	November 2018
SAPA premium service	Sapcorda Services GmbH	Throughout most of Europe and the USA	January 2020
CenterPoint RTX-Fast	Trimble	Selected areas in the USA, Canada and throughout most of Europe	
PPP-RTK TERIA	Teria-Exagone	Mainly in France	
TerraStar X	Hexagon	In some testbeds (Germany, California, Arizona and Michigan)	

▲ *Table 2: PPP-RTK services with rapid convergence. (Compiled from publicly available information)*

satellites, but these have low throughput data channels which limits the data volumes.

Since the PPP-RTK augmentation services have a global coverage, rapid convergence time and centimetre-level accuracy, they are attractive for niche applications as well as mass-market applications. The resulting demand has stimulated commercial service providers and the Japanese government to offer PPP-RTK wide-area services with rapid convergence times (Table 2). The Japanese centimetre-level augmentation service (CLAS) provided by the Quasi-Zenith Satellite System (QZSS) and Safe And Precise Augmentation (SAPA) premium service are using an open data format which enables many GNSS vendors to manufacture PPP-RTK-ready receivers. The open format facilitates low bandwidth, high accuracy, availability, reliability and integrity for safety of life applications. The SAPA premium service – released on 31 January 2020 by Sapcorda Services GmbH – can be used throughout most of Europe and the USA. Mitsubishi Electric has already launched a PPP-RTK GNSS receiver for CLAS and will soon launch a similar receiver for the SAPA premium service in Europe and the USA.

CLAS

CLAS – operated by the Japanese government and in use since 1 November 2018 – is the first free-of-charge and nationwide PPP-RTK service. It enables automated operation of road and utility vehicles, docking of ships and guidance of drones, and supports agriculture and disaster response. In the ground segment, GNSS measurements from continuously operating reference stations (CORS) are used to compute corrections, which are broadcast through satellites using the L6 band (1,278.75MHz). The precise coordinates are available almost instantaneously after initialization. The data format of the corrections, called Compact State-Space Representation (CSSR), requires a bandwidth which is a factor thousandth lower than that of RTK. Together with the short convergence times, CSSR facilitates global high-precision augmentation services. Galileo High Accuracy Service (HAS) is considering CSSR for maintaining interoperability between Galileo HAS and QZSS CLAS. GNSS receivers for PPP-RTK services using CSSR are beginning to be released worldwide. In Japan, for example, the AQLOC Light for CLAS service was launched in November 2019 (Figure 1).

MOBILE MAPPING

Mobile mapping systems (MMSs) are widely used to generate highly accurate 3D maps and spatial data for surveying, infrastructure maintenance and road and tunnel inspections. For example, the Japanese consortium Dynamic Map Platform Co. has mapped all 29,205 kilometres of Japan's highways using Mitsubishi Electric's MMS (Figure 2). With a precision of 25cm, the resulting 3D maps are used for automated driving. The consortium is led by a government fund and Mitsubishi Electric, and supported by investments from all major Japanese automotive manufacturers as well as survey and mapping companies. The digital twins created by MMS enable operators to visually identify which roads require maintenance (Figure 3). Artificial intelligence can be used to identify the best maintenance procedure to minimize overall costs, and the Internet of Things can help to

▲ *Figure 1: AQLOC Light for CLAS was launched in Japan in November 2019.*

▲ *Figure 2: The Mitsubishi Electric mobile mapping system.*

enhance the digital twins to create value-added applications.

LAND SURVEYING

High-precision positioning, which today is mostly based on GNSS technologies, is widely used for surveying cadastral boundaries, construction sites and mines. The accuracy ranges vary from millimetre level to metre level. With centimetre-level accuracy, high-precision positioning by PPP-RTK can cover many of these application with easy procedures which provide the measurements almost instantaneously. No own base stations consisting of expensive high-accuracy geodetic GNSS station are necessary. Some professionals prefer traditional surveying methods for certain applications, especially in locations where it is not possible to receive sufficient GNSS signals. For example, urban canyons may degrade PPP-RTK performance. In such cases, other sensors or systems may complement the GNSS measurements.

MINING AND AGRICULTURE

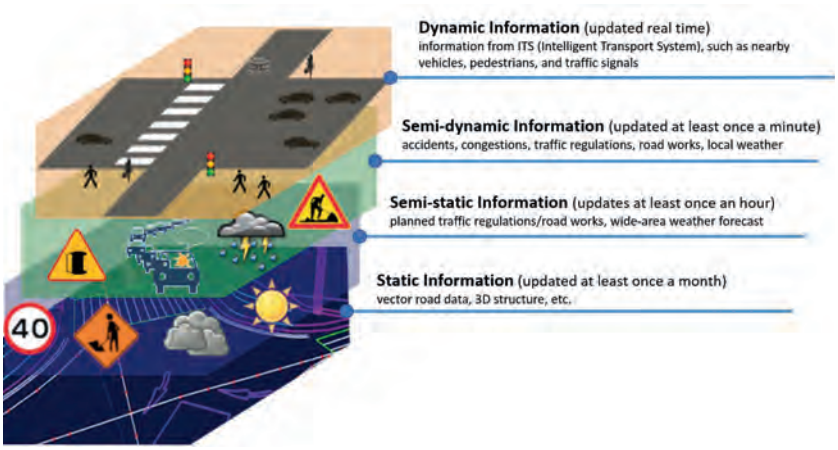
In open-pit mining, the trend is towards increased automation. Some companies, such as Rio Tinto, have already started to operate with driverless trucks which require decimetre-level accuracy for guidance. Here, one alternative to establishing a private RTK network is the use of a global PPP-RTK service. Obstacle avoidance may require millimetre-level accuracy and this calls for alternative or complementary technologies. Meanwhile, in precision agriculture, the aim is to increase yields and worker safety while also reducing the use of fuel, pesticide and fertilizers. Guidance of farm machinery and unmanned airborne systems requires high-precision positioning, which relies on wide-area PPP-RTK services such as CLAS. The SAPA premium service could be a key enabler.

DRIVERLESS CARS

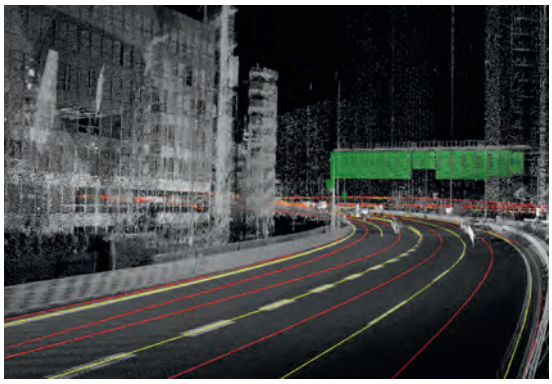
The cornerstone of autonomous car navigation is high-precision GNSS, which provides high-precision absolute positioning supported by cameras, Lidar and other sensors. A complex architecture is required to ensure the proper functioning of the ensemble of sensors. Positioning accuracy is not the only concern; availability, integrity and robustness are also important factors. Augmentation services are continuously being developed and improved to meet these needs. Vehicle-to-vehicle communications, or vehicle-to-infrastructure communications (V2X), are essential for autonomous cars. Such communications are based on the Dynamic Map, a major research spin-off of the Automated Driving for Universal Services (ADUS) project of the Japanese Strategic Innovation Promotion (SIP) programme. The road maps consist of dynamic Information, semi-dynamic information and semi-static information (Figure 4). These three layers are necessary for the safe manoeuvering of vehicles. The creation of static information, which is a fourth layer consisting of a high-precision 3D map, has been a nationwide cooperative effort.

CONCLUDING REMARKS

It will take some time for PPP-RTK to become mainstream because the technology is complex. But the convergence to reliable centimetre-level positioning is easy, the service area is large, and the low bandwidth for correction data transmission will contribute to widespread use. Since CLAS and SAPA premium service use an open data format, AQLOC Light users will be able to find many receiver solutions for PPP-RTK in the near future. ◂



▲ *Figure 4: Schematic representation of the Dynamic Map concept.*



▲ *Figure 3: Example of data acquired for the creation of 3D maps of Japan's highways. (Image Courtesy: Dynamic Map Platform Co.)*

FURTHER READING

- European GNSS Agency (2019) PPP-RTK market and technology report: https://www.gsa.europa.eu/sites/default/files/calls_for_proposals/rd.03_-_ppp-rtk_market_and_technology_report.pdf
- Motooka, N., Hirokawa, R., Nakakuki, K., Fujita, S., Miya, M., Sato, Y. (2019) CLASLIB: An open-source toolkit for low-cost high-precision PPP-RTK positioning. In: ION GNSS+ 2019
- Mitsubishi Electric Mobile Mapping System: http://www.mitsubishielectric.com/bu/mms/
- Sapcorda Services GmbH: https://www.sapcorda.com/
- List of products that support the QZSS: https://qzss.go.jp/en/usage/products/list.html
- http://www.sip-adus.jp/

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5 Questions to... Håkan Engman, Bentley Systems

The 'digital city' or 'smart city' is a hot topic. What makes it so relevant for geospatial surveying professionals?

In most cases, smart initiatives in a city originate from an ambition to improve the services delivered to its citizens or to manage its resources at less cost. Geospatial information and digitalization are essential components of these initiatives, regardless of whether to improve transportation, shorten lead time for building permits or optimize water supply systems. The challenge is to capture the data and to structure it in a way that enables the implementation and distribution of services. One way to do this is by creating a city-scale 'digital twin'. A digital twin is a digital representation of a physical asset, process or system, as well as the engineering information that allows us to understand and model its performance. It is enabled by open data across engineering data, operations and information data to the geospatial model, and also adds the fourth dimension: the chronology to track historical performance and predict future behaviour. City-scale digital twins begin with and are updated through 4D surveying and reality modelling by ContextCapture and Orbit GT to derive as-operated 3D models from photogrammetry and/or point clouds. Reality modelling provides engineering-precise, real-world context to support planning, design, construction and operations. As cities continue to advance their digital processes and automate workflows, data accuracy and accessibility are even more critical. When accuracy and access are an issue, data-driven decision-making is problematic. But because digital twins can be continuously updated, they can reflect the reality at any given time.

Bentley has a long history concerning both building information modelling (BIM) and geographic information systems (GIS), and the two are becoming increasingly intertwined. How do you expect this to impact the industry in the future?

Bentley does indeed have a long and rich history in both geospatial technology and in BIM for municipal infrastructure applications, spanning capital expenditure and operational expenditure. We are also the leading innovator in reality modelling, as well as in geotechnical modelling and data management. With our new cloud-based iTwin services bringing all this together, city and campus digital twins now offer an immediate opportunity to help cities and regions tackle a wide range of challenges and problems, enhancing their infrastructure performance and their constituents' quality of life. In infrastructure projects, the geospatial data is always essential to associate the engineering data with the landscape. Frequent surveying of a project using unmanned aerial vehicles or terrestrial mapping gear gives an updated view of the status of development and compares reality with the engineering models. Combined visualization of engineering models and the geospatial information is becoming more essential.

How is Bentley accelerating digital transformation in urban areas?

At Bentley, going digital is about an ongoing process of digitalization. We provide software and services to help both city departments and organizations in the urban ecosystem with solutions that span the lifecycle from planning to performance. We offer applications that support various use cases which are enhanced by access to trusted information that may live in different applications and data sources but can seamlessly work together with a federated approach, which enables digital twins.

In 2018, your company Agency9 was acquired by Bentley. How did that come about and how have things evolved since?

Bentley had been evolving the 3D reality mesh produced by Bentley's ContextCapture application and applications in Scandinavia and internationally. Agency9 solutions were adopted by many cities in the Nordics for communication and engagement in urban development, including Stockholm and Gothenburg. The software was capable of streamlining unlimited-size mesh models even before Bentley acquired it. Now hosted in Microsoft Azure, OpenCities Planner delivers cloud-based, city-scale digital twins to improve stakeholder and citizen engagement and to simplify and facilitate urban development. Addressing a wide variety of potential use cases, OpenCities Planner helps users – through devices like web, mobile, touchscreens and digital billboards – to intuitively visualize and explore 2D, 3D, GIS and other data aligned with the reality modelling of the city. We are seeing opportunities with city-scale and campus digital twin workflows to consume information from other analysis and simulation results (created in other applications). However, displaying and visualizing in OpenCities Planner makes it a great application for communicating across not only cities and their residents, but also the expanded ecosystem within which Bentley has other applications used for design projects across all infrastructure segments.

Projects such as the Helsinki 3D+ initiative seem to have set a trend, with many other cities keen to follow suit. What lies ahead for 3D city modelling?

Read the answer on on this question question on the website of *GIM International*: www.gim-international.com

Håkan Engman is the director of business development in the digital cities business unit at Bentley Systems. In that role, Engman is leading business management activities for OpenCities products. He is also responsible for the integration of the Swedish company Agency9 following Bentley's acquisition of it in September 2018. As the CEO of Agency9, Engman was instrumental in positioning the company as a key player in web-based urban planning 3D applications for project communication and citizen dialogue. Before Agency9, Engman worked at IBM, BMC Software, Ericsson and several start-up companies in the mobile and media software market.

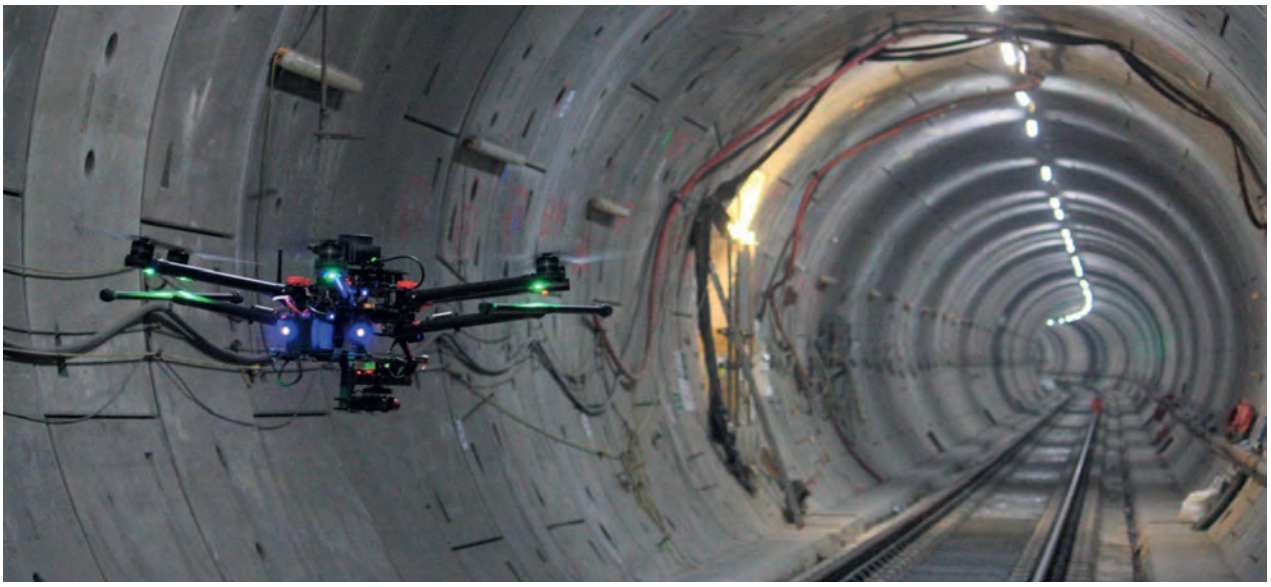
UAS Mapping – Where Is It Heading?

The use of an unmanned aerial system (UAS) – cameras and Lidar sensors mounted on an unmanned aerial vehicle (UAV or 'drone') – to acquire geodata for mapping purposes has evolved beyond infancy and is now rapidly maturing. How will UAS mapping evolve in foreseeable future? To envisage where exactly UAS technology is heading, it is appropriate to start with the big picture before examining the details.

What is the current big picture for unmanned aerial systems? How are they embedded in today's society? First of all, our planet is confronted with climate change. The most threatening effects are sea-level rise and lengthy heavy rainfall putting valleys, rivers, lowlands and deltas at increased risk of flooding. Each year, the world's population expands by more than the equivalent of the total number of inhabitants in Australia and Canada combined. Less than 250 years ago, just one billion people were living on this planet. Today, that number has reached nearly eight billion. This represents an annual population growth rate of over 1% and a doubling of the population every 70 years – which is less than a lifetime for many people. Remember this when you complain about overcrowded cities! The Industrial Revolution brought the world machinery to plough, sow and harvest fields – which freed peasants from hard labour on farms, but also transformed smallholdings into industrial operations and signalled the end of the idyllic pastoral scenes immortalized in 19th-century paintings. Since then, those peasants' descendants have continued to move around in search of work, contributing to the rapid growth of urban agglomerations. The resulting – and ongoing – societal developments have continuously increased the need for highly detailed, accurate and timely spatial data. This ever-evolving landscape forms the backdrop for examining where UAS mapping is now heading.

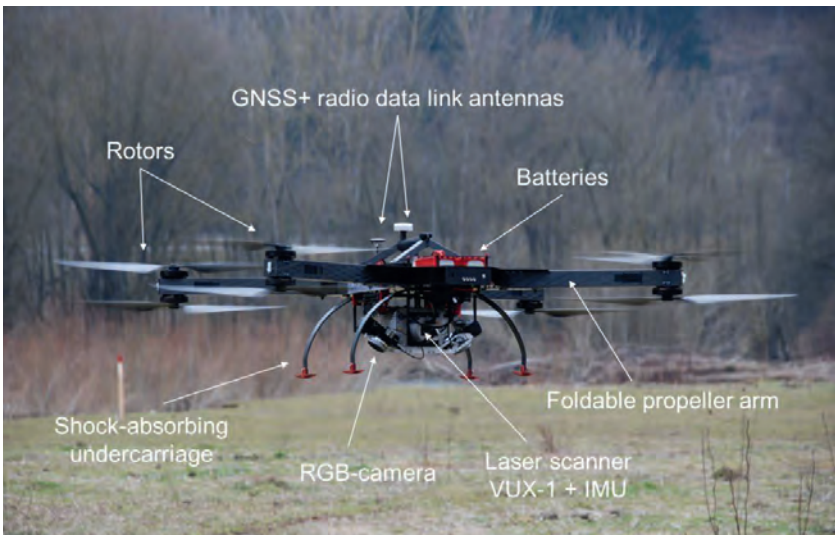
PERSUASION SKILLS

The main spatial data acquisition technologies for detailed 3D mapping of sites are based on imaging devices (photogrammetry) and Lidar sensors (laser scanning). The processing software to extract meaningful information from the data is greatly supported by the achievements of the computer vision research community over the last four decades. The major semi-finished products are point clouds. Cameras and Lidar sensors can be mounted on a wide variety of platforms or carriers, including vehicles and aircraft. Platforms operating outdoors, such as manned aircraft and cars, are usually equipped with GNSS and an inertial navigation system (INS) to accurately determine the six exterior orientation parameters of the sensors (3D position and orientation of the sensors in space). To improve reliability of georeferencing, additional sensors are often used such as wheel counters and compasses. The use of ground control points further enhances the geometric accuracy of the data.



▲ *UAS systems are increasingly being used for indoor environments and underground constructions. (Courtesy: Hovering Solutions Ltd)*

Thanks to simultaneous location and mapping (SLAM) algorithms, indoor mapping has become possible using trolleys, backpacks or handheld solutions. The decision for a specific platform depends on the application, size of the survey area, severity of disruption to human activities (e.g. interference with train timetables), required accuracy and level of detail, costs, instruments available at the surveying firms and the ability of those firms to communicate the benefits of their solutions to potential customers.



▲ *Due to ongoing miniaturization copters are able to carry camera and Lidar sensors simultaneously. (Courtesy: XXX)*

MINIATURIZATION

On the flip side of societal developments are the technological advances. The key trend in the evolution of UAS mapping can be summarized as the miniaturization of components. Cameras and Lidar sensors suited for capturing high-quality data are becoming smaller and lighter, propped up by advanced processing software which facilitates the use of calibrated metric cameras and heavy Lidar sensors for precision solutions. Today's positioning and orientation systems (POS) based on GNSS and INS can be held in the palm of one's hand. The miniaturization of rotors, electric engines and batteries, in combination with carbon-fibre frames, has enabled the construction of lightweight UASs without compromising air stability. On such systems, camera(s) and Lidar (sensors) can be mounted abreast for the simultaneous capture of images and Lidar point clouds. Concurrent capturing of Lidar point clouds and photogrammetric images has proven to be beneficial for 3D mapping of built-up areas.

HOT SPOTS

As illustrated by the numerous case studies published in *GIM International* in recent years, the UAS has proven its suitability for many 3D mapping applications, including at archaeological sites, industrial complexes, power stations, open-pit mines and construction sites. The use of UASs for capturing such sites will continue to flourish. Particularly, UAS photogrammetry is routinely used for mapping, inspection and monitoring of such sites. The projects concern individual buildings, small areas of interest and other isolated outdoor sites. Vast areas, such as urban agglomerations, are usually three-dimensionally mapped by selecting one geodata acquisition technology (often aerial photogrammetry) for the entire territory. That means all spots are treated equally. However, it is not always a case of 'one size fits all'; some spots are more equal than others. Choosing one technology based on the greatest common denominator results in a dataset in which some spots are captured at the right level of detail while others are over-detailed or under-detailed. A UAS – possibly complemented with trolley-based, backpack or handheld mobile mapping systems – can capture underdetailed spots at the desired level of detail.

CIRCULAR ECONOMY

The ongoing miniaturization of carriers and sensors in conjunction with SLAM algorithms for positioning and orientation purposes has also made it possible for copters to manoeuvre through indoor spaces. Equipped with cameras and/or laser scanners, they can collect high-density point clouds. The high level of detail and accuracy of the data helps facility managers to inspect their property. It also supports the creation of 3D cadastres, which are aimed at recording the ownership of volumetric parts of buildings and other constructions. Authorities and citizens alike are convinced that wasting fuel and other resources as well as the emission of harmful substances should be minimized through reuse, refurbishment and/or the use of alternatives in pursuit of the circular economy. The main consequence is that sites where humans are active, including agricultural lands and mines, need to be mapped and monitored in ever-greater detail. Within today's industrial agriculture,

▲ *Examples of small, lightweight Lidar sensors: South's Lidar SZT-V100, weight 1.5kg (left); Teledyne Optech's CL-360 OEM Lidar sensor released in 2019, weight 3.5kg (middle); the RIEGL VUX-1UAV, weight 3.5kg (right).*

for example, the collection of spatial data supports regular inspections to avoid waste of fertilizers, fuel, seeds and water. A UAS is well-suited for capturing such spatial data on a regular basis. When it comes to indoor mapping, UAS and mobile mapping complement rather than compete with one another. For example, if used indoors a UAS could collide with objects or people, causing damage and possibly injuries, making it useless in crowded indoor environments. In such a setting, mobile mapping is a perfect solution. In addition, the two platforms have different perspectives (i.e. view angles): sideways-looking versus image capture from above.

Building information modelling (BIM) plays an essential role in the circularity mindset, since information on the types and quantities of construction materials used is key. Such an information system, which is also needed for the inspection and maintenance of indoor and outdoor spaces, could be called a building materials cadastre.

BOTTLENECKS

Ever since the emergence of computers, it seems to have been a rule of thumb that the amount of data acquired by sensors is ten times as much as the processing capacity of computers – so it's no wonder that so many researchers are throwing themselves into data science and artificial intelligence to speed up the processing of geodata. Another major bottleneck preventing the rapid introduction of UASs in several applications is that many professionals seem reluctant to replace tried-and-tested technology with a novelty that has a non-proven outcome – even though it may be convincingly cheaper and demonstrably more efficient.

ESSENTIALS

There are four essential ingredients determining data quality (i.e. accuracy and detail) in 3D mapping systems: the sensors, the software, the platform and, above all, the survey plan. The design of the survey plan requires thorough knowledge, skills and expertise. This is where the geomatics specialist comes in. Given the strong societal needs for geoinformation outlined above, it is odd that universities in so few countries offer bachelor-level geomatics degrees; at best, the subject is usually on offer at master's level only. There is a serious risk that society will pay the price for this in the future and be forced to increasingly depend on the less specialized knowledge of the multinational informatics industry. ◂

FURTHER READING

Lemmens, M. (2020) Simultaneous Capturing of Lidar and Imagery, *GIM International*, 34(1), pp. 10-13 https://www.gim-international.com/content/article/simultaneous-capturing-of-lidar-and-imagery

ABOUT THE AUTHOR

Mathias Lemmens is an independent geomatics consultant. He recently published his latest book: *Points on the Landscape*, a compilation of 150 of his columns since 2000 (see review in *GIM International* 33(6), 2019, p. 46).
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Configure, Please...

Having worked in land administration for many years, I've seen all types of projects succeed and fail. We know the reasons for most of the failures – building an unsustainable and unscalable system, not understanding the total cost of ownership, poor system security, inadequate funding models, lack of local capacity, costly maintenance of custom-built software and many more. Although there is no golden ticket to success, we can increase our chances of success by learning from these failures.

THE END OF CUSTOM CODE

For most applications, developing software by writing code is a thing of the past. Modern software platforms have application builders that enable you to build mobile apps, web maps and web apps with just a few keystrokes. There is no longer a reason to hardcode workflows either. Yes, you may do things differently and your legal structure may have requirements that others don't, but that doesn't mean you have to hard code them. Just like web apps and maps, you can configure workflows and tasks to fit your organization's needs. Remember, every line of code you write needs to be maintained and requires staff. Moreover, when your system is upgraded, all custom code needs to be updated as well. This is a cause of many land system failures. So unless you have sustained access to a lot of resources, don't code.

Modern systems offer configurability. Whether you are working on valuation workflows, parcel editing or data sharing and publishing, these are all configurable in ArcGIS. Leveraging standards such as the Land Administration Domain Model (LADM) and Open Geospatial Consortium (OGC) web services makes it relatively simple to configure your land administration workflows. This is key to system sustainability.

SOLVING SOLVED PROBLEMS

Thomas Edison once said, "I start where the last man left off". Why do we keep solving solved problems? Instead, we should start with what we know and is already built. Commercial off-the-shelf software (COTS) developers identified common capabilities that all land administration systems need, like parcel editing, and then built the data structures, functionality and workflows, and made their solution configurable so it fits many organizations' requirements. By using COTS, the total cost of ownership (TCO) is dramatically reduced – no code to maintain, no custom training and you get the benefits of professional support and new capabilities with new software releases, so you can work on unsolved problems specific to your organization.

Most commercial software is built to be scalable, so there is no need to rewrite the software to scale a project from a pilot to an enterprise land administration system. This includes security protocols, user identity management and cloud data management. These capabilities are costly to build and maintain. Large geospatial platforms like ArcGIS have modern security protocols and, as security threats emerge, countermeasures are developed and deployed for all users. It's difficult to imagine how much it would cost to do this effectively in custom-developed software.

THE NGO EXAMPLE

Thousands of non-governmental organizations (NGOs) and non-profits use commercial software, particularly ArcGIS. Why? Because they have limited resources and focused missions. Many NGOs are accountable to their donors and need to show results, which usually aren't expressed in custom-developed, single-use software. Cadasta, for example, is focused on delivering technical tools and services to document land rights in the most challenging environments around the world. Originally conceived to deliver software tools based on open source, Cadasta realized that the time-consuming creation and maintenance of custom software was not its core mission, yet it was spending more time writing and testing software than serving partners on the ground. Frank Pichel, Cadasta programme manager, said, "Simply put, we could not keep up with increasing scale and functionality requests from our partners while maintaining a full open-source infrastructure. Core Esri technology like secure data storage, GIS based analytics and the ability to use different datasets has enabled our partners to make better decisions and for Cadasta to better serve its core challenge – strengthening property rights." Like many other organizations, and not just NGOs, Cadasta has a vision and mission. Originally developing a software solution was part of that vision, but over time it realized that supporting the complexity, required resources and end-user demands went beyond its capability.

EVOLVE

When looking at land administration and cadastral systems around the world, the successful ones have several things in common. One notable characteristic is that these systems have evolved over the years to meet changing demands – mandates change, legislation changes, government leadership changes, funding fluctuates and technology advances, to name but a few. We can't control all of these factors, but we can put together a nimble, responsive system that can evolve in line with changing requirements and respond to new opportunities. Hardcoding inflexible systems with the resources to support them in the long term is a recipe for certain failure.

We've all made plenty of mistakes, but isn't it much nicer to learn from others' mistakes rather than your own? We now know what works and what doesn't when we implement, expand and modernize cadastral and land administration systems. So please, don't continue to reinvent the wheel and build unsustainable systems from scratch. Let's learn from the past together and begin where the last man left off, to configure scalable, secure and sustainable land systems. ◀

ABOUT THE AUTHOR

Brent Jones is Esri's global manager of cadastre/land records. Based in Washington D.C., USA, he oversees Esri's worldwide strategic planning, business development and marketing activities for land records and cadastral, surveying and land administration. As a recognized technology innovator, Jones specializes in modernizing existing land administration systems and designing new GIS-based cadastral management platforms for governments of all sizes around the globe.
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FIG President Staiger Visits Nigeria

On 26 February, FIG President Staiger met with the President of Nigeria and the President of the Senate. Further to this, he paid a visit to Surveyors Council of Nigeria where he witnessed the induction of 344 Registered Surveyors. FIG President Rudolf Staiger was invited to Nigeria to witness the induction of 344 newly licensed surveyors at a ceremony organized by the Surveyors Council of Nigeria (SURCON) and the Nigerian Institution of Surveyors (NIS). The investiture took place at the International Conference Centre of Abuja on 27 February. In his welcome address to the new inductees, Rudolf reminded them about the importance of their future task – not only on a technical level, but also on a legal and ethical level.

MEETING WITH THE PRESIDENT OF THE REPUBLIC OF NIGERIA

On the same day, the President of the Republic of Nigeria, His Excellency Muhammadu Buhari, honoured our Nigerian colleagues and FIG with a 30-minute reception. This was the first time in history that the Nigerian president himself had received a delegation of surveyors. In collaboration with FIG, SURCON thanked the president of Nigeria for his unprecedented support in promoting the application of surveying and geospatial information in Nigeria's national development.

MEETING WITH THE PRESIDENT OF THE SENATE OF NIGERIA

On the previous day, the Honourable President of the Senate of Nigeria, Ahmad Ibrahim Lawan, had received a delegation of Nigerian surveyors and the FIG president. In the context of the induction of the newly licensed surveyors, SURCON introduced the 'Distinguished Senator Ahmad Ibrahim Lawan Award for the Development of the Surveying and Geoinformatics Profession in Nigeria' and conferred it on Lawan, who studied surveying engineering and holds a PhD in remote sensing.

INDUCTION OF 344 REGISTERED SURVEYORS

The festive induction ceremony took place in the afternoon, during which all 344 newly licensed surveyors received their certificates. The first certificate was handed out by the President of the Senate to the 'Best Overall Candidate' in the SURCON 2020 professional examinations. Besides him, 12 other senators of the Federal Republic were present during the induction ceremony. President Staiger also had the honour to hand out some of the certificates.

VISIT TO THE FRENCH EMBASSY

During his stay FIG President Staiger was also able to pay a visit to the French Embassy which, together with the Belgium Embassy, handles visa issues for the Dutch Embassy. Therefore, he was joined by Surveyor Kabir Mansur Mohammad (registrar of SURCON) and surveyor Acabo C. D. Charles (president of NIS) in a meeting with Mr Sylvain Naulin, political officer at the French Embassy in Abuja, to discuss the handling of Nigerian visa applications for the FIG Working Week 2020.

More information
www.fig.net/fig2019

▲ *High-level Nigerian delegation of surveyors from SURCON and NIS together with FIG President Rudolf Staiger, received by the President of Nigeria, Muhammadu Buhari. Later in the day, the delegation participated in the festive induction ceremony of 344 new surveyors.*

Satellite Laser Ranging School

In October 2019, a one-day Satellite Laser Ranging (SLR) School was organized by the German Aerospace Center (DLR) in Stuttgart, Germany. Inspired by similar events in other disciplines, the SLR community set up this event for the first time. In a series of lectures, distinguished experts from the field shared their experience and knowledge about SLR technology, data evaluation and the challenging endeavour to achieve and maintain sub-centimetre accuracy in the data products.

▲ *DLR's one-day Satellite Laser Ranging School was held in Stuttgart in October 2019.*

About 50 students and 20 lecturers from 15 countries participated in this event. During the day there was also plenty of opportunity for networking and knowledge exchange between participants. Due to the great success and very positive feedback of the participants, similar events may be held again in the future, possibly even over two days. All lectures were video-recorded for people who were not able to attend. All videos and presentation slides are freely available on the website.

More information
https://cddis.nasa.gov/2019_Technical_Workshop/SLR_School/index.html

New ISPRS Services for Members and the ISPRS Community at Large

Since the last ISPRS Congress in Prague in 2016, the ISPRS Council has revised the services it offers to its members and the ISPRS community at large and has initiated a number of new opportunities to benefit from ISPRS membership. The most important ones are listed here, in the hope that as many members as possible will take advantage of these new opportunities.

The Key Note Speaker programme, commenced in 2019, offers financial support to Ordinary, Associate and Regional Members to invite international experts to one of their meetings. The general principle is that ISPRS covers travel costs, while the member covers local accommodation expenses. Three presentations have already been given in 2019, when ISPRS sent speakers to Bogota, Suva and Kathmandu.

Following requests from members, the ISPRS Archives series has been opened for proceedings of meetings organized by Ordinary, Associate and Regional Members. The first of these new publications will come from ASPRS in spring 2020. In a cooperation with the Technical Information Library Hannover, earlier versions of the Archives are continually being added to the ISPRS website with the aim of eventually having all Archive volumes available in digital form. In addition, for both the Archives and the Annals, an automatic plagiarism check will be introduced in 2020 to maintain the high quality of the two proceedings series. Additionally, ISPRS has formulated a strategy for how to deal with pre-prints submitted to public repositories.

As the scientific community turns towards open-access publications, and authors increasingly have to pay so-called author processing charges (APCs) to have their work published, ISPRS now supports authors who have an accepted paper in the International Journal of Geo-Information with a partial waiver of the APCs. In addition, as of 2020, the best paper in between two ISPRS Congresses will be awarded with the Jack Dangermond Award. We see this new award, which is generously supported by ESRI and the journal publisher MPDI, as an additional motivation to submit first-class papers to this journal to further increase its reputation.

ISPRS now also issues yearly calls for the ISPRS Scientific Initiative (in even years) and the ISPRS Educational and Capacity Building Initiative (in odd years). All Working Group Officers are eligible to submit proposals. These two initiatives provide seed money to successful applicants for projects which in raise the visibility of ISPRS in some way.

As of last year, ISPRS also supports organizers of ISPRS events by covering the costs of the meeting software ConfTool to manage paper submission and registration. In this way, we also hope to harmonize the way in which ISPRS events are being organized and facilitate the administration of these meetings for all sides.

The whole community can take advantage of the multi-lingual ISPRS flyer. While it had only been available in English for many years, we have now also produced versions in Arabic, Chinese and Russian, and following a particular effort to make ISPRS better known in South America, in Portuguese and Spanish.

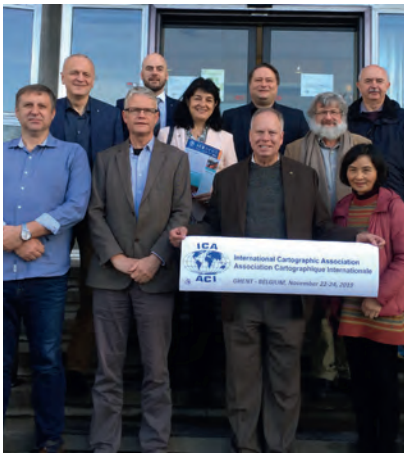
We hope that these services, which have all been developed over the last four years, will further increase the popularity of our society and will add to the experience of being a member of the ISPRS community.

By Christian Heipke

More information
- www.isprs.org/society/ksp/default.aspx
- www.isprs.org/news/announcements/details.aspx?ID=199
- www.isprs.org/documents/guidelines/pre-publication.aspx
- www.isprs.org/news/announcements/details.aspx?ID=174
- www.isprs.org/publications/brochure.aspx

First Meeting of the New ICA Executive Committee and Commission Chairs

During the last International Cartographic Conference in Tokyo, Japan (August 2019), the entire Executive Committee was newly elected for the next term 2019-2023. The assembly of national delegates also approved the applications for 28 ICA commissions and voted in the new commission chairs. On 22 November the newly elected Executive Committee met for the first physical meeting during the new term in Ghent (Belgium). A full day of intense discussions and a huge list of work items set out the agenda for the International Cartographic Association for the next four years. Following ICA's Strategic Plan and the ICA president's motto, that 'Maps make a difference and that cartography is today more relevant than ever in an increasingly complex world', the committee discussed next steps. These included the necessary actions in order to achieve these goals and make our important discipline and the ICA society even more visible and heard, both among decision-makers and a larger audience beyond the geospatial community.



▲ *On 23-24 November the entire Executive Committee met for the first joint working meeting with the newly elected commission chairs.*

Reaching the next term's goals is of course a collaborative project that the Executive Committee, national members, affiliate members and ICA commissions need to undertake together. Every member of the Executive Committee has an important role to play in this context as a coordinator, enabler and facilitator. Hence, all vice-presidents were assigned the role of liaison with commissions and working groups.

FOUR NEW WORKING GROUPS FOR THE TERM 2019-2023

Some of the strategic tasks that the new Executive Committee wants to tackle during the next term are very specific or transversal in character and not fully covered by existing commissions. Therefore, four new Working Groups were set up during the meeting in Ghent:
- Cartography and Sustainable Development (Philippe De Maeyer)
- Cartographic Body of Knowledge (Terje Midtbø)
- History of ICA (László Zentai)
- New Research Agenda in Cartography (Liqiu Meng)

The respective members of the Executive Committee (in brackets) will help with startup and organization, find interested members and supporters, and lay out the work schedule for the next four years.

NOMINATIONS OF HEADS OF COMMITTEES AND ICA OFFICERS

Furthermore, the Executive Committee nominated the new Heads of ICA Committees and Officers to the ICA Secretariat who will help to keep the society running and inform members and the public in the best possible way through the various channels. Congratulations to those nominated for the term 2019-2023!

FIRST JOINT MEETING WITH NEW COMMISSIONS

Directly following the meeting of the Executive Committee, on 23-24 November the entire Executive Committee met for the first joint working meeting with the newly elected commission chairs. Altogether, 22 out of 28 ICA commissions were present during the meeting, either represented by their chair or vice-chair. On two exciting, busy working days commission representatives and ICA officials got to know each other better, learned about administrative guidelines and procedures for smooth cooperation and dedicated themselves to common strategic tasks for the next four years. The president pointed out once more the important role that commissions play in our international society – it is through commissions that the actual thematic work of ICA is being done which ultimately brings forward our discipline, advances cartography as a science and sets the standards for the quality and usage of our work.

More information
- https://icaci.org/executive-committee/
- https://icaci.org/commissions/
- https://icaci.org/mission/
- https://icaci.org/committees/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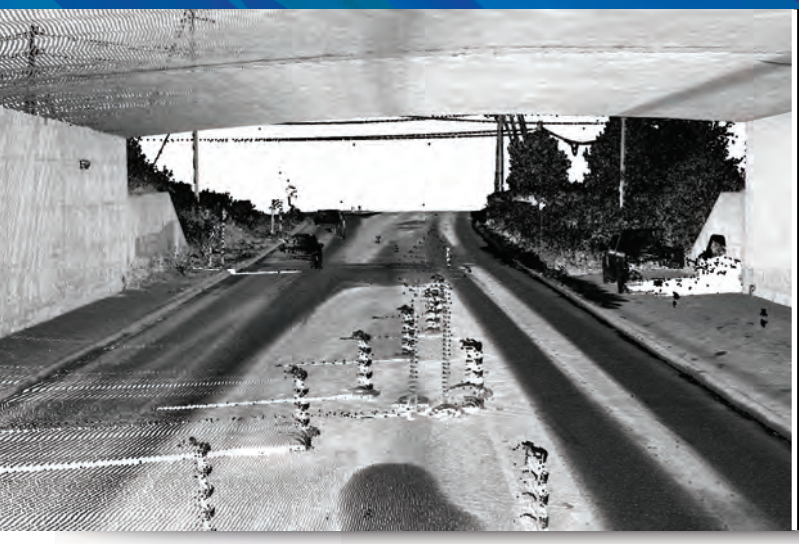

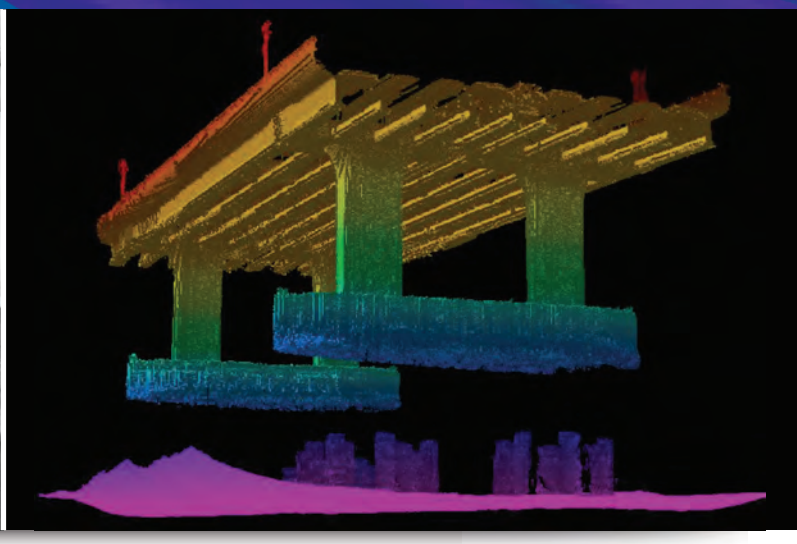

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