



REPORTER



HEXAGON
GEOSYSTEMS

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President's Message

In our business, we talk a lot about connecting. Field work is connected back to the office through sophisticated software. Machines on a construction site are connected to each other through integrated platforms. People are connected to one another through technology. This connection is what distinguishes modest ecosystems from smart ecosystems, the basis for smart digital realities. In this edition of *Reporter*, we define what it takes to make smart ecosystems leading to smart digital realities for a true digital transformation.

The construction industry is rapidly digitalising and connecting more and more the field to the office. When Clark Builders discovered the efficiency and simplicity of Geosystems latest generation of robotic total stations, GNSS and software for construction, this top-ranking general contractor in Canada streamlined its layout time by 25 to 30 per cent, lowering its survey costs and increasing its profits.

When technology is used to share information and connect cities, the global community benefits. The Unreality Journeys Team and G2 Foundation, a collective of technology visionaries, use Geosystems laser scanning technology to capture antiquities throughout Guatemala. The organisation is on a mission to decentralise and enable communities to share the captured data through virtual, augmented and mixed reality environments so everyone can experience these UNESCO World Heritage Sites.

At Hexagon, we don't just talk about smart ecosystems and digital realities – we create them. In our latest innovation, Xalt, we are fast-tracking our customers digital transformations by harnessing the power of the Internet of Things (IoT). The goal of Xalt is to create Autonomous Connected Ecosystems (ACE), a state where data is connected seamlessly through the convergence of the physical world with the digital and intelligence is built in to all processes, from the core to the edge of a customer's network. Learn how Xalt will ultimately underpin all our forthcoming technology.

When businesses work in smart ecosystems, they create smart digital realities for more efficiency, productivity and sustainability. To address this generation's most critical challenges, digital transformations must take place. We are proud at Geosystems to support our customers in taking the leap and discovering the potential of connections.

Enjoy your read.

A handwritten signature in blue ink, appearing to read 'J. Dold', written in a cursive style.

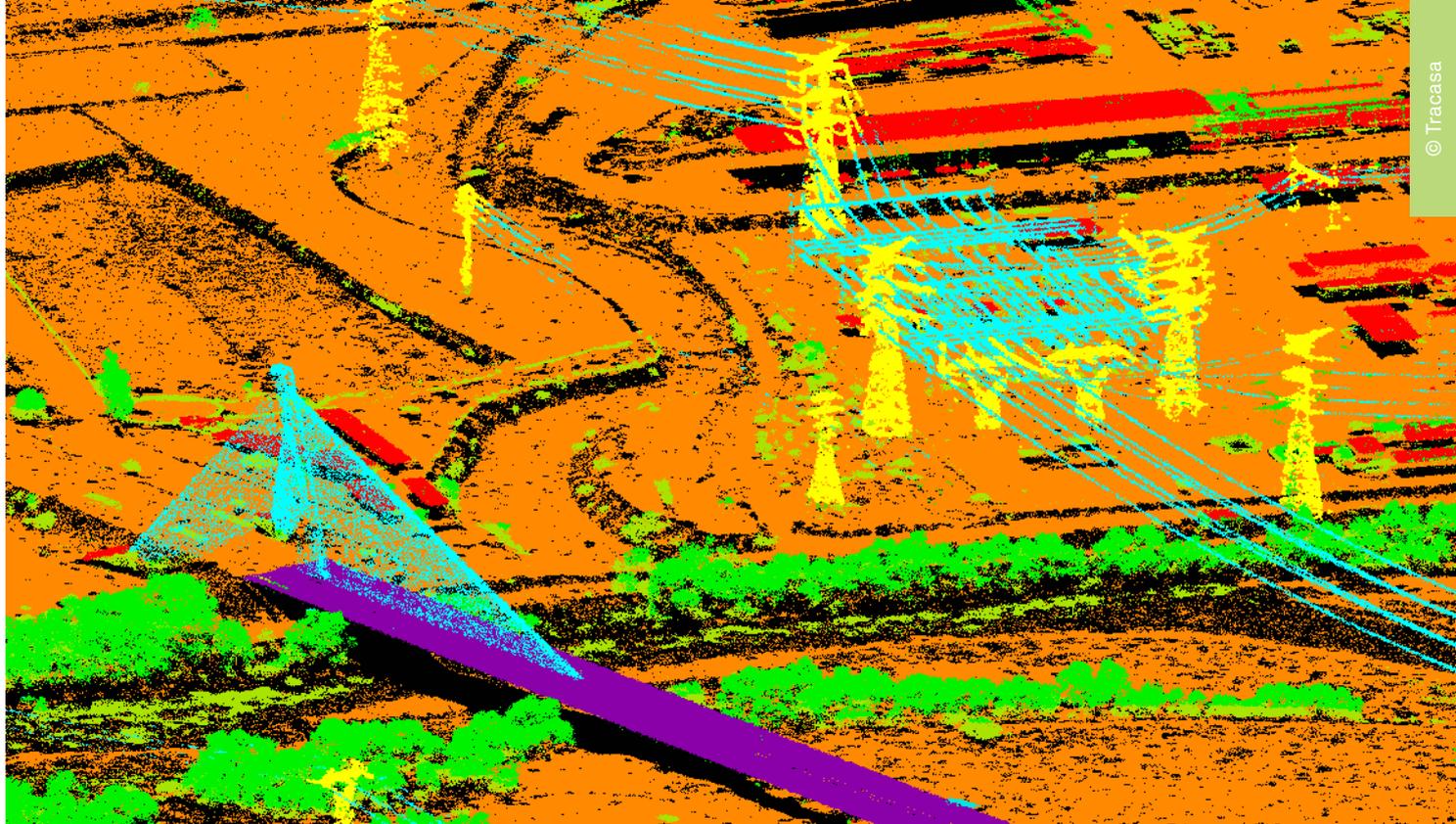
Juergen Dold

President, Hexagon Geosystems

PIONEERING SINGLE PHOTON LIDAR IN EUROPE

Renata Barradas Gutiérrez  Case Study

**LiDAR data capture with SLP100 sensor in the Region of
Navarre, Spain**



The first maps were painted in parchment and were very limited in accuracy, quality and distribution. Technological changes have revolutionised cartography drastically, changing the way we capture, communicate and distribute spatial information. Today, detailed maps with geographic information can be viewed from any device with a browser.

If you are visiting Pamplona, capital of Navarre province in northern Spain, famous worldwide for the running of the bulls, and you are planning an excursion, maps with all the topographic information of this multifaceted region are accessible through the comfort of your mobile phone.

Navarre's Department of Economic Development has opened its doors to give access, in a single interface, to multiple base maps, including cadastre, hydrography, culture, infrastructure, cartography orthophotos and more. Beyond the level of detail and information available, these maps are the first information capture in Europe taken with single-photon LiDAR.

QUANTUM LEAPS

Navarre has historically been a pioneer region introducing new technologies to obtain cutting-edge geographic information. In 1929, a pilot flew the region of Navarre to photograph and produce a cadastre of the region. In 1967, Navarre's government prepared the first cartographic plan, which required the construction of a remarkable geodesic infrastructure, leading in its time.

Navarre's surface was captured with LiDAR 44 years later. Between 2011 and 2012, Tracasa, a firm developing major projects in cadastre, cartography and territorial information systems in the Spanish market, covered Navarre's territory with high point density LiDAR. Using the Leica ALS60 airborne sensors, Tracasa captured 1.2 points per square metre of this heterogeneous region from the sky.

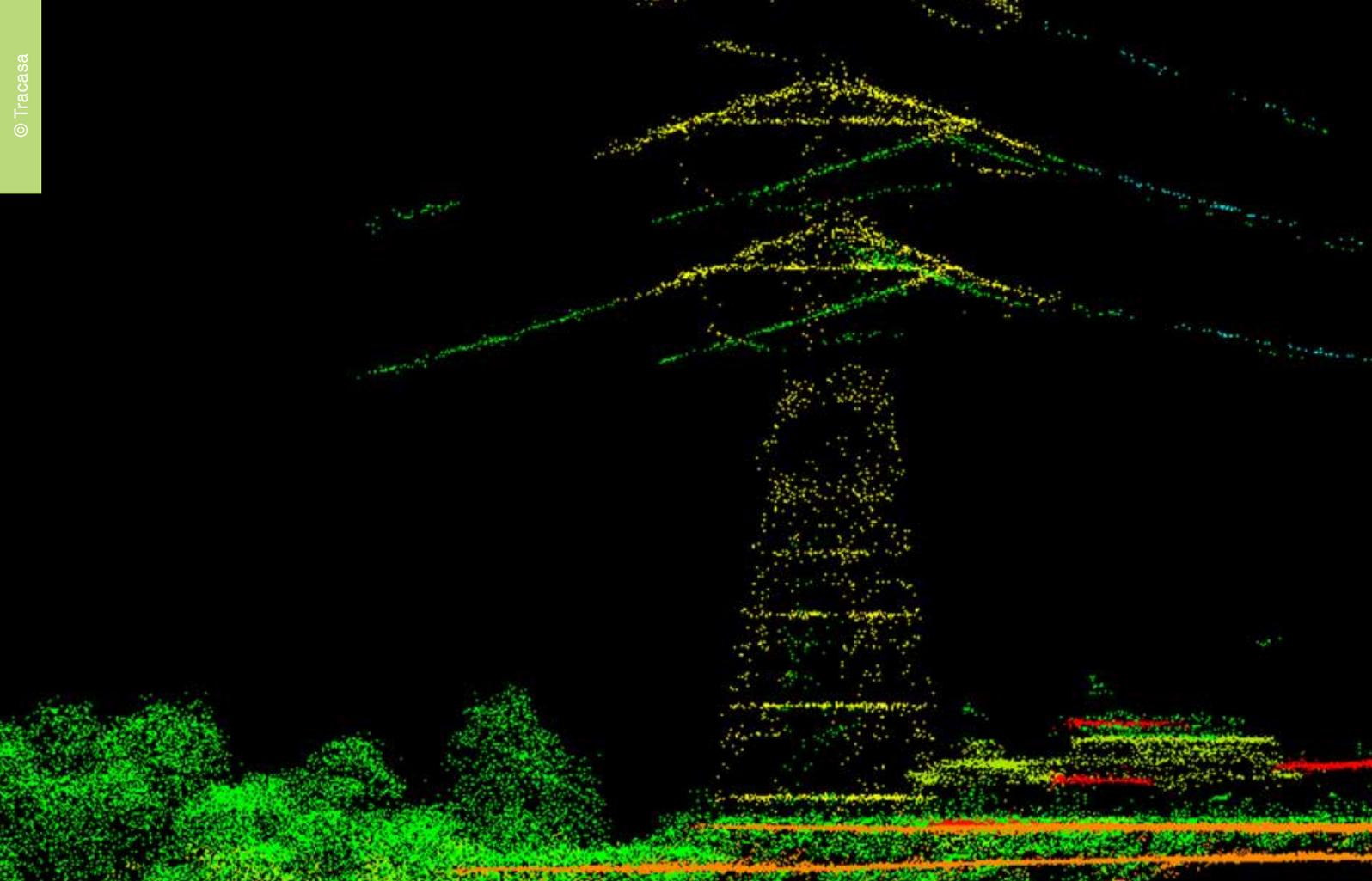
In 2017, the management of cartography in Navarre decided to update the LiDAR data of the region, increasing the point density of the previous LiDAR flight by 10 – the technology provided by the Leica SPL100 LiDAR sensor made a quantum leap, increasing the density of the previous LiDAR flight to 14 points per m².

CHOOSING THE RIGHT TECHNOLOGY TO TRY SOMETHING COMPLETELY NEW IN EUROPE

With no other companies in Europe having experience with this sensor, *how to decide the first commercially available single-photon LiDAR airborne sensor was the right technology?*

Tracasa, following the assignment of the government of Navarre and in collaboration with the Spanish National Geographic Institute (IGN), set up a demanding tender that included a very high point density of 10 points per square metre – very few sensors could comply with these high specifications with the efficiency needed for such a vast area.

Geared with a SPL100 LiDAR sensor and the medium format Leica RCD30 camera in a B200 aircraft, Tracasa entrusted the flight and capture



of information to Grup-Air-Med and COWI. With 100 output beams and a total of 6 million measurements per second provided by the SPL100, the team mapped the entire vast area in just a couple of months.

“The novelty of this coverage is the increase in point cloud density that will allow us to obtain a wide range of applications. We obtained an average point density of 14 points per metre squared with an accuracy better than 20 centimetres in planimetry and 15 centimetres in altimetry. The joint capture of RGBN images with a medium-format photogrammetric camera made also possible to obtain simultaneous images of the LiDAR data used to colourise the point cloud.

“We are happy with the data – we have the point density, zone specification and accuracy we desired. In 2011 we had 1 point per metre squared and now we have 14 points per metre squared,” said Víctor García Morales, project manager at Tracasa.

AIN'T NO MOUNTAIN HIGH ENOUGH

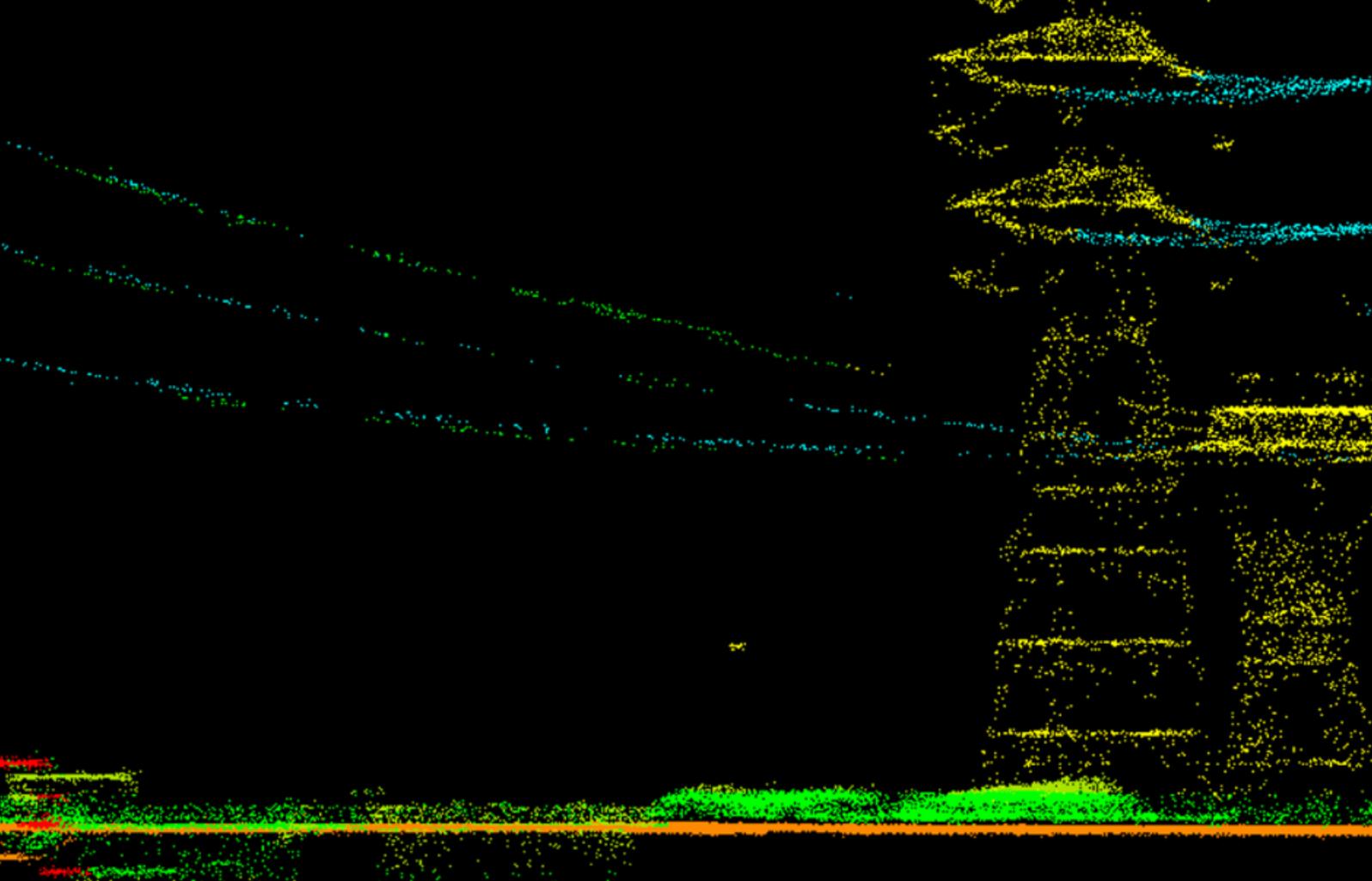
Bordering with France, between the Pyrenees and the Ebro River, the region of Navarre covers

a surface of 10,391 square kilometres. Despite its relatively small size, Navarre is quite a diverse region dominated by the Pyrenean mountain range, with altitudes above 2,400 m, contrasting with the flat alluvial plains of the Ebro valley.

“Navarre is the perfect area to pilot any airborne sensor. If this sensor ran here, in this heterogenous area were vegetation, flight planning and execution can be very challenging, it can run everywhere,” said Moisés Zalba Almándoiz, director at Tracasa.

Before flying, many aspects needed to be considered. The flight plan to cover Navarre initially offered 200 flight lines. The SPL100 created high-density point clouds penetrating Navarre's vegetation, ground fog and thin clouds while the 80 MP camera captured RGBN colour information.

“It took us approximately 270 hours to fly with the previous technology; with the SPL100, time was reduced to 170 hours and point clouds are 14 times denser. With enhanced planning this can even be further reduced,” said García Morales.



When decision making affects wide areas, requires detailed and consistent data, and demands frequent updates at manageable costs, companies should be driven by cost per data point. Single-photon LiDAR systems capture 1 million measurements per second with 2 km swath width. The SPL100 is ideal to acquire large areas, lowering the cost per acquired data point.

MULTIPLE APPLICATIONS, MULTIPLE BUSINESS

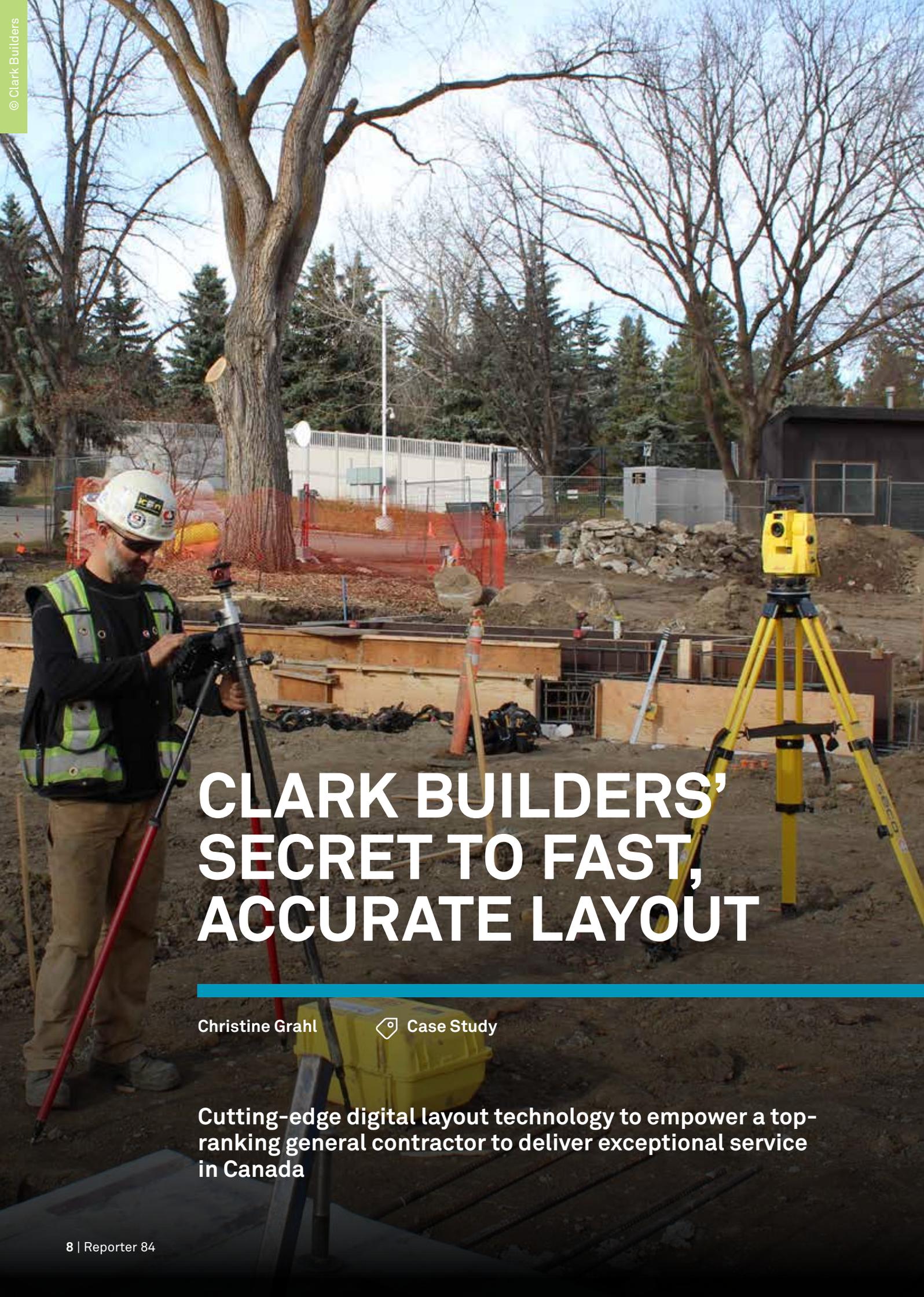
This project, framed within IGN's National Orthophotography Area Plan (PNOA), aims to update LiDAR information with high density throughout Spain every six years. Enabling cartographic data at everyone's fingertips is an arduous process where LiDAR data collection is one piece of the puzzle. A workflow would not be completed without data processing and visualisation.

The SPL100 LiDAR data of Navarre was postprocessed with HxMap, while Leica MissionPro flight planning software enabled a 3D virtual globe planning environment and traditional 2D map planning view. HxMap was the main post-processing platform used in this project to generate all LiDAR data products within one single interface. Combining single-photon LiDAR and HxMap into one workflow

allowed experts to generate airborne data for varied applications including:

- Produce a digital terrain model and a digital surface model
- Update cartography
- Prepare a forest management plan
- Mapping flood zones and other hydrological applications
- Support emergency management plans
- Map powerlines
- Deliver information to the public.

"Aware of the potential LiDAR data has to generate multiple applications, the government has a policy of open data. Companies and universities are downloading the point cloud data to understand fully our environment and generate business," concluded Zalba Almándoiz.



CLARK BUILDERS' SECRET TO FAST, ACCURATE LAYOUT

Christine Grahl

 Case Study

Cutting-edge digital layout technology to empower a top-ranking general contractor to deliver exceptional service in Canada



Cutting-edge digital layout technology combined with a forward-thinking approach empowers a top-ranking general contractor to deliver exceptional service.

Ninety to 100 points an hour – that’s how fast Jeff Gerber and the surveyors of Clark Builders typically move when they’re on a project doing layout. The top-ranking general contractor, based in Edmonton, Canada, delivers buildings and structures in the industrial, commercial, and institutional sectors, and concrete layout work is a key area of focus.

Within the last year, the team has streamlined their layout time by 25 to 30 per cent after adopting the latest generation of Leica iCON robotic total stations, GNSS and software. *“We’re all rock stars in our old way of doing layout, but the iCON is so much more efficient, so much more intuitive,”* Gerber said.

Gerber, the company’s head surveyor, said Clark Builders first adopted robotic layout seven years ago using another brand of technology. Although the first set of robots increased their speed compared to manual methods, the technology was complex and required pressing multiple buttons in the right combination to accomplish a simple point layout. Transferring data from the field to the office required importing and exporting between a third-party software. Training involved weeks of trial and error, and field surveyors needed a high level of experience and expertise to do the job right.

As building projects became increasingly elaborate, with more angles, curves and slopes, Gerber kept pushing the envelope, trying to find a better way to get the job done. One day, while he was working on a three-level parkade, Courtney Gehring from Mountainview Systems stopped by to show him the Leica iCON robot 60. *“I was blown away by the iCON’s ability to do surfaces easily, as well as its ability to do point and line layouts,”* Gerber said. *“This was the technology we had been waiting for.”*

SPEED AND ACCURACY PROVIDE BIG EFFICIENCY GAINS

In a matter of days, Gerber mastered the iCON workflow. Impressed with the simplicity, he spent the next several months building a business case for his firm to invest in the technology. As he finished up the three-level parkade, he used the iCON on half of the structure and his previous robot on the other half, carefully tracking the amount of time required to lay out columns and slab beds, set the tables and pour the concrete. *“It was a complicated project, with the tables and concrete sloped in all directions. The efficiency gains with the iCON were significant,”* Gerber said.

On another project, Gerber had to lay out Heating, Ventilation, and Air Conditioning (HVAC) core hole locations through a concrete slab under every seat in a theatre. With his previous robot, Gerber was able to lay out a maximum of 50 or 60 points per hour in this type of application. *“With the iCON robot, I was easily getting 80 points an hour plus*



at high accuracy, and that was in the first two months with the technology,” he said.

The documented improvements made it easy for the Clark Builders’ management team to justify a complete fleet upgrade. In August 2017, the company purchased six iCON robot 60 robotic total stations, an iCON gps 60 GNSS smart antenna, and the iCON build software. After a two-hour training session, the team was confident and ready to use the technology on the job. “It was instant, let’s go,” said Gerber. “There was no hesitation; everybody was all in.”

EASE OF USE GENERATES A FAST ROI

Ease of use was a key selling point for Clark Builders. Gerber compares the iCON solution to the latest generation of consumer smartphone technology. “Moving from our previous robots to the iCON was like going from a flip phone to an iPhone,” he said. “They both do the same operation, but with the iCON it’s so much easier to do the same tasks and more. We just tap once and we’re going. Same thing with lines—just tap on the line, and we’re doing it. It’s very simple yet very powerful.”

Moving the data between the field and office is also much easier. The team saves AutoCAD

or Revit files as a DXF, with no additional imports or exports required. Points are overlaid perfectly on the drawings, which provides valuable information in the field. “The software automatically creates points at the ends of lines and centres the circles,” said Gerber. “We just save it as a DXF and go.”

Transferring field data to the office is also easy, Gerber said. The team simply exports a CSV or DXF file from the tablet and loads it into AutoCAD or Revit as required.

Because of the faster and easier workflow, Gerber estimates the company now spends 25 to 30 percent less time on every project, which directly impacts the bottom line. “Our survey costs are lower because we’re not onsite as long, and the risk of rework is practically eliminated because of our high accuracy,” he said. “Plus, our ability to provide the layout in a timely and accurate way enables the trades to do their work and stay on schedule. We all win.”

ENHANCED CAPABILITIES CREATE NEW OPPORTUNITIES

As Gerber and the other surveyors at Clark Builders have continued to push the limits of the iCON solution, they have discovered other



advantages. For example, the ease of laying out surfaces and slope lines has enabled the team to pursue increasingly complex projects. *“It’s so much easier to do advanced work with angles and curves,”* Gerber said. *“It’s given us a huge boost of confidence.”*

Gerber also sees the potential to gain even greater efficiencies by using the iCON build software with IFC files—the software’s Object Layout App loads IFC data straight from Mechanical, Electrical, and Plumbing (MEP)/Building Information Modelling (BIM) design software so users can select objects graphically.

With the increasing digitalisation of the building construction industry, companies that are fast, accurate and innovative will emerge as the leaders in delivering the projects of the future. Clark Builders’ forward-thinking approach through its investment in intelligent digital layout positions the firm ahead of the curve.

“Technology isn’t going away, and it’s incredibly powerful when it’s used properly,” said Gerber. *“Our approach is to embrace the technology and learn from it, and don’t look back.”*



© Clark Builders

TAKING EVENTS TO THE NEXT LEVEL WITH THE BLK360

Tamara Stakic  Case Study

Using reality capture and the BLK360 to create vivid and captivating 3D projections in Australia



The Bakery Design Co. specialises in providing design solutions to the events and entertainment industry. The projects that the company undertakes are often concerts and unique events with a strong focus on visual experience and production design. This encompasses anything from lighting, video and set design.

Adopting digitisation, more specifically reality capture, has enabled The Bakery Design Co. to expand its business portfolio by delivering 3D models and CAD drawings faster and with more detail compared to traditional methods.

THE IMPERATIVE OF ACCURACY

Recently Jayden Sutherland, founder of The Bakery Design Co. invested in the Leica BLK360 imaging laser scanner, opening new opportunities for his company. Using the 3D imaging scanner, The Bakery Design Co. discovered a fast and uncomplicated way to capture measurements and as-built information. With the BLK360, Jayden has optimised his approach to projects with an efficient workflow to make 2D floorplans, cross sections and 3D models. *“The BLK360 solves the challenge of being able to capture the right information for each project,”* Jayden said.

The Bakery Design Co. relies on the portability, simplicity and sophistication of the BLK360 to map an indoor or outdoor environment at which an event is going to be held. Detail and accuracy is imperative to their work. *“A lot of our work is done in venues that don’t have accurate 2D plans and, in most cases, no 3D plans at all. Our projects are usually very detailed and specific, typically requiring me to work in a 3D environment when designing – having an accurate virtual space to design in is imperative to me,”* explains Jayden.

EXTRA DIMENSIONS: PROJECTING ONTO 3D SURFACES

The BLK360 is also used by The Bakery Design Co. for the projection of mapping projects. Projection mapping, like video mapping and spatial augmented reality, involves mapping video projectors onto 3D surfaces rather than flat 2D screens to create a visual display. Projection technology is used to turn objects, often irregularly shaped, into a display surface for video projection.

These objects may be complex industrial landscapes, such as buildings, small indoor objects or theatrical stages. A 2D or 3D dimensional object is spatially mapped on a virtual program to mimic the real environment it is to be projected on.

For Jayden, a significant part of the work flow is having accurate models of the surface to be projected onto. This is important for artists creating video content and for technicians aligning projectors. It enables content creators to understand the environment and provides media playback systems a virtual environment to correctly map the video surface.

SELF-SUFFICIENCY WITH THE HELP OF TECHNOLOGY

In the past, The Bakery Design Co. has relied on outsourcing and contracting specialist companies to provide the point clouds, to later turn them into simplified 3D models. *“Since the BLK360 was announced my eye was on it,”* said Jayden. *“It’s made this type of work more accessible in our industry and, as a result, I’m now able to provide a full-service solution and in turn increase my service capabilities.”*

Jayden contacted C.R. Kennedy, the exclusive Leica Geosystems distributor in Australia to learn more about the BLK360 and how his business could benefit by adopting reality capture solutions. C.R. Kennedy’s technical consultant, Matt Rumbelow, supported Jayden with application demonstrations at the Adelaide Casino to conduct scans in lead up to the Chinese New Year, a project that The Bakery Design Co. was working on. It didn’t take long for Jayden to realise the true potential of the BLK360 and its impact to growing his business becoming more self-sufficient.

The real-world application demonstration helped realise the full potential of the BLK360 and how The Bakery Design Co. could integrate reality capture to grow their business, offering and delivering projects more efficiently. The Bakery Design Co. has used the BLK360 for over a year and is one of the earlier adopters of the smallest imaging laser scanner.

THE
YOU

**YOUR REALITY.
YOUR WAY.**

Monica Miller Rodgers

 Event

Hexagon's Geosystems Division President Juergen Dold presented Your Reality. Your Way. at HxGN LIVE in Las Vegas, USA

CHANGING SHAPE

Hexagon's Geosystems Division President Juergen Dold presented Your Reality. Your Way. at Hexagon's premier cross-industry technology conference 13 June at the Venetian Ballroom in Las Vegas, Nevada, USA.

Focusing on the Reality Economy, Dold led his keynote address with a "digital first" approach. Dissecting the pervasive and rapid shift in the world's digital landscape, Dold shared use cases from around the world on how technology is disrupting industry dynamics, economic fundamentals, and what it means to compete. He explained how to sustain a competitive advantage, to meet greatest potential, and why professionals need a data-driven approach that is unique to each individual. A smart digital reality, Dold said, is imperative to success, requiring one that is relevant, accessible, and in whatever format needed by the specific user.

YOUR REALITY CHECK

"Your reality check is about the change you shape," Dold stated at the beginning of his keynote. He elaborated on how we all need reality checks from those closest to us to keep us on track.

If we don't surround ourselves with those of differing opinions, we miss seeing the whole picture. To create more efficient and better realities, Dold encouraged the audience to embrace the possibilities of reality checks, regardless of how challenging they may be to take.

WHAT IS THE REALITY ECONOMY?

An economy is defined as a network of producers, distributors and consumers of products and services in local and global communities. If the products and services are smart digital realities, then you have the Reality Economy.

"Connecting the digital reality with intelligence; connecting the digital reality with everyone and everything – that creates smart digital realities," said Dold. "And, there is a big shift in our industry ... that ultimately leads to autonomous operations and fosters the adoption of autonomous mobility ..."

Smart digital realities, the currency of the Reality Economy, ultimately enable digital transformation, which is what happens when technologies change the conditions under which business is done. According to Dold,



there are three ways for organisations to handle digital transformation:

1. Drive it
2. Participate in it
3. Ignore it

He cautioned that businesses who take option three do so at their own peril as they will be left behind. Companies that take options one and two must then operate by one certain rule – Your reality. Your way.

THE RULES OF THE REALITY ECONOMY

Whether you're an operator who needs to understand your plant, a surveyor who is measuring a bridge, or a police officer working on a crime scene, you need a smart digital reality that is unique to you.

Your smart digital reality should always have three attributes:

1. **Digital first** where the physical world is fused with the digital world.
2. **Innately intelligent** to be empowered by intelligence everywhere, including the edge.

3. **Infinitely connected** to everyone and everything to drive autonomous operations.

Throughout the rest of his keynote, Dold provided examples of how Hexagon is driving each attribute and how customers around the globe are adopting the technology in each step.

DIGITAL FIRST

With highly sophisticated airborne solutions, such as the Leica SPL100 single photon LiDAR and Leica CityMapper hybrid sensors, entire countries, states and cities are being more easily and accurately mapped. From capturing the dense rain forests of Hawaii to creating city models of major urban areas, the digital data from this exclusive technology is being made available to all. Deploying a fleet of sensors through content partners, this processed information is readily accessible in the HxGN Content Program.

"Our ultimate goal is to democratise the 3D city data through an ecosystem where multiple industry partners are working together to make this an affordable product for every city in the U.S. and going from there abroad," said Dold.



With mobile mapping and ground penetrating radar solutions, such as the Leica Geosystems Pegasus line, cities and their assets above and below ground can now be analysed in a 360-degree view. By digitising these assets, urban planners, city managers and other public officials can work in a connected ecosystem to provide improved maintenance and other more efficient city operations.

An explosion of curiosity has taken place around democratised laser scanning technology found with the Leica BLK360 imaging laser scanner. From the real estate industry providing augmented reality property tours to researchers better understanding the dimensions of caves, this curiosity has given way to demand. Digital first here has become digital everywhere. Consider small businesses, such as a rock wall climbing facility, that use the technology to provide better experiences for customers to larger firms, like a yacht manufacturer, that have incorporated the technology into workflows for more efficiency.

“With a digital first approach, everything is being digitised with highly sophisticated solutions and democratising solutions that bring 3D to everyone to create demand,” said Dold.

INNATELY INTELLIGENT

Intelligent solutions enhance ecosystems and improve how work is completed. Brought forth with edge computing, intelligence is now real-time processing at the point where data is being captured.

“We are rethinking better ways to work by making our solutions think, process and connect much earlier at the edge,” explained Dold.

In safety, Dold used the example of landslides. Around 5,400 people each year are killed in rock falls and landslides. Using interferometric radar solutions by IDS GeoRadar, the first signs of a rock fall or landslide are instantly monitored and reported. This early warning alerts the proper authorities to clear areas quickly and can potentially save lives.

As Dold first walked onto the stage, he wore a backpack. Raising the curiosity of the audience, he now went over to retrieve the backpack and reveal its contents. The first item he withdrew was the new Leica BLK3D handheld imager. As he continued to demonstrate the new technology, he explained how the BLK3D

takes users beyond the visible by allowing 3D measurements directly on a 2D image.

“With the BLK3D, we have again created a new category of 3D reality capture to democratise digital reality for everyone, and again I say if everyone works digital, nothing would be done without digital processes,” said Dold. *“It’s another approach to your reality, your way.”*

Retrieving the second item, Dold revealed the Leica RTC360 3D laser scanner and Cyclone Field 360 mobile app. He explained the power of scanning through many features of the fast laser scanner, such as 2 million points per second and less than two minutes for full-dome scanning.

“The RTC360 is innately intelligent because it is a ‘seeing machine,’” said Dold. *“This is built-in visual inertial technology at the edge in the sensor. The cumbersome, time-consuming and sometimes prohibitive post processing is gone. It’s nearly invisible. It’s automatic.”*

INFINITELY CONNECTED

When all the data from different sources connect, they become an ecosystem for the basis of smart digital realities. The information contained within becomes applicable, accessible and interoperable.

Users can share the intelligence and analysis throughout their local ecosystems or with external parties.

With Geosystems’ sophisticated software, such as Leica Infinity surveying software that provides the bridge from the field to the office, these various data sources are now brought into a single and simple interface. Bringing together total station, GNSS and, for the first time, Unmanned Aerial Vehicle (UAV) data, users receive their own unique and accurate digital reality to operate within and successfully complete their projects.

Introducing the acquisition of AGTEK, a leading software solutions provider to the civil construction industry, to the audience, Dold shared the example of the connected ecosystem created on a construction site. Applying analytics to a reality capture map of a construction project, a machine operator can automatically see where to further cut or add dirt for smooth roads and rides.

Finally, Dold shared the modelling of USA cities Denver and San Francisco to demonstrate the sharing of information in a connected ecosystem. From insurance assessments to flood risk analysis, the digitising of city assets enables city planners and other authorities to make better informed



decisions with information supplied by more in-depth understanding of the cities' makeup.

With the acquisition of Luciad, a leading provider of 5D visualisation and analysis solutions, the city modelling is moving from 3D to 5D. Seeing all the data into one platform, a photo-realistic city model, switching from airborne-sensor-collected point clouds to mobile-mapping-captured imagery or laser-scanner-gathered terrestrial point clouds, provides 3D information for the clearest and most detailed information.

"We invent technologies to create digital realities with the highest efficiencies," said Dold. "We invest in connected ecosystems ... to bring all 3D together for limitless possibilities to use the data. These ecosystems will be developed over the coming years, so all disciplines will be using these city models."

CHANGING HOW BUSINESS IS DONE

To wrap up his keynote, Dold shared his vision for not just creating smart digital realities but moving ahead to sharing them.

"The technology is there. Now we need to evangelise and bring this information to the end user," explained Dold. "We are on the path to create

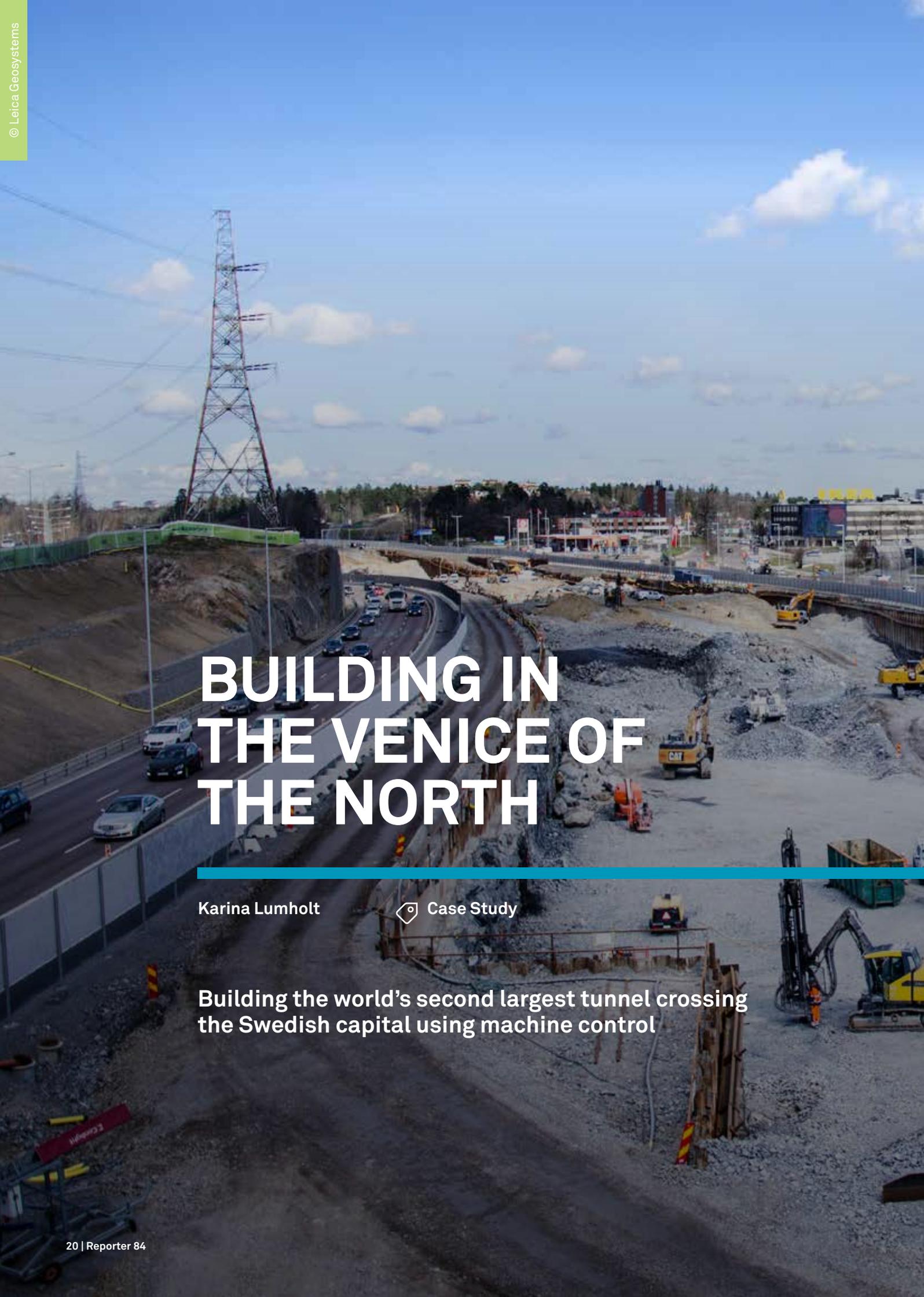
solutions to fuse and share this mass data to a single solution ... Being part of this Reality Economy is more than just creating a digital replica of a physical world; it is connecting everything with everyone, and, the openness for a sharing economy for autonomous connected ecosystems."

Dold encouraged the audience to be the "rule setters" for the Reality Economy, continuing to use the technology and providing valuable reality checks back to Hexagon. Though he admitted the feedback could be challenging, he empathised the excitement to be leading technology in this era. He left the crowd with three actions:

- 1. Demand** and embrace your reality, your way.
- 2. Expand** the Reality Economy and support, not fear, the democratisation of technology.
- 3. Imagine** the next experience and focus on how technology can be better.

"We need to constantly be pushing ourselves to move further. Demand for reality is growing exponentially, and there is great opportunity here," said Dold. "Together, we are shaping the future."





BUILDING IN THE VENICE OF THE NORTH

Karina Lumholt

 Case Study

Building the world's second largest tunnel crossing the Swedish capital using machine control



Facing the Baltic Sea to the East, the Swedish capital of Stockholm is built on 14 islands in Lake Mälaren. Gamla Stan in the old town of the city centre is one of the best preserved medieval cities in Europe. The many waterways and bridges over the canals are characteristic features of Stockholm – often referred to as *Beauty on Water* or simply *Venice of the North*.

The region is facing major challenges and the need for improved infrastructure is becoming more and more urgent. With approximately 30,000 people moving to the capital every year, equivalent to two buses full of people per day, Stockholm is currently one of the fastest growing metropolitan regions in Europe. The transport system in the capital is vulnerable because there is only one north-south connection running through this city of great cultural and natural heritage.

GOING UNDERGROUND TO BYPASS STOCKHOLM'S TRAFFIC BOTTLENECKS

The Stockholm Bypass project, or Förfärdarten, is a new 21-kilometre highway crossing the Swedish capital, part of the largest infrastructure projects ever made in Sweden. The planning of this 2.7-billion-Euro project commenced in 2006, preliminary construction started in 2014 and the opening is planned for 2026.

Great precautions have been taken to protect the landscape and surroundings that lie above the ground surface. To protect Stockholm's valuable nature and historic sites, it has been decided to build approximately 18 km of the total 21 km through tunnels. Under lake Mälaren the construction will have a depth of 65 metres below the water body. 80 per cent will be financed by a congestion charge and 20 per cent by government



funding, but the overall utility value is calculated to be paid back from the resulting economic development and reduced travelling time. With an estimated passing of 145,000 vehicles per day, the journey time through the city is calculated to be reduced to 15 minutes.

Starting at Kungens Kurva in the south and ending at Häggvik in the north, once the Stockholm Bypass project is finished, it will be the world's second largest tunnel built in an urban area after the Yamate Tunnel in Tokyo.

BUILDING AT KUNGENS KURVA

Long-term customer of Leica Geosystems, Skanska Sverige AB, has won the 12.6-million-Euro contract for building the south entrance to the tunnel, connecting it to the E20 motorway at Kungens Kurva, the largest shopping area in Scandinavia and the busiest highway in Sweden. This high-profile project has a strong focus on security and is obliged to not slow down the traffic more than necessary.

Pontus Holmberg works as chief surveyor for Skanska Sverige at Kungens Kurva. Holmberg is managing field surveyors and the site fleet that mainly consists of drillers, excavators and

dozers from different contractors, many of them equipped with machine control solutions from Leica Geosystems. Holmberg works with Leica ConX to transfer model files to the machines and the field crew working on site.

“When working with different contractors on a site like this, it is important that all are working with the latest updated files,” Holmberg explains. *“Leica ConX helps me to track the machines from the office and transfer files to the machine in real time so everybody is on the same page.”*

The Epiroc SmartRoc T35 driller working on the site is equipped with a 3D machine control solution that is tailor-made for Epiroc SmartRoc by Leica Geosystems and interfaces with Epiroc's HNS sensor system.

The drill rig follows a digitally-defined pattern to drill holes into the rock for blasting. Traffic is stopped on the two highways that go around the job site, and blasting of the rocky underground is performed every day at either 10 A.M. or 2 P.M. The blasting is done under a carpet of old truck tires that are sewn together to avoid rocks falling onto the two roads.



“Two wheel loaders are standing ready at each side to clear the roads if rocks unintentionally fall on the highways making sure that the roads are blocked for a period of time as short as possible,” explains Dana Matti, project manager at Skanska Sverige.

STAYING CONNECTED

Nicklas Gustafsson, owner of the company Granskogens Gräv, is one of the contractors working on site for one and a half years. Gustafsson uses the new Leica MCP80 machine control panel on site and he is content with the improvement. “The larger screen is easier to read, and the buttons are improved, so that is a great advantage,” says Gustafsson.

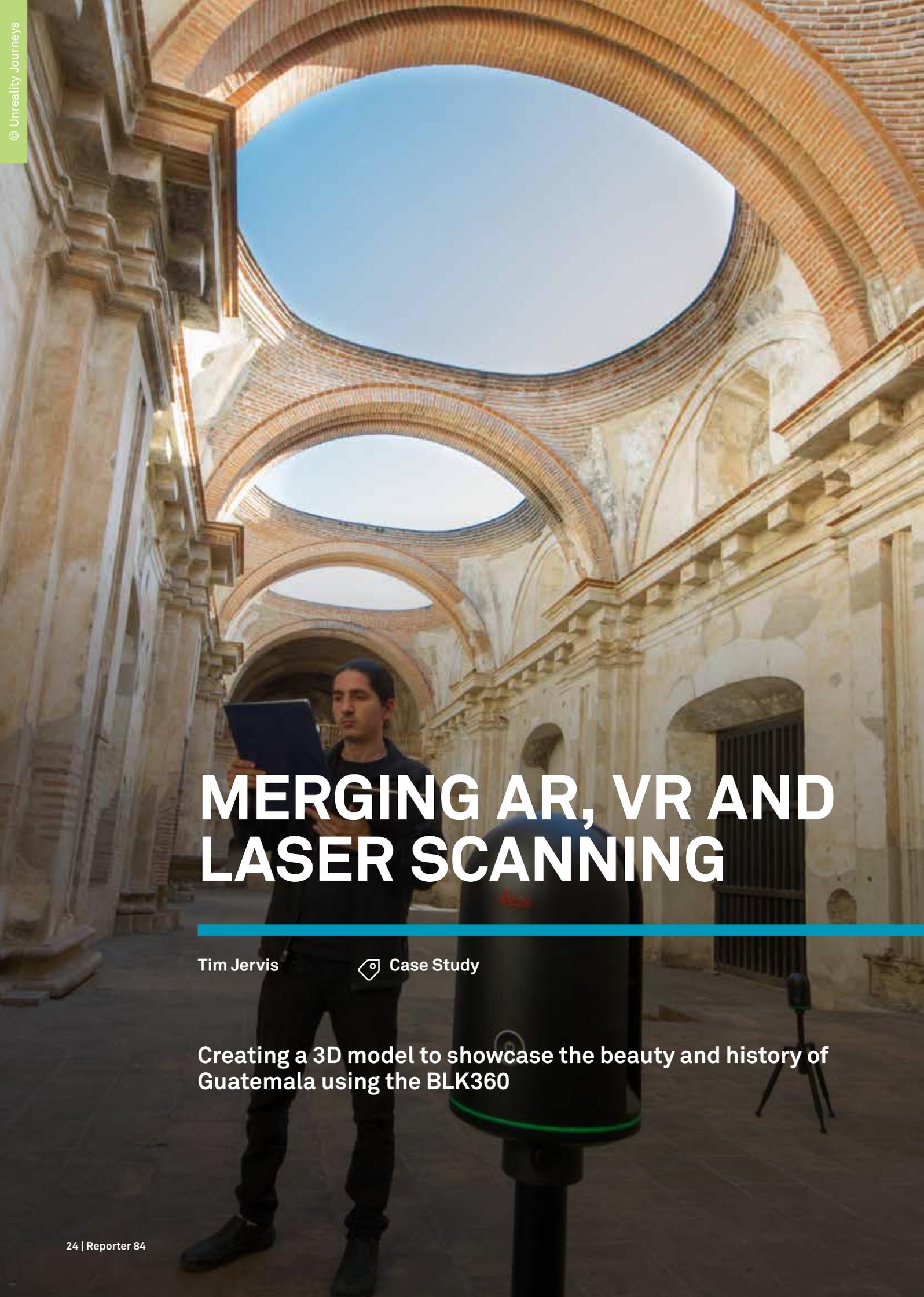
Gustafsson explains that it has been a difficult underground with rocks and high ground water level, and when building in the one of the busiest urban areas in Sweden it is important to have reliable technical solutions that minimise downtime.

“Solutions from Leica Geosystems help us staying connected with the site office and make sure that we have a flexible dataflow to support the workflows on the job site. I have worked with the machine control solution from Leica Geosystems on my Liebherr 926 Compact excavator for four years,” Gustafsson explains. “I am

online on ConX for most of the day and receive my reference files from Pontus directly on the panel.”

Solutions from Leica Geosystems are key in the multiple stages of constructing interchanges, tunnels and temporary harbours for this big project. Machine control solutions, total stations, prisms and scanners from Leica Geosystems are some of the many products that are needed for a fast and efficient construction of projects at this scale.





MERGING AR, VR AND LASER SCANNING

Tim Jervis

 Case Study

Creating a 3D model to showcase the beauty and history of Guatemala using the BLK360



A collective of augmented reality (AR), virtual reality (VR) and mixed reality (MR) visionaries, programmers and render artists are on a mission to create a digital replicate world to showcase the beauty and history of Central America, starting with the entire country of Guatemala.

The Unreality Journeys team and G2 Foundation are pushing the boundaries of High Definition Surveying (HDS), AR and VR technology in a not-for-profit cultural heritage project.

In this ground-breaking cultural project, Unreality Journeys captures ancient structures created by indigenous communities and their impact in modern society.

Using VR and AR technologies in conjunction with 3D laser scanning and volumetric video, Unreality Journeys is on a mission to create an interactive digital environment that would allow users to walk, drive and fly around these mystic places. New Zealand-based innovators and project partners, G2 Foundation have donated several Leica BLK360 imaging scanners to Unreality Journeys to enable this project.

To create high-quality 3D scans of the project base, including the UNESCO World Heritage Site of Antigua, Mayan ruins, 400-year-old churches and local indigenous villages, the team is relying on the BLK360 imaging scanner. The team is using the 3D scans to mesh the complex architecture and then texture with imagery. The textured meshes serve as the base for the VR platforms – meshed and textured elements could also be used in both AR and MR settings in the future.

PUSHING THE BOUNDARIES OF DIGITAL CITIES

Unreality Journeys has a vision – to use the Antigua, Guatemala project as a prototype for the world’s first fully-documented and scanned city, where every attraction and business can be explored in VR, AR and MR.

Unreality Journeys is pushing the boundaries of what a digital city and country can accomplish by using state-

of-the-art wireless internet service providers (WISP) technology to create decentralised networks for local communities to share data with each other in a secure and private way.

“Our team’s main goal is to create digital country-history books in the highest quality possible and make them accessible to as many people as possible for free. We’re starting in Guatemala, then the rest of Central America and eventually more,” said Remy Malex, director of Unreality Journeys. *“We will focus on developing countries with a rich history that demands to be preserved but may not have the resources to do so, especially at a high level.”*

SPEEDING THINGS UP WITH THE BLK360

The BLK360 workflow has enabled the project team to quickly and efficiently collect and process in REGISTER360 and ReCap copious amounts of quality data. *“The BLK360 was a dream come true and we decided to get a few units and take this project full force. “Prior to obtaining the BLK360, the workflow was based around photogrammetry. This workflow involved taking thousands of photographs to be able to create a point cloud, then turned into a mesh, refined and then textured. The BLK360 dramatically improves this workflow as the project team can remove a large step in creating the point cloud with the added advantage of generating a more accurate and detailed mesh. Because the initial data is better, the mesh quality is also improved. The BLK360 has greatly improved efficiency on site and generated a better product,”* said Malex.

With data captured from the world’s-smallest imaging laser scanner, the finished project will allow users to digitally experience the whole country. Online visitors will be able to virtually walk the black sand beaches of Guatemala’s south coast, explore the jungles of Petén, drive a riverboat down the mystical Río Dulce, fly to the Garifuna villages on the Caribbean coast, stroll the local artisan markets and discover the secrets of the Mayan pyramids.

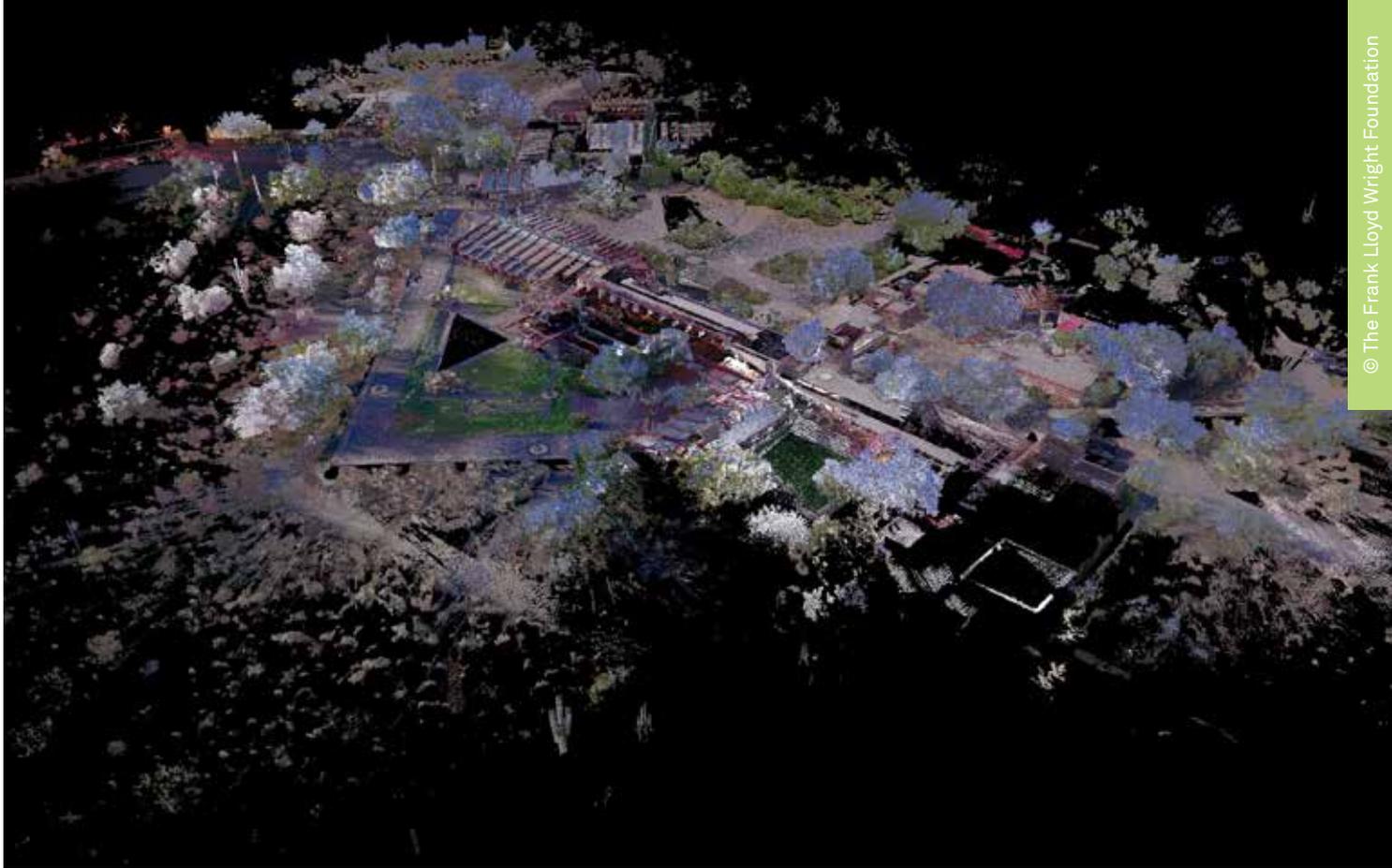


DIGITALISING FRANK LLOYD WRIGHT'S DESERT LABORATORY

Fred Prozzillo

 Case Study

3D digital scanning to amplify the legacy and understanding of Frank Lloyd Wright's Taliesin West in the USA



Frank Lloyd Wright's Taliesin West was always a place of innovation and exploration, where the architect returned every fall to test the limits of architecture, design, and building. To continue this legacy, the Frank Lloyd Wright Foundation partnered with Leica Geosystems and Multivista to make Taliesin West a universal and accessible experience, as well as give a new depth of understanding into this unique and ever-evolving site.

Using the Leica BLK360 and the Matterport Pro2 3D Camera, Multivista conducted a series of 3D digital imaging laser scans of Wright's winter camp, generating a highly-accurate, fully-detailed, 3D point cloud of the property, along with a high-definition virtual reality model.

PRESERVING MASTERWORKS

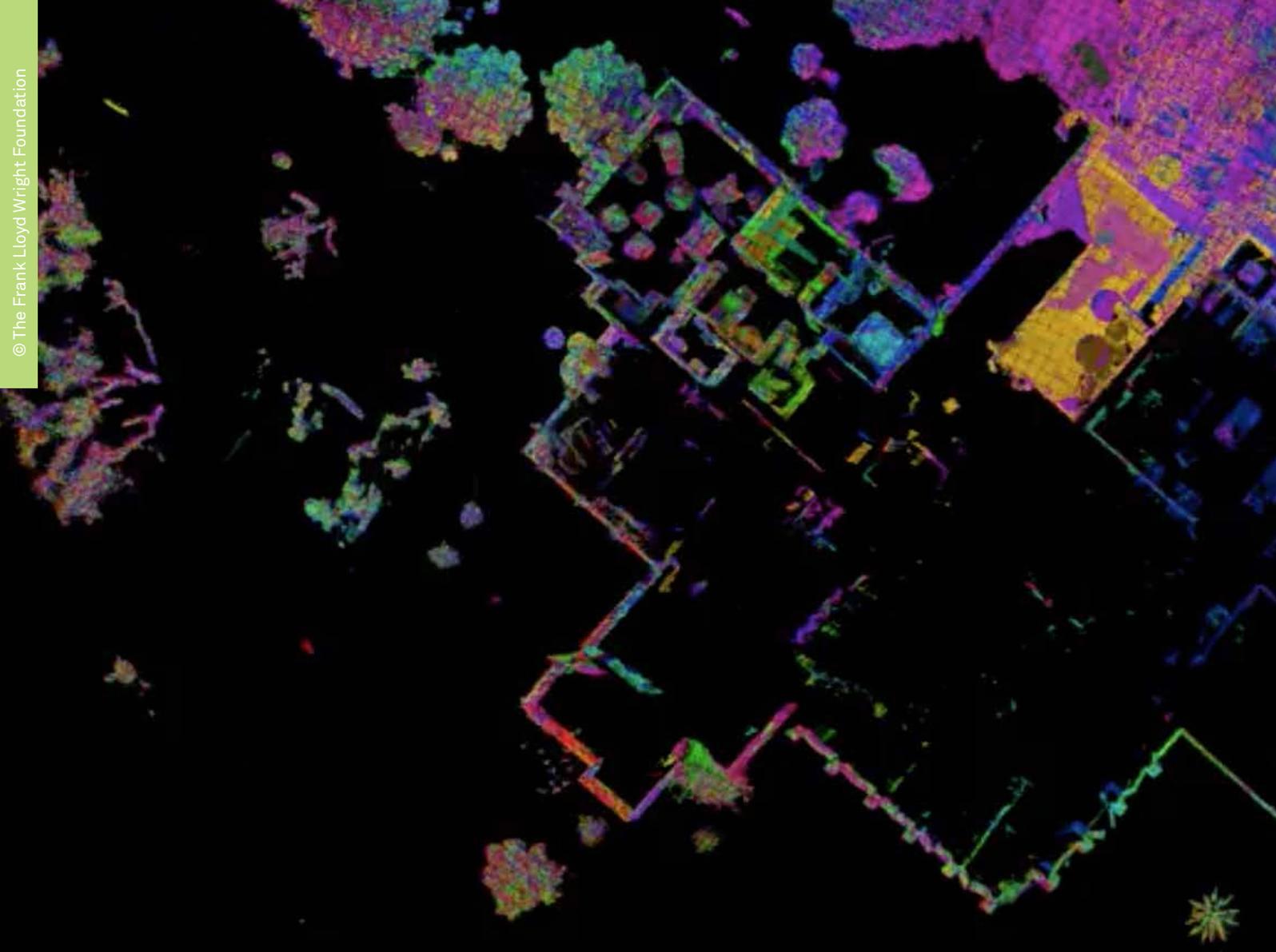
Recognised as one of Wright's masterworks, Taliesin West was his winter home and studio in the desert of Arizona, United States. From 1938 to 1959, this is where Wright and his apprentices constantly experimented with different building techniques, forms, and materials. Each winter Wright would view his camp with a fresh eye, having spent his summers at his home in the Midwest United States. With a cadre of young apprentices to work on the buildings, he was free to make alterations and test his theories, treating Taliesin West as his architectural laboratory.

Wright always referred to Taliesin West as his "winter camp," where four of the main structures were designed with a canvas roof. It was under the fabric roof of the drafting studio that apprentices assisted the master architect on the design of the Guggenheim Museum. For Wright, the canvas provided cover from the desert sun and produced wonderful filtered light for drafting. With spatial characteristics of an open-air pavilion, the fabric-roofed buildings seemed alive as desert breezes lifted the fabric as if the buildings were inhaling and exhaling. Over time, the buildings lost these important spatial and experiential characteristics to meet program needs, with hard acrylic panels replacing the canvas. The goal of the preservation team was to return the camp characteristics to the buildings.

TOOLS FOR VISIONARIES

Taliesin West's complex data set was captured by Multivista using Leica Geosystems' BLK360. It proved to be an invaluable tool for the preservation work at Wright's desert camp. The data provides the ability to access and assess elements of the site remotely in a meaningful way and provides a platform for cataloguing patterns of construction methodology and building condition assessments and documentation.

"True to our mission, the Frank Lloyd Wright Foundation is dedicated to preserving Taliesin and Taliesin West for future generations. Through our partnership with Leica Geosystems and Multivista,



we're able to carry out our mission, and Wright's vision into the future, by making Taliesin West available to the world so it can experience his ideas, architecture and design in new ways," said Stuart Graff, president and CEO of the Frank Lloyd Wright Foundation.

To embrace the original spirit of Taliesin West and support Wright's legacy of change, Frank Lloyd Wright Foundation used the BLK360 to explore the space on a deep level. The 3D dimensionally-precise scans, and the detailed understanding of material, form, and space they provide, will be used as models to dissect and analyse minute details to identify construction methodologies.

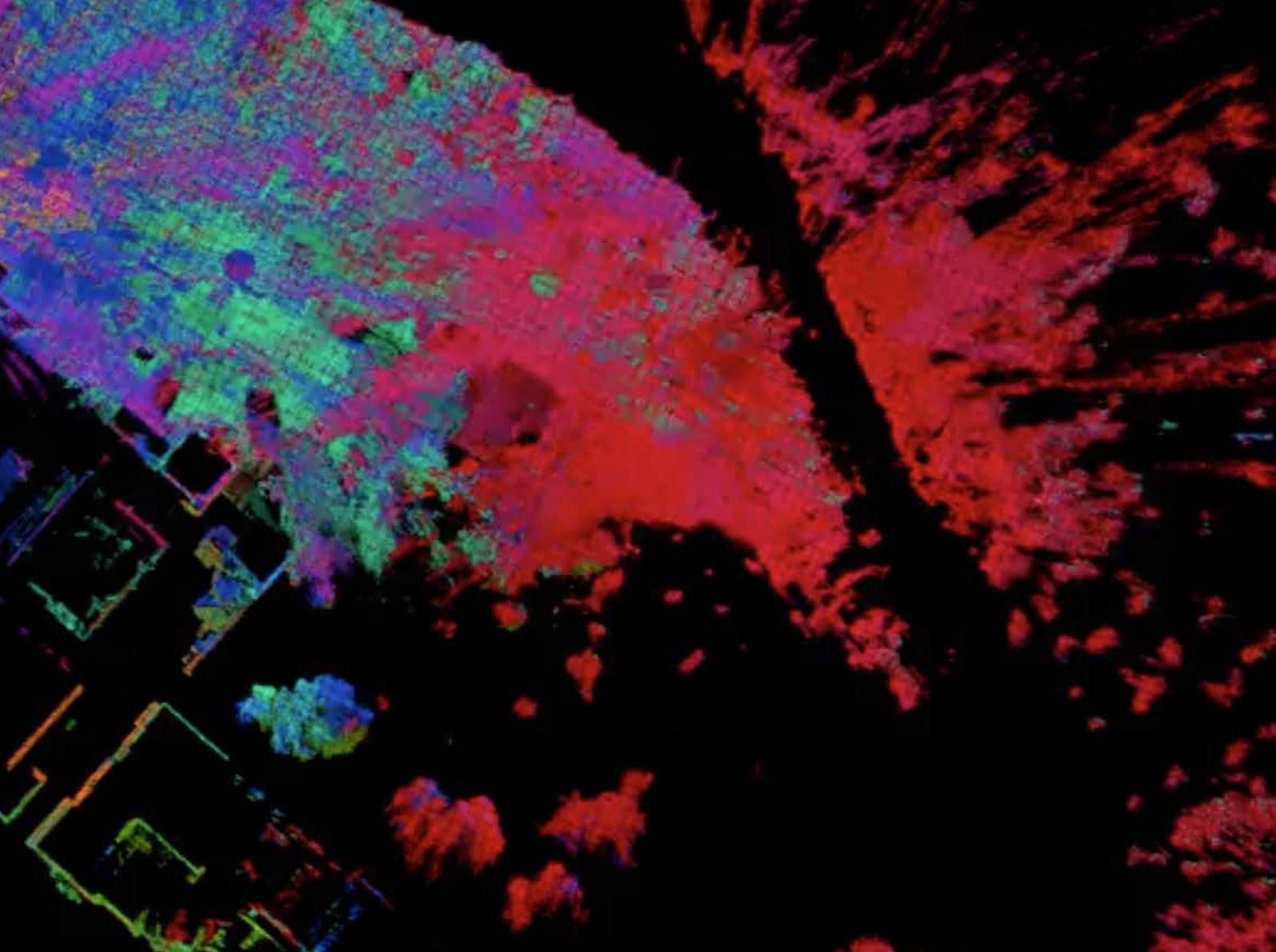
Using this new data, research and planning are currently underway to test materials and installation techniques to implement a fabric roof system in the drafting studio and bring the poetry and movement back to the buildings, restoring the open-air camp-like feel of Taliesin West.

ARCHITECTURAL ENTHUSIASTS WELCOME

The BLK360 provides data that was largely out of reach in the architectural industry. It creates an accurately scaled 3D digital replica — known as a point cloud — of the site, putting visual and dimensional project information in the hands of designers and preservationists. The point cloud will be used by the Frank Lloyd Wright Foundation to analyse each space as they develop preservation plans.

The team's BLK360 data was processed in the Cyclone suite for precise registration and visualisation. The highly accurate measurements can be navigated from their desktop, or opened in a CAD design software, like AutoCAD or Revit, where the dimensional data can be used to build floorplans, elevations, and 3D models.

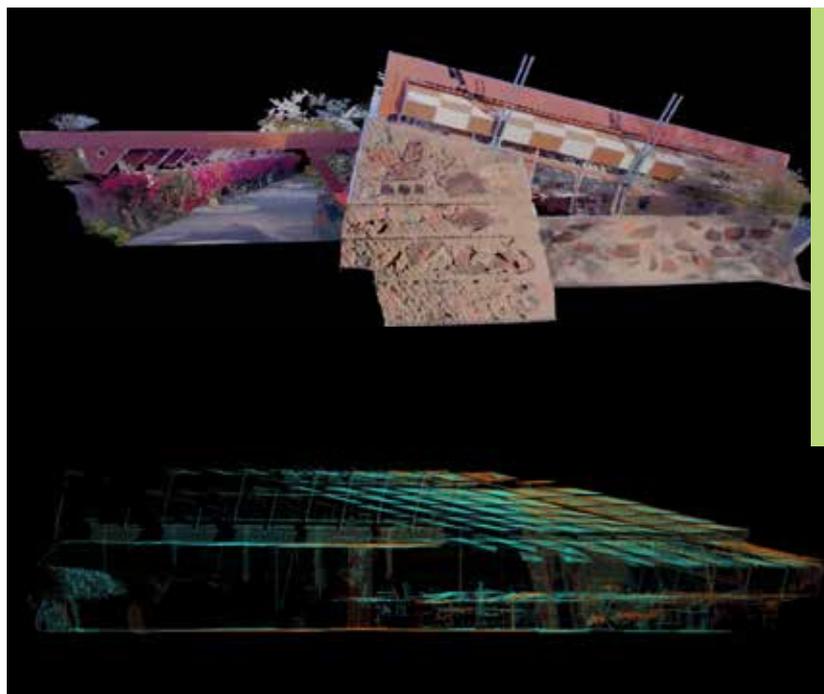
"Having the opportunity to work with the Frank Lloyd Wright Foundation and Leica Geosystems' new technologies on such a world-renowned site



has been an amazing experience. This project has been a boundary-pushing exploration from day one, which seems so fitting for Taliesin West. While testing new software, hardware and workflows in order to create a dimensionally-accurate 3D point cloud that will be used for critical preservation-related decisions, it was equally important for us to invite the world to experience and be inspired by the work of Frank Lloyd Wright,” said Brian Smith, Multivista’s product manager of emerging technologies.

The brilliance of Wright’s architecture is the space within, not simply the parts and materials that make up the envelope. Leveraging the technology of Leica Geosystems and Multivista’s construction documentation service, Frank Lloyd Wright Foundation is now able to fully understand, dissect, and analyse the details of the site and continue more thoroughly toward the goal of preserving and interpreting Taliesin West.

A version of this feature first appeared in ICON magazine.



XALT: UNLEASHING THE POTENTIAL OF IOT DATA

Monica Miller Rodgers

 Q&A

Josh Cranfill discusses Hexagon's newest technology framework, Xalt



Josh Cranfill

Hexagon digital transformation advisor for Geosystems and Safety and Infrastructure

Hexagon recently released its latest innovation, Xalt, at HxGN LIVE 2018. Unlike any other offering in the company's portfolio, though, Xalt is not so much a technology as it is a framework for the convergence of various technologies.

Lauded as a "radical new approach to accelerating digital transformation," Xalt is Hexagon's cornerstone in creating Autonomous Connected Ecosystems (ACE) and fast tracking customers to discover the full potential of the Internet of Things (IoT) data. To learn more about this revolutionary concept, *Reporter* spoke with Josh Cranfill, Hexagon digital transformation advisor for Geosystems and Safety and Infrastructure. Here's what he had to say.

There is certainly a lot of buzz around Xalt since the announcement, but what is Xalt really?

Xalt is a new framework for fast-tracking our customers' ability to harness IoT data and ultimately accelerate their digital transformation journey. Ultimately, Xalt will underpin all of Hexagon's digital solutions (i.e. it will come "standard"/embedded) and enable interoperability with future solutions as they develop. The goal of Xalt is to create Autonomous Connected Ecosystems (ACE), a state where data is connected seamlessly through the convergence of the physical world with the digital intelligence built into all processes, from the core to the edge of a customer's network.

How does Xalt work?

We're taking disruptive technologies we've been working on in Hexagon for some time and addressing IoT points of leverage, which include:

■ **Cloud Orchestration**

Delivers enterprise security out to the edge, connecting B2B with a microservice framework and cloud analytics.

■ **Completely Mobile**

Provides a secure and nimble framework that is native iOS- and Android-ready with zero client footprint.

■ **Edge Computing and connectivity**

Processes, combines and analyses IoT and sensor data at the edge of the network and puts it to work with artificial intelligence (AI).

■ **Enterprise integration**

Provides plug-in enterprise integration to a single intuitive interface for legacy connections, databases and IT systems.

■ **AI everywhere**

Supports predictive maintenance, change and anomaly detection through analytics, visualisation, and sensor and data fusion.

■ **Advanced visualisation**

Visualises 2D and 3D data, including point clouds, optimised for all mainstream OS, mobile, and web platforms.

There is quite the distinction with Xalt as a framework and not a platform. What's the difference?

We're purposely positioning Xalt as a "framework," and not a "platform," which will help it stand out from all the IoT platforms that are primarily sold as generic "toolkits" to do IoT-related things. Xalt is much more than a platform, which is why we are calling it a framework (i.e. an enabler of a connected ecosystem). Typically, a software platform is defined as an environment for developing and running software, but Xalt – much more than such an environment – permits seamless interoperability of foundational, modern, digital capabilities for configuring and operating transformative applications, leveraging Hexagon's key domains: reality capture, intelligent positioning, situational intelligence and industrial design.

Speaking of those other platforms, what makes Xalt different?

While there are other IoT platform technologies in the market that offer a subset of the partial stand-alone capabilities of Xalt, they don't offer the full spectrum:

XALT

- Permitting process interoperability in addition to data orchestration (i.e. synchronising everything in the ecosystem, like workflows and machines).
- Tight integration with Hexagon’s core technology stack in fundamental domains, such as reality capture (measurements, physical world inputs and digital realities); intelligent positioning (location and control of machines, objects, and vehicles); situational intelligence (active knowledge of events, locations, and processes); and industrial design (smart digital assets for use beyond design).
- Unique architecture for interoperability and distributed computing where edge computing, edge-cloud orchestration, and AI everywhere are core foundational elements.
- While configurable and horizontally scalable, Xalt is agnostic to other architectural elements (i.e. data, analytic tools, BI platforms, geospatial platforms, mobile platforms) and operating systems of other solutions.
- Xalt will be used to augment the capabilities of Hexagon’s existing solutions, adding significant value to our end users.
- Xalt is tuned to specific vertical applications, as opposed to the holistic approach of other platforms, wherein diverse solutions from different suppliers must be integrated, for both data and processes, or “one-size-fits-all” universal platforms offer limited integrability, efficiency, productivity, and applicability, which typically lead to patchworks that are very difficult to manage.

How proven are Xalt’s capabilities?

The capabilities of Xalt are proven in hundreds of applications in place for many years (Edge Client, Edge Frontier, Visualisation SDKs, Cloud Mobility and Orchestration, Enterprise Integration, Advanced Analytics/ AI modules, etc.). The Xalt framework permits enhanced integration and seamless interoperability of these capabilities, as well as a plug-in with other Hexagon’s capabilities, functionalities, and platforms (e.g. Smart M.app, 5D, Positioning and Navigation Solutions, Reality Capture Sensors and Software, Dispatching, Design and Planning Solutions, etc.). Essentially, Xalt is an evolution of existing solution platforms merged together with a best-in-class innovative architecture and ongoing continuous development with Hexagon’s divisions. For example, we are continuously developing new AI modules as well as data composition frameworks (data-fusion: mining, preparation, compressing, streaming, representation in multi-platforms, etc.) for different applications.

Why did Hexagon see the need to create Xalt now?

Xalt represents an official commitment from Hexagon to its customers to focus time, effort, and R&D on powering Hexagon’s full portfolio with Xalt’s capabilities. Ultimately, Xalt will underpin all of Hexagon’s digital solutions (i.e. it will come “standard”/embedded) and enable interoperability with future solutions as they develop, drawing on Hexagon’s deep domain expertise in multiple vertical industries worldwide. Some of Xalt’s capabilities are already embedded in Hexagon’s solutions, combined or stand-alone. This convergence of disruptive technologies, combined with Hexagon’s deep domain expertise and solutions, will ultimately equip all of Hexagon’s customers to quickly adapt to technology shifts and innovation, new business models, and changing marketing demands.



MAPPING MEDITERRANEAN ORIGINS IN 3D

Renata Barradas Gutiérrez

 Case Study

Merging traditional archaeological tools and methods with the use of geospatial technologies to unveil the secrets of Motya island in Italy



Archaeologists measure what we treasure to study and preserve our heritage. Geospatial and measurement technologies have improved methods to generate permanent records where we can thoroughly document, study and access information.

To understand and create a complete picture of the ancient Mediterranean, the secrets of the island of Motya have been unveiled merging traditional archaeological tools and methods with the use of geospatial technologies.

The Archaeological Expedition to Motya (Dept. IISO) and the Geodesy and Geomatics Division (DICEA) of Sapienza University of Rome, supported by Leica Geosystems, joined efforts to create a 3D model of the Mediterranean island, preserving the historical Mediterranean treasures concealed in this island for the future generations.

This interdisciplinary laboratory is innovating archaeology using a mix of non-intrusive technology solutions to collect Motya's spatial data onsite, including GNSS, photogrammetry, laser scanning and orthorectified airborne imagery.

BEFORE THE GREEKS

From the *medius* 'middle' and *terra* 'land', the Mediterranean Sea, as in the original sense, is the "sea in the middle of the earth." Intersecting at the pass between the East to the West, the 850-metre long Mediterranean island of Motya holds the key to many ancient history secrets of the region. This Sicilian island is, therefore, a strategic point to study the history, exchange, trade and cultural mixing that converged in this area, the bottle-neck of the "Middle Sea."

More than 3,000 years ago, Phoenicians spread west in the Mediterranean reaching Sicily and settled in the island of Motya. Recent archaeological investigations, carried out by the Sapienza University, discovered the earliest Phoenician landing berth in Motya dates back to the 8th century BC. Phoenicians lived all around Sicily and gathered in Motya after the Greeks arrived in vast number.

Led by Prof. Lorenzo Nigro, experts from Sapienza University have studied for years, together with the Superintendence of Trapani and with the support of Whitaker Foundation, Palermo, this unique archaeological site to make



accurate assumptions on the people, cultures and civilisations that intersected in the island. Based on the ruins and remains that have been unveiled, producing maps and 3D models of what meets and escapes the eye is helping the team to better understand and share the past of this region.

BLENDING TECHNOLOGIES TO DOCUMENT CULTURAL HERITAGE

The Motya 3D Model Pilot Project created 3D models of the archaeological findings and the excavation sites to support the archaeological research, both in the field and in the office. The specific goals of this survey campaign were to create the first complete 3D model of the entire island of Motya and the 3D models of six relevant archaeological areas.

Most survey operations are time-limited; in archaeology, this is no exception. To generate accurate 3D models and capture the survey data quickly to not interrupt the archaeological excavations and the tourist visits, Prof. Mattia Crespi and Dr. Roberta Ravanelli from the Geodesy and Geomatics Division of the Sapienza University of Rome joined the team. To do the

survey, the team relied on Leica Geosystems' Geographic Information System (GIS) collectors, Unmanned Aerial Vehicle (UAV) systems, GIS application software and HxGN SmartNet satellite positioning service.

"We had the support of a Leica Geosystems team in the field, which was directly involved with the data collection. We are very pleased with the products and the support of the personnel. The data acquired in the field allowed us to produce high quality 3D models, with an accuracy ranging from a few millimetres to a few centimetres, of the six archaeological areas, including some details within them and the entire island," said Crespi.

Images and GPS coordinates were collected to reconstruct the 3D model of the Motya island. The aerial imagery provided by the HxGN Content Program was used as a basemap for the GNSS measurements. The Leica Zeno 20 GIS data collector was used together with Leica Zeno GG04 plus Smart Antenna to collect the positions of the ground control points. With the coordinates of the control points, the team in the field could save further info, such as



pictures, notes and IDs using the Leica Zeno Mobile data collection software. The measured control points were then exported as ASCII files to be used for the photogrammetric processing of the images captured by the UAV.

Despite the fierce winds, the two UAVs perfectly captured the images needed for the photogrammetric processing. Special attention was paid to the six relevant archaeological areas and the coastline, needed to compute the sea-level projections. HxGN SmartNet was finally used to get the required RTK corrections.

All raw spatial data, including the digital images acquired from the UAVs and on the ground, the GNSS data and the surveying measurements were collected and processed through Agisoft software, to create the 3D model of the entire mythic island and of single excavation sites and relevant archaeological finds.

Last but not least, the 3D model of the entire island will also enable, for the first time and in detail, the study of the effects of the eustatism (sea level rise) on the whole archaeological area

by experts of the Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy.

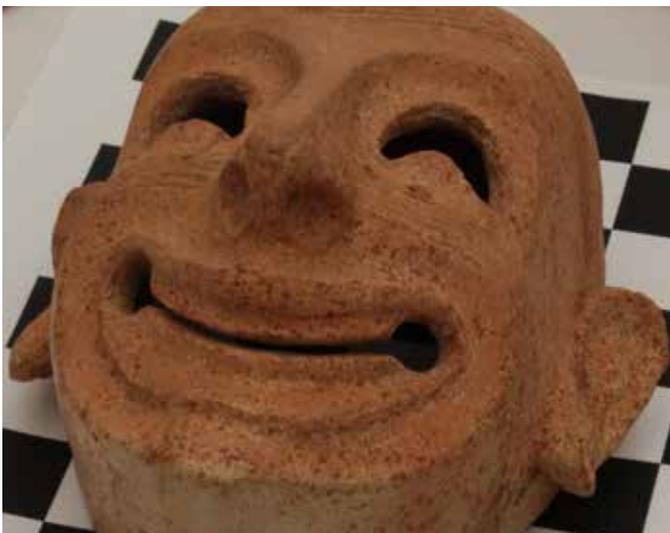
MERGING ARCHAEOLOGY WITH GEOMATICS

Collecting, analysing and interpreting georeferenced data is an area where experts from multiple disciplines converge. Referenced bases, maps and 3D models are key for all professionals in the archaeological realm. Cultural heritage sites can be documented with a variety of technologies:

- Mobile mapping
- Asset collection and management
- 3D laser scanning
- Photogrammetry
- Remote sensing
- Airborne sensors and UAVs
- GNSS
- Utility detection
- Measurement software
- Cloud-based dynamic maps.



"The new needs asked by the archaeological research and the new methodological and technological solutions offered by geomatics remarkably boosted the interaction between two disciplines belonging to different and apparently distant areas during the last decade," concluded Nigro.



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PROTECTING PEOPLE AND PROPERTY WITH BATHYMETRIC LIDAR

Renata Barradas Gutiérrez

 Case Study

Creating accurate and precise models of riverbeds in Japan to support disaster risk management



Japan is a large archipelago situated along an active convergent zone next to deep trenches on the Pacific side and many faults and canyons in the Japan sea. Due to its geography and complex topography, Japan is one of the most exposed countries on Earth to natural hazards, such as sea-level rise, flooding, earthquakes and tsunamis. Population growth, climate change and economic development, furthermore, are threatening people, infrastructure and the ecosystems located at the plains of several rivers and coasts.

Despite its great exposure to hazards, ranked by the 2016 World Risk Report as the 17th most prone disaster risk country, Japan has lowered its vulnerability by adapting long-term preparedness strategies and taking actions to understand its topography and environment.

Aero Asahi Corp's (AAC) mission is to protect life and property from any disaster or incident

by using the latest hardware and software technologies. This aviation and spatial information services company is aware that data is required to mitigate the risks in the event of future disasters. To support disaster management and prevention, maintain infrastructure and map properties, AAC uses mobile mapping, aerial photo surveys, and LiDAR topographic and bathymetric surveys.

ON A MISSION

Rivers in Japan, directly managed by the government, have a total length of approximately 8,800 kilometres and are characterised by a deep V-shaped rinsing from steep forests. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) manages and monitors the rivers of the Nippon country. To monitor the river bed deformation every 200-metre pitch, MLIT used in the past an echo sounder performing cross-sectional terrain surveys every five years on the major rivers. To prevent disasters and speed up



any recovery efforts, AAC now provides bathymetric and topographic data and maps to MLIT's river management bureau.

AAC collects data precisely and safely using the Leica Chiroptera II bathymetric and topographic LiDAR sensor mounted in a helicopter, covering large areas in just minutes. The Chiroptera II's near-infrared (NIR) wavelength for topographic and a green wavelength for bathymetric data collection allows the team to map and measure depth in shallow coastal zones and inland freshwater bodies, such as rivers and lakes and surrounding flood-plains.

"We collect and analyse all the precise data to provide information ready to use, such as deformation, sediment, cross sections, erosions, and bank height for management authorities. Since the Chiroptera II combines a topographic and bathymetric LiDAR, we can seamlessly measure from water to land – this is particularly useful when rivers are running shallow," said Hiroshi Isobe, deputy chief of airborne operations at AAC.

AAC improved the approach used in the past by complementing the data captured with Chiroptera II with an in-house solution – an echo sounder "Underwater Inspector." The team tested this approach on the government-controlled rivers in Japan. This combined survey helped the team to create a seamless dense point cloud regardless of the water depth, turbidity, colour, temperature and PH of the river.

THE PERKS OF ATTACHING A LIDAR SENSOR TO A HELICOPTER

Mountains cover 73 per cent of the land of the rising sun. When performing aerial surveys in mountainous terrain, AAC attaches the Chiroptera II to the back of an AS350-B3 helicopter with a GNSS antenna on the top of the vertical stabiliser to obtain a georeferenced point cloud with higher density. AAC is convinced that the variable airspeed, the flexible base location, the shorter turning time and the very low-altitude that can be flown with a helicopter is preferable than the quieter flight with long range and extended flight time that a fixed wing plane provides.

"Point clouds obtained in slower airspeed are denser. Flying with a helicopter allows us to collect water depth where a swath boat with an echo sounder cannot enter and control the altitude along the Japanese steep terrains," said Isobe.

MULTIPLE APPLICATIONS

A wide range of deliverables like digital surface and terrain models, classified point clouds, orthophotos, and GIS layers can be created using Chiroptera II's collected data to develop hydrological models to analyse the water flows, drainage management, flood control and support land planning activities. The team of experts uses Leica LiDAR Survey Studio (LSS) to understand the river's topography and create accurate risks analysis.

The periodical cross-sectional survey AAC provides can be used for a wide variety of applications including:

- Flood mapping
- Environmental modelling and monitoring
- Visualise the riverbed deformation ground and underwater
- Deriving flow capacity
- Accuracy controls for water level applications.

PREDICTING THE UNPREDICTABLE

To protect populations living near water bodies authorities need to study the topography of a river and its surrounding area to monitor changes and predict the behaviour of a water body under



different conditions. Airborne LiDAR bathymetry is an effective method to survey even in hazardous areas and turbid waters, creating accurate and precise models of coastal and inland water bodies.

“The detailed topographic data obtained from aerial laser surveys is used to simulate flooding and make hourly predictions of how floods spread. The simulation results and infrastructure information maps are analysed to provide optimum data for crisis management, such as evacuation routes, evacuation shelters and affected population. In addition, stereo matching of aerial photos during flooding is used to analyse surface flow rate and flow direction,” concluded Isobe.





HOW TO BEST PROTECT BURIED ASSETS

Andrew Allen

 Feature

Exploring a comprehensive approach to protecting underground utilities

Attitudes around the world are changing when it comes to protecting buried services. This is most noticeable when we look at the terminology people are using. Most markedly, there has been a shift from talking about underground *utilities* to talking about underground *assets*. When companies and regional governments change names to money-related terms, attitudes transform. Money also drives awareness and legislation. People sit up and listen when their assets are threatened.

Globally, the move from attitudes like *you know it's there if you hit it* to *we must maintain accurate and reliable maps of our buried utilities* have developed at a slow rate. Leading countries, such as the United Kingdom, Germany and the USA, have a highly-regulated and formulaic approach to breaking ground. Germany, as an example, introduced a government rebate for every locator bought. On the other side, however, there are regions and countries where not even the utility companies know where assets lie.

How do we protect assets from damage? The answer to that lies in:

- Adequate government support
- A global approach from the contractor
- Building awareness
- Better equipment
- Increasing user skill.

Let's look at these in detail.

GOVERNMENT SUPPORT

When trying to change minds or introduce a new concept to a new area, we tend to need a nudge in the right direction, either with legislation, regulation or guidance from our governments. As mentioned earlier, countries where this has been very successful are Germany, the United Kingdom and the USA. These three countries have some form of government support for protecting buried assets, either through encouraging the purchase of the necessary equipment, formal guidance on what should be done before breaking ground, or dedicated services to help with identifying potential utilities near where you dig. Ideally, all three should be present if we really want to keep people and assets safe.

A GLOBAL APPROACH

Some larger companies in developing countries try to take the same approach to breaking ground as they do in the United Kingdom and Europe, setting standards for local contractors to follow. By doing this they:

- Introduce safe working practices
- Train local contractors in equipment use
- Implement methods of safe working
- Build awareness of the dangers involved in excavation work.

Leading by example drives governments to develop and improve legislation for their countries.

BUILDING AWARENESS

Following on from legislation, regulation and guidance, we need to build awareness not only of what lies underground but also of the consequences of not knowing what is beneath your excavator, bucket or shovel. A utility strike is not only costly in terms of damaged equipment, damaged utilities and service interruption, but it can also damage lives and potentially end them.

This means that scanning before digging needs to become a standard practice wherever there are buried cables. This change of attitude will be driven by governments being urged by utility owners and health and safety bodies.

BETTER EQUIPMENT

The process of locating cables for avoidance has changed little over the past decades. Many manufacturers have stuck with fiddly dials and buttons which require user training to even switch the product on. This can lead to inexperienced or untrained users being unable to use the equipment when the time comes to perform their avoidance scan.

Since the introduction of the automatic DigiCAT locators in the early 2000s, Leica Geosystems has been one of the big innovators in utility detection, simplifying workflows and increasing capabilities to analyse assets performance in less time.



The launch of the new DD SMART utility locator solution allows users to map buried utilities, and transfer and access data remotely to a hosted service for multiple users across multiple sites to manage site activities. The Leica DD SMART utility locator series uses industry-leading digital signal processing to identify underground assets deeper, faster and more accurately than any other system.

INCREASING USER SKILL

This is the No.1 key area for asset protection. The best laws, equipment and risk awareness will not help someone who does not know how to use the equipment. Yet, it is not simply user skill in equipment use – it is ensuring that operators know how to visually scan an area for clues about what might be underground and where. It is giving them the understanding that one scan at ground level is not enough; they need to keep scanning throughout the dig. It is ensuring they know that only some buried cables can be found using the locator on its own, and if you want to be thorough, you need to use a signal transmitter, too. It is all these things and

more. Leica Geosystems offers several courses ranging from a half-day user training to a five-day utility surveyor course.

With automatic pinpointing, onboard video tutorials, usage alerts, and audio and visual displays in DD SMART utility locators, Leica Geosystems simplifies utility location. Nonetheless, without formal training in the use of the equipment and cable locating, assets and people are still in danger.

Knowing how to use the equipment properly and applying knowledge to an excavating environment is most important for finding and identifying assets correctly, and therefore, staying safe during excavation.

Each of the above areas have their benefits on their own, but only when they all work together are buried assets truly protected.

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TOWARD SMART DIGITAL SOLUTIONS FOR BUILDING CONSTRUCTION

Bernd Moeller

 Feature

Providing efficient tools to smooth the workflow and data flow in building construction

Today's construction industry is characterised by shorter building cycles, shrinking budgets and growing expectations for accurate data on demand. Although this situation presents numerous challenges for contractors, it also creates tremendous opportunities for firms that wish to differentiate themselves in an increasingly competitive market.

Coordination issues between design teams in the office and construction teams on site are common in most construction projects. Going digital enables construction professionals to see and understand what is missing and needed on a site. Whether a construction company is actively embracing BIM or just looking for a way to increase efficiency and transparency on the jobsite, integrating accurate as-built data capture, digital construction layout workflows, and early deviation detection and documentation can help them reach their goals.

Leica Geosystems helps to tear down the barriers to digitalisation by providing efficient tools for building construction that smoothen the work on site, the workflow and data flow between design teams in the office and construction teams on site.

CLEVER FUNCTIONS AND ROUTINES THAT BOOST PRODUCTIVITY

The quest for productivity is driving the demand for digitalisation across all user levels and fostering technological advanced hardware and software solutions as well as smart services. To boost productivity, Leica Geosystems created a new construction layout solution that achieves a level of speed and precision like never before while transporting digital plans on site.

The new iCON solution for construction layout offers an all-in-one tailor-made hardware and software for all positioning and measurement tasks in building construction – it consists of two new iCON robotic total stations, the Leica iCR70 and iCR80, together with the proven Leica iCON CC80 tablet computer with an enhanced version of the custom-built iCON build construction field software.

The one-person operation of the iCON robotic total stations increases layout productivity by more than 50 per cent compared to traditional methods. With industry-leading prism lock, increased range and better measurement speed, challenging and changing environmental



surroundings are no reason to lose our user's target. In case of interruption of lock by co-workers, other trades, or equipment on a congested site, re-lock to the prism occurs automatically and quickly.

The new auto-staking feature of the iCON build software, coupled with an enhanced management of work tasks plus improved handling of design models, boosts productivity in critical phases of the construction process.

THE KEY IS DIGITALISATION

Digitalisation in the building construction industry has many facets. There are many different personas involved with varying objectives and expectations – connecting key stakeholders with an integrated solution is key to merge in real time the design and reality on site with all stakeholder needs.

The iCON layout solution connects different parties involved with remote support functions to enable site managers to help or advise layout crews online on the best solution of a request from site. Via Leica ConX cloud solution, up to date plans and data can be coordinated easier and in real time so the office and the construction site are always synchronised with the latest project data to improve productivity and reduce rework and delays.





Complemented with Leica iCON prep office software, the iCON layout solution offers a complete preparation, editing and reporting toolkit.

BETTER BIM

Through digitalisation, more complex design data are also now available to construction teams on site. Until now, data enriched design models, however, were too complex to construct from. Reducing the digital information to just what is required to carry out the actual construction step is key to keep efficiency high. Leica Geosystems removed the hurdles in the data flow by facilitating 3D design models out on construction sites.

Where design models had to be adapted, converted or points for layout manually had to be added, now rich intelligent design data from the iCON build software can be handed over from the office to the field crews as fully rendered 3D models right in the field. Field crews have full flexibility in selecting their work packages by objects with simple yet powerful filter mechanisms inside the iCON build construction field software, significantly increasing efficiency on site. Because of its structure into object classes such as columns,

slabs, or beams, each design model can be simplified by ignoring classes that are not relevant for the construction layout process, such as furniture for instance.

Unlike alternative solutions, iCON build does not rely on simple background graphics for context and pre-produced extracted point lists for layout which increases errors (wrong selections) and reduces flexibility (not adaptable to last minute changes of design or site conditions). iCON build provides full autonomy to the field crew while maintaining detail integrity of the intelligent design model. This makes them autonomous and highly reactive to non-planned changes on site. Operating in this digital reality, firms can alert stakeholders to required revisions and further improve design and final layout.

Data management departments in building construction companies, for instance, consider efficiency increase and cost savings in double-digit growth rates. By better integrating BIM processes, critical issues and risks can be identified at an early point in the design phase with coordination of data from all involved stakeholders in the construction process.

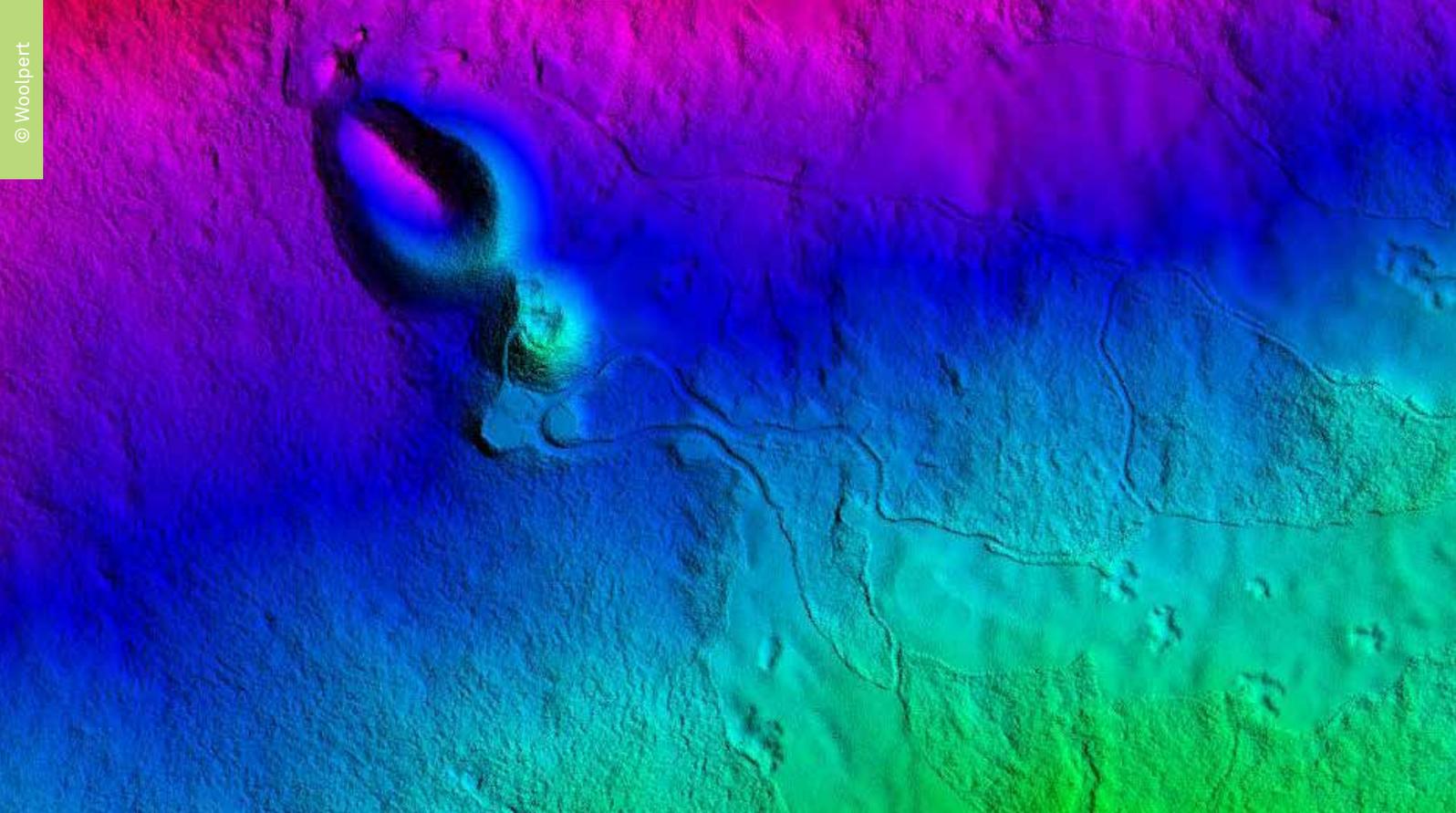
ALOHA AIRBORNE

Monica Miller Rodgers



Case Study

Airborne mapping with the Leica SPL100 of the
Big Island of Hawaii



Lush tropical vegetation. Refreshing rain showers. Iconic mountainous landscapes. The exact features that make Hawaii such an ideal holiday spot also present the most challenging aspects to airborne mappers. Woolpert, a leading national architecture, engineering and geospatial firm, acutely understands these obstacles. Conducting approximately 1,000 LiDAR missions a year across 100,000 square miles, the firm is well versed in overcoming difficult environments to provide quality results.

Dealing with heavy forest canopies, cloud interference and uneven terrain, Woolpert is a firm believer in the benefits of using LiDAR in such conditions. A traditional user of linear-mode LiDAR, such as the Leica ALS80 airborne sensor, the firm was presented with the opportunity to use single-photon LiDAR in the form of Leica SPL100. The format switch was perceptible.

FLYING HIGHER FOR MORE COVERAGE

Contracted by the U.S. Geological Survey (USGS) and National Oceanic and Atmospheric Administration (NOAA), Woolpert was tasked with capturing the entire topography of the big island of Hawaii and the Hilo Bay breakwater. The data will be used for:

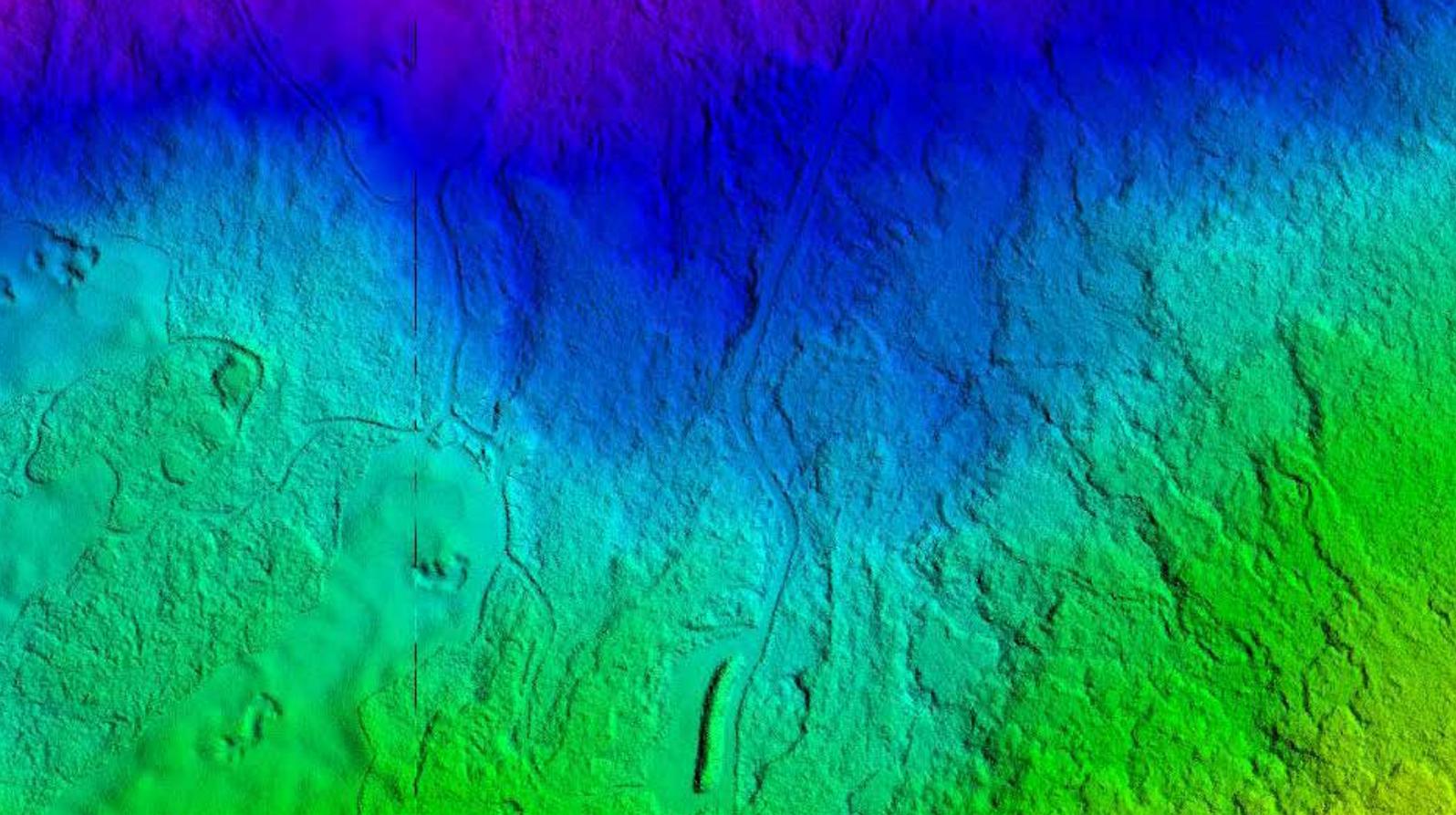
- Change detection
- Preliminary construction planning
- Slope analysis

- Forestation study
- Hydrology mapping.

The coverage area is approximately 10,404 square kilometres, and Woolpert only had about two months to collect the data. The firm was also held to the criterion of Quality Level 1 (QL1) by the USGS, the standard level for the USGS 3D Elevation Program (3DEP), which requires data densities of eight points per square metre and vertical accuracy of 10-centimetre root mean square error, among other requirements. Under such constraints, Woolpert determined the SPL100 would be the best solution for the project.

“With the atmospheric issues we knew we would face, combined with the short time frame, we needed to be able to fly higher and gather more data in fewer passes,” said Mike Meiser, Woolpert project manager. *“Given the unique terrain and atmospheric conditions presented in this project area, we saw an effective means to do this with single-photon LiDAR.”*

For large-area projects, the SPL100 exceeds the QL1 standard, collecting up to 30 points per square metre to produce high-density point clouds. The dense jungles of Hawaii were also more easily captured as the SPL100 is specifically designed to penetrate semi-porous obscurations. Emitting 6 million laser pulses per second and responding to multiple



returns from each outbound pulse, Meiser said this sensor afforded favourable opportunities for canopy penetration by virtue of the high-density of pulses.

PARTNERING FOR TECHNOLOGY ACCEPTANCE

As a long-time partner, Woolpert worked closely with Leica Geosystems to develop the flight plan and process the captured data. To capture the large area, the island was split into five zones based upon terrain elevation, covering a range from 0 to 3,600+ metres. A 20 per cent to 50 per cent overlap from flight line to flight line with a 100-metre buffer around each zone assured continuous coverage of the entire island.

The captured LiDAR data and four-band frame imagery were processed in Leica HxMap, the unified high-performance multi-sensor workflow. With a single user interface, high-density point clouds were created on a weekly basis for delivery to USGS and NOAA. Under USGS' National Map provision, the point clouds will be made available to the public as standard digital elevation models.

The close partnership between the two companies has enabled the widening acceptance of single-photon LiDAR in the industry, especially in the use of elevation capture.

"Leica Geosystems has had the privilege to work on many new technology implementations

with Woolpert over the years, and the use of the SPL100 on this data acquisition recognises a major step in the maturity of this technology from both an operational side as well as from processing and data quality perspectives," said Bruce Wald, Geosystems Geospatial Content Solutions Division COO. *"This is the direct result of a continued development effort since the initial introduction of the technology – the SPL100 meets the goal of providing a highly productive technology, targeted to high point densities and large areas."*

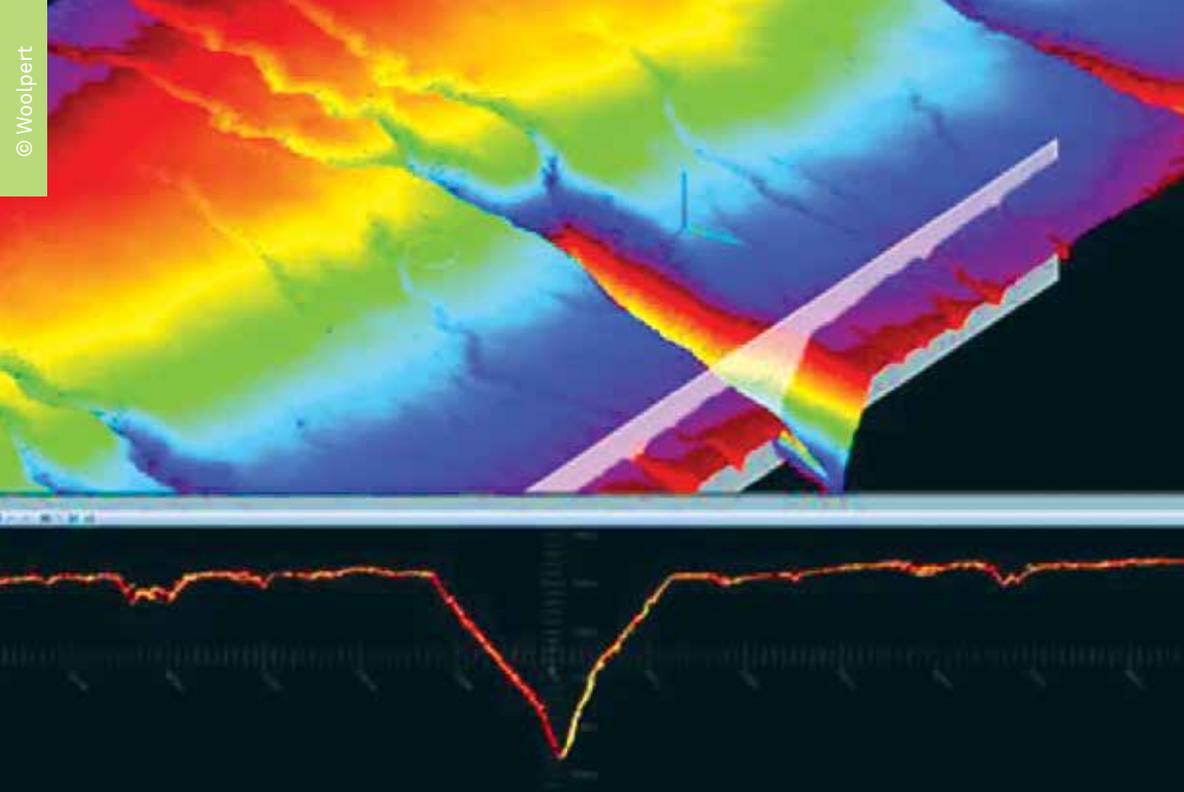
CONTINUING TO CAPTURE, PARTNER

Experiencing one of the wettest winters in the recent history of Hawaii, flight plans were severely affected, only allowing the capture of 43 per cent of the overall 10,404 square kilometres. The remaining portion of the project is planned to be captured in the late fall of 2018.

With the eruption of Kilauea Volcano on the big island of Hawaii in the spring of 2018 and, to date, the continuous flow of lava, the geography continues to be altered.

"Anytime you create map data, it's dated as soon as the data leaves your hand," remarked Meiser. *"When we go back, our goal will be to acquire as much as we can."*

The Woolpert team originally supplied data from previously-established ground control points for



the project. In the second phase, the team will revisit these points and re-establish as needed.

Continuing with the SPL100 and HxMap, the Woolpert team is already working with Leica Geosystems to establish the next set of flight plans and data processing deliverables. With no other foreseeable delaying events, the team expects to complete the project in early 2019.

“We have a strong working relationship and certain comfort level with Leica Geosystems. This was a major reason for us selecting the SPL100 for this project,” said Meiser. *“Our familiarity with the workflows have enabled us to be more efficient and provide faster results.”*

Whether being enjoyed by tourists on holiday or presenting hurdles for airborne mappers, the unique features of Hawaii are being captured accurately and efficiently for further analysis. With detailed, high-density point clouds, government agencies like USGS and NOAA can make the most informed decisions to better support communities and provide vital information to the public.

NORTH AMERICA

In the spring of 2018, the U.S. Geological Survey (USGS) approved the largest acquisition by single-photon LiDAR to date. Using the Leica SPL100, Woolpert captured approximately 9,650 square kilometres of South Dakota, USA. The data has been approved for use in USGS 3D Elevation Program (3DEP) and will ultimately be made available to the public via the USGS National Map website.

The nearly \$1 million project realised significant efficiency gains with the SPL100. John Gerhard, Woolpert vice president and program manager, said SPL is more efficient and can collect Quality Level 1 (QL1) or denser data from higher altitudes when compared to a traditional linear lidar sensor. Woolpert deployed its Twin Commander turboprop aircraft, equipped with the SPL100 sensor, for this project.

“Leica Geosystems developed and provided the sensor, which was introduced last year,” said Gerhard. *“As 3DEP and the need for enhanced elevation data applications expand, it’s vital to employ the tools most appropriate to each project to best support the USGS and 3DEP. Leica Geosystems has been a great resource and an outstanding partner on multiple projects.”*

ORE CONTROL TECHNOLOGICAL INNOVATIONS AT GOLDCORP PEÑASQUITO MINE

Christian H. Calderón Arteaga

 Case Study

Improved geomodelling, material routing and model reconciliation in Mexico's largest gold producer mine



Located in the northeast corner of Zacatecas State, Mexico, Peñasquito is Mexico's largest gold producer, consisting of two open pits - Peñasco and Chile Colorado - containing gold, silver, lead and zinc. Mining (pre-stripping) began in 2010 and full production in 2011. The open pit mines feed both a sulphide concentrator (mill) and a heap leach pad. Peñasquito's project is owned by Goldcorp, Inc. and is a poly metallic deposit with gold, silver, zinc and lead being recovered as payable metals.

NEW ORE CONTROL TECHNOLOGY

Due to expected lower grade ores with advancing mine-life, Peñasquito is facing a declining metal production profile. The requirement of the ore control system to accurately predict ore feed characteristics is critical to maximising metal recovery at Peñasquito, while the ability

to accurately route materials from the ore control system is critical to site success. These challenges have been overcome by the adoption and implementation of a new ore control (OC) technology from Hexagon's Mining division.

The solution has improved geomodelling, material routing and model reconciliation. The technology's implementation has also significantly improved selectivity, performance and data management while reducing the variance between planning and execution. This has helped to drive overall improvement across the operation.

This project requires managing blasthole data, model interpolation and model calculations, among other modelling related tasks. Also required are the creation of new ore control databases to manage material routing, daily mining, model reconciliation and the



communication with third party systems at the mine. The implemented solution uses the blasthole database as a primary input while also serving as material routing input for the fleet management system, and as a source to generate various reports. The OC system data is turned into information that supports the decisions and evaluation making processes at the mine.

FROM WEAK TO WISE WORKFLOWS

The process used by Peñasquito's ore control team to update the OC model was beset with issues: a lack of knowledge of the intermediate steps from the users, the excessive number of steps, and the ability to troubleshoot when there were errors in the process. These issues prevented Peñasquito from running a robust ore control model that could be accountable for the new needs of the mine. The team sought greater confidence and reliability in the model.

This old process was replaced with a newer, standardised workflow that allows the users to trust in the results and to make informed decisions with higher confidence. Using HxGN MinePlan Operations (formerly MineSight Axis), a new workflow for Peñasquito's OC was designed and implemented. The new workflow includes the usage of different tools to resolve the issues that ore controllers had faced using the previous process.

"Thanks to the new technology, we have increased the reliability of the model, which leads to higher confidence in our reserves," said Juan Barrios, ore controller for Peñasquito. "We have also reduced the working time to process a blast polygon, and now we can visualise and report the results almost in real time."



IMPROVING ORE CONTROL PROCESSES

The implemented solution includes new tools to:

- Manage the OC model update process
- Manage the polygon routing and progress
- Report and release the necessary information to all mine consumers
- Run the model reconciliation, where the exploration model is compared against the OC model.

These tools were placed together in a custom design that allows them to work in a step-by-step process. Information flows between the tools so the users can report the necessary information to make informed decisions with more confidence.

Qualitative, quantitative and collateral improvements have been documented since implementation.

Qualitative improvements include:

1. Data security has improved by implementing the usage of SQL server technology;
2. The process is now automated with automatic calculations, i.e.: automatic naming of the OC cut, or the cut's automatic material assignment based on reserves from the block model;
3. Process is auditable, meaning that the results are repeatable even after a long period of time;

4. The user can now interact with the data to make informed decisions.

Quantitative improvements include:

1. The new OC process is much faster with an average reduction of 75 per cent in the processing time;
2. Monthly reconciliation processing time was reduced by approximately 80 per cent.

Collateral improvements include:

1. Density calculations are now reconciled between exploration and OC models;
2. A new pit has commenced with no additional project setup required;
3. A new forecasting report of the available material for the planning department was implemented;
4. New daily and weekly reconciliation reports are possible now and implemented by the end users.

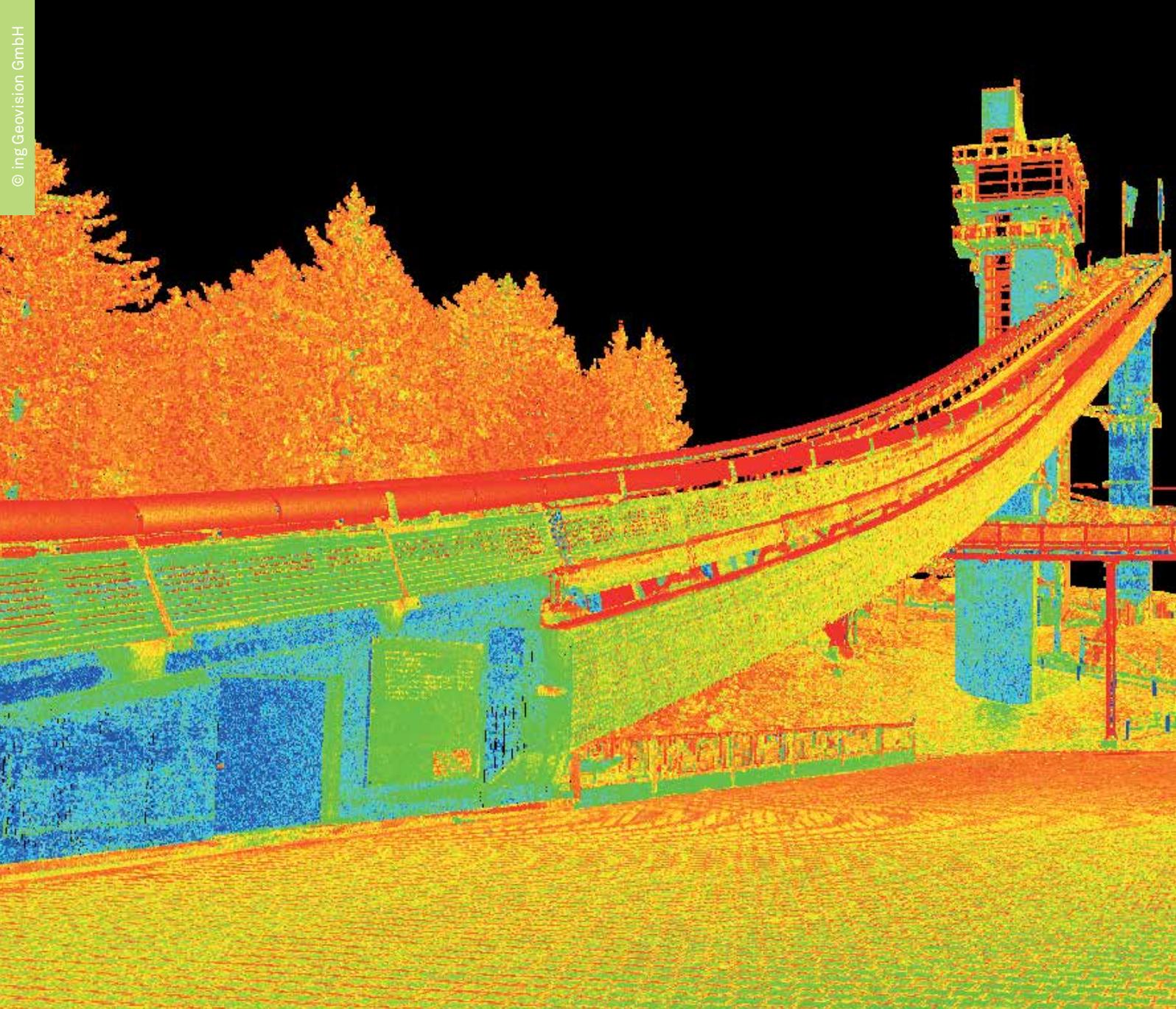
The implementation of the new ore control system from Hexagon's MinePlan software narrows the gap between what is and what should be. The software helps to not only shape smart change, but also to unlock and realise significant improvements in the OC process.

CREATING A NEW SKI JUMP COMPLEX

Beate Wesenigk

 Case Study

Creating a digital terrain model of the Audi Arena in Oberstdorf, Germany



Whether for the World Ski Championships, the Four Hills Tournament or the Alpine World Ski Cup, the Schattenberg ski jump in Oberstdorf in Bavaria, Germany, is the main venue for international ski jumping competitions each year. Refurbishment and new build work is being planned for the 53rd Nordic World Ski Championships in Oberstdorf in 2021. This will include a new “Einkehr” jump complex, named after the “Einkehr-Schwung”, the existing culinary establishment facing the arena. ing Geovision has created a digital terrain model (DTM) as part of the planning process.

SKI JUMPING ON SCHATTENBERG

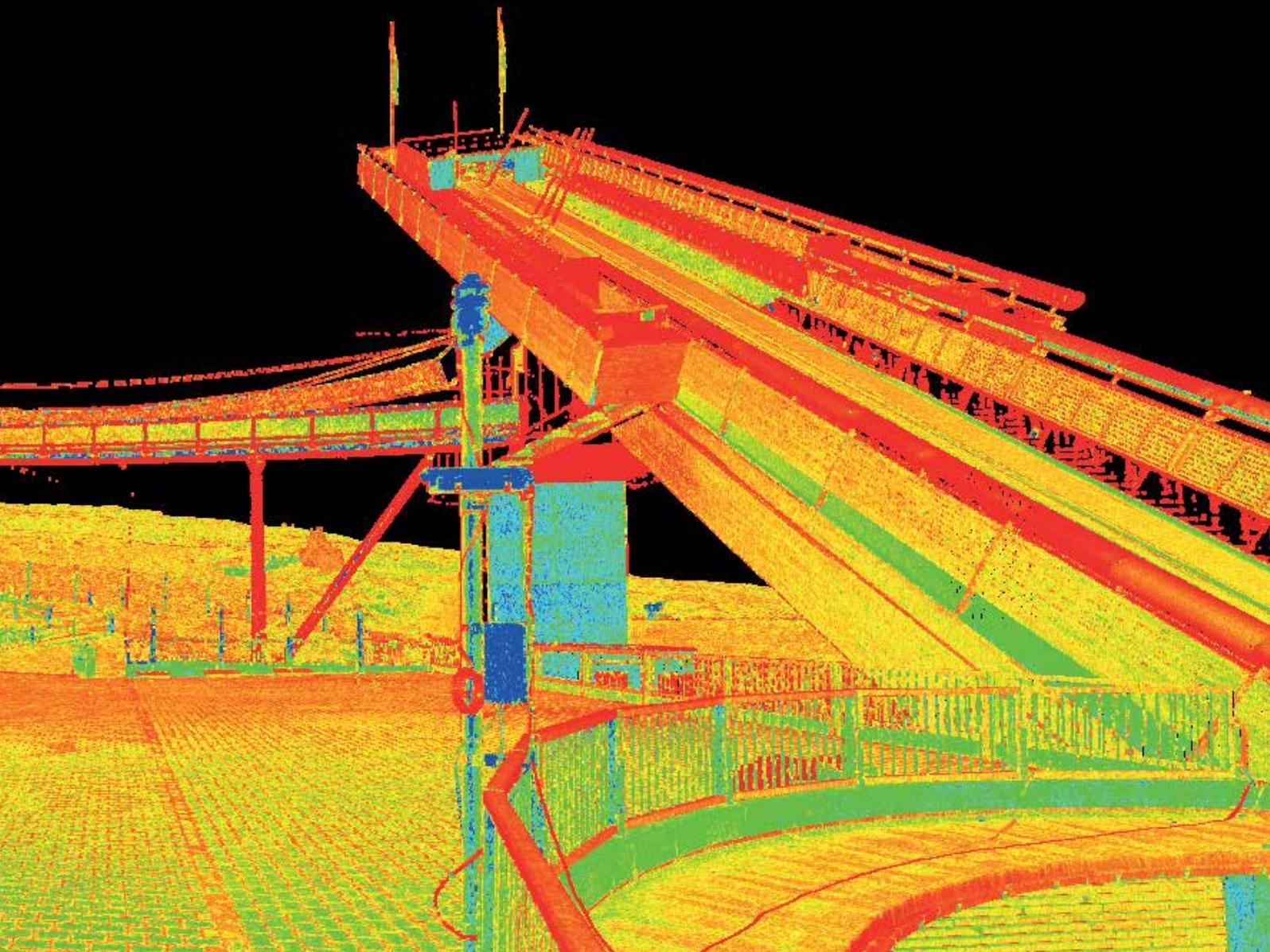
In 1909, the first ski jump stage was built near Oberstdorf in Germany’s Allgäu Alps. Beautifully situated on a sunny hillside, after some initial

scepticism, the sport was received with great enthusiasm. During the very first year, Bruno Biehler set the record jump at 22 metres pushing the limits of the facility. Plans for a new jump were devised at the start of the 1920s.

The new Schattenberg ski jump was used for the first time on 27 December 1925 – it is now 93 years old. The jumps and surrounding terrain have been modified and expanded repeatedly over the years. To improve the ski jump track for the 53rd Nordic World Ski Championships in 2021, the facility will be refurbished.

CHALLENGES: AREA SIZE, ACCESSIBILITY AND SELF-IMPOSED TARGETS

German surveying company ing Geovision received the task to create a DTM required as



a reliable basis for the ski jump complex plans. The firm faced several challenges:

1. The size of the area to be recorded – approximately 270,000 square metres.
2. Some areas of the hilly, wooded areas are, in addition, very difficult to access and cannot be reached with terrestrial surveying equipment.
3. The self-imposed target of capturing all data within just one day.

SURVEYING 38 ALPINE FOOTBALL FIELDS IN ONE DAY

The three-person surveying team set off early from Traunreut to Oberstdorf in Germany perfectly prepared with different surveying equipment.

STEP 1: THE CONTROL POINT FIELD

The foundation for the survey of the terrain was measured with the Leica GS16 Smart Antenna formed from an existing six-point control field. The GS16 Smart Antenna minimised the problem of mountainous areas with valleys and woods, which shadowed satellite reception for the GNSS survey.

STEP 2: MEASURE THE CONTROL POINTS, THE PROFILE AND THE RIVERBANKS

While the control point field was being determined, the targets for the scanning and the control points for the fly over were being set with the Leica TS16 total station. The TS16 was also used in surveying the profile of the wood. In total, this method produced 900 individual points measured almost entirely on steep terrain.



STEP 3: LASER SCANNING AND PANORAMIC PHOTOS

The Leica ScanStation P40 was used to scan the area with 36 standpoints. All round scans with a resolution of 3x3 millimetres at 10 m were recorded.

“The P40 ScanStation took just 3.5 minutes per standpoint and has the added advantage that the black/white target points are available in the office. The result was a very dense point cloud made up of a total of 2,036,358,871 individual points. Full-HDR 360° spherical images were also recorded at each scan in a matter of seconds. The pictures can be read by the Leica Cyclone laser scanning software without any further processing and used for registering and processing the data,” said Richard Steiglechner, head of surveying for Ing Geovision.

STEP 4: FLY OVER

To better survey the vast area and to be able to record the sections that cannot be reached using other methods, a fly over was done with a Leica Geosystems Unmanned

Aerial Vehicle (UAV). A flight plan was generated with the software supported by the UAV before the automated GNSS supported fly over took place, covering all the sloping terrain as well as any obstacles, such as the jump towers. The software calculated the waypoints of the desired flight path based on the flight altitude, the obstacles, and the required accuracy using Bing maps. A series of 643 aerial photographs were taken using the attached camera in the UAV.

The three Ing Geovision “aries”, who are also trained mountaineers, captured the data of 270,000 m² at more than 4,000 of altitude in one day and store their instruments before dawn.

PREPARE THE MEASUREMENT DATA FROM THE SENSORS

The surveyed control and individual points from the GS16 and the TS16 were loaded by the experts into the national coordinate system via an ASCII file. The scan data from the P40 and the MS50 were later entered into the

Leica Cyclone scanning software for registration. Additional options were selected for importing, such as filtering the point cloud to eliminate unwanted erroneous points.

“The combination of the Cyclone’s sophisticated filter technology and the ScanStation’s pulse measurement technique makes it possible to eliminate so-called mixed pixels, the hazy points that occur when the laser beam is split over an edge and an underlying surface,” said Steiglechner.

ing Geovision experts could automatically align the spherical 360° panoramic images with the point cloud and the true colours assigned at each scan point using the “fixed” option in Cyclone to transform the point clouds from each position into an overall coordinates system using target marks, cloud constraints (point clouds with identical geometry in the overlapping sections between two scans) and point standards.

“The target marks were collected directly in Cyclone. Identical cloud constraints, or sections, are automatically found by the 3D point cloud processing software. We could use a viewer to assist us in case of doubt,” said Stefan Nawrat, head of engineering surveying for ing Geovision.

THE RESULT: A DIGITAL TERRAIN MODEL THAT PERFECTLY FITS

Once the data from the individual sensors was edited, all the individual points and the point clouds from the fly over were imported into Cyclone to join the already registered point clouds from the P40 and MS50 scans. All the points from five different surveying instruments were now combined in one software. Then, a visual check was made of the positional accuracy of the point clouds by cutting through the point clouds.

The collected point clouds consisting of 2.15 billion points was exported as a Leica JetStream project so the point cloud could be further used and accessed anywhere.

“This approach reduces processing time and the risk of errors as the data does not need to be constantly copied backwards and forwards and it ensures that exactly the same accurate information is available for all further processing stages in different programmes, be that AutoCAD, MicroStation, 3D Reshaper or Autodesk Revit,” said Bernd Hafensteiner, managing director of ing Geovision.

To draw the ski jump complex in the CAD programme, the open JetStream point cloud was split, assisted by the Leica CloudWorx point cloud plug-ins, simplifying the drawing of the layout on the point cloud.

The DTM was created with 3D Reshaper, a software system for creating terrain contours and extracting ground and break lines.

“3D Reshaper purges the point cloud and creates a point cloud group that contains only the ground points, all in barely 30 seconds. Its comprehensive settings guaranteed our team precise results,” Markus Prechtel, head of surveying flights for ing GeoVision.

The DTM created in 3D Reshaper was transferred to the contractor as a DXF file. To give contractors access to the point clouds in a browser, an additional password protected area on the company’s Leica TruView Enterprise server was set up.

To plan the new “Einkehr” jump in the Audi Arena in Oberstdorf, only a precise point cloud and a comprehensive DTM would do. Using Leica Geosystems’ technology, the ing Geovision team provided the best foundation for the next 93 years and beyond of ski jumping on the Schattenberg ski jump arena.





IMPROVING INFRASTRUCTURE WITH AUTOMATED MACHINE CONTROL

Karina Lumholt

 Case Study

Converting a summer house area into permanent residences
with machine control in Sweden



The Swedish municipality of Värmdö, located about 25 kilometres Northeast of Stockholm, is a very attractive residential area close to the archipelago and only 20 minutes away from the capital. The municipality hosts a large number of summer houses that are currently being converted into permanent residences and demand a higher supply of drinking water, sewage, broadband and better roads.

Värmdö municipality assigned Frentab AB as the contracting construction company for the work at Skeviksstrand, the project is to be completed by the end of 2018. Frentab AB is a 30-year-old family-owned construction company specialised in building and infrastructure, including projects in residential areas like Skeviksstrand where the work must be performed respecting nature and the people living in the area. This is a representative project where machine control is put extensively to use.

THE LINK BETWEEN THE OFFICE AND THE MACHINES

Jonas Isaksson works as volume manager at the office in Gustavsberg, Sweden. He is using Leica ConX to track machines, manage 15 excavators working on the project, and to assign reference models and localisation files to the machines. Isaksson also uses ConX to collect as-built documentation from the machines to

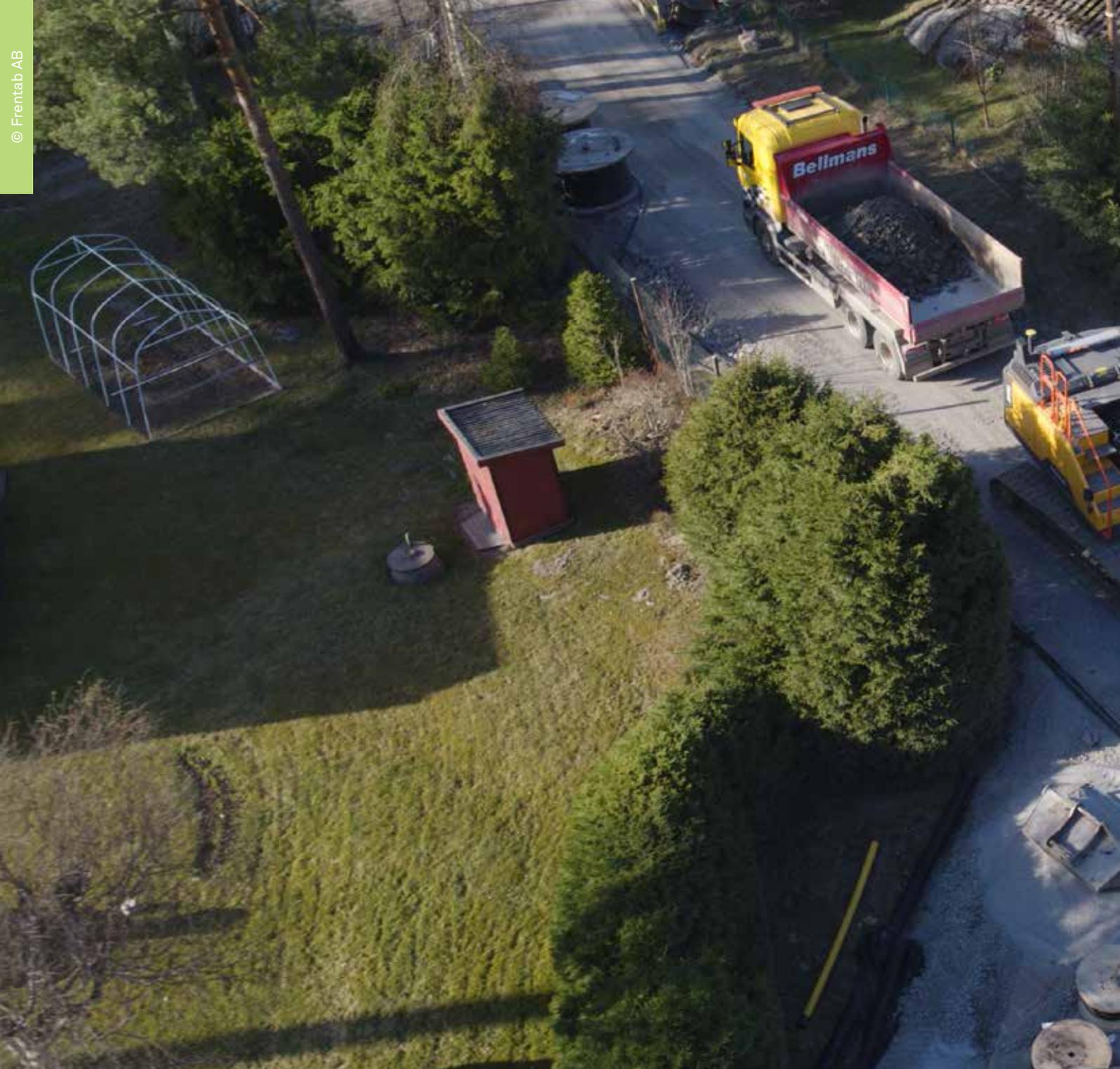
communicate remotely with the machine operators.

USING THE IXE COPILLOT FUNCTION FOR THE FINAL GRADE

Machine operator Bertil Jakobsson has been working on the site for 15 months digging trenches down to approximately 60 centimetres for water and waste water pipes, electrical cables and broadband. As it is very common for machine operators, Bertil has a nickname; “Berra” – it is even printed on the cabin of his Volvo EC250EL excavator.

Jakobsson uses the Leica iCON iXE3 3D excavator machine control solution all the time. *“Without machine control, I would be working as if I were blind,”* Jakobsson explains. *“I am no longer dependent on a surveyor to get my job done. I used to spend a lot of time waiting for a surveyor to come to the job site, now I can do everything myself.”*

Jakobsson is one of the first machine operators in the world to work with the Leica iXE3 CoPilot. The world’s first automated tilt rotator solution automates the tilt function on excavators equipped with a bucket with tilt rotator. This system simplifies the operation of the tilt rotator, so operators like Berra become less fatigued and achieve the correct target slope.



“I have worked on a large project in Tollare with grading of large plane surfaces. In this case, the iXE3 CoPilot was a great help for me because I didn’t get tired and got the correct grade faster. On a project like this, in Värmdö, I use the iXE3 CoPilot function to create the final layer before the grader comes. The advantage is that I don’t have to look at the panel all the time. I just hold the automation button on the joystick – that makes my work simpler and faster,” says Jakobsson.

USE OF 2D MACHINE CONTROL WHEN NATURE COMES IN THE WAY

One of the challenges when working in an area with several buildings and tall trees is that the GNSS signals can be lost, making it momentarily impossible to use the 3D machine control solution. When the GNSS coverage is lost, Jakobsson changes to the 2D mode on the panel and a surveyor has to set up the reference points. *“The problem today is that often there is no backup plan for situations like these, because we no longer have surveyors that are standing*



ready to go out for the more traditional surveying tasks, so I have to wait,” explains Jakobsson.

Alternatively, Jakobsson can move the excavator to a place with better GNSS coverage and use the excavator to set a reference point and work even in the dead spots.

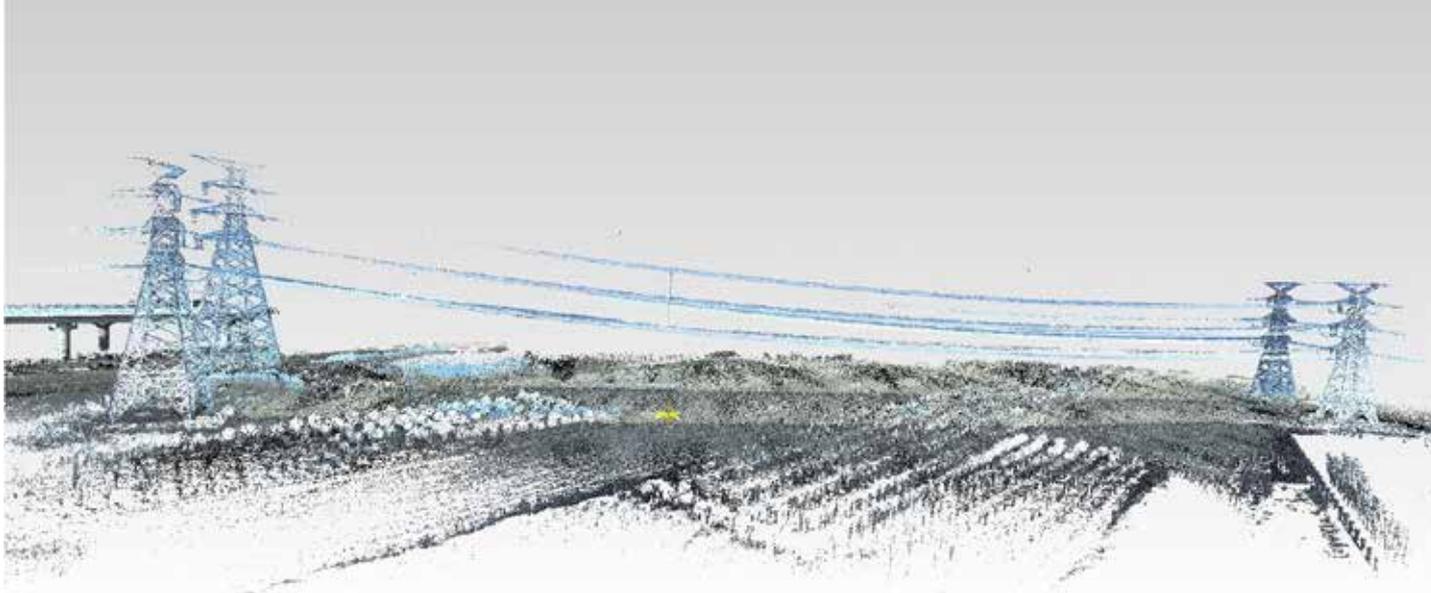
“The versatility of the machine control solution and the possibility of switching between 3D and 2D mode is a great advantage for us when working on projects like this,” concludes Jakobsson.

CAPTURING CHINESE HIGH-SPEED RAILS

Jing-long Xie

 Case Study

Capturing rail with wearable mobile mapping sensor platform in China



High-speed rail (HSR) in China has witnessed significant development in recent years. With nearly two-thirds of the world's HSR, exceeding 25,000 kilometres in 2017, China now has the world's largest HSR network. The world's longest and most extensively used HSR network relies on leading surveying technology to keep China on the move.

Surveying rail is indispensable for rail design, construction and maintenance. China Railway Design Corporation (CRDC), a large-scale survey and design consultant enterprise, has surveyed and designed more than 40,000 km of rail, including 7,500 km of HSR. Surveying and mapping this large extension of rail brings challenges to surveyors and engineers. To overcome them, CRDC experts rely on the Leica Pegasus:Backpack wearable mobile mapping system to capture railways.

SURVEYING IN SHENYANG, CHINA

The unique wearable reality capture sensor platform has revolutionised the traditional survey methods of CRDC. With the Pegasus:Backpack's two LiDAR scanners and five high dynamic cameras, the team is improving efficiency by generating an accurate, fully-registered and colourised 3D point cloud model of the rail environment, even in GNSS-denied areas thanks to the Simultaneous Localisation and Mapping (SLAM) positioning technology integrated in the reality capture platform.

The operator collecting the data turned on the Pegasus:Backpack and connected it to tablet to see in real time the data acquisition, images, LiDAR units and GNSS signal strength. With no need of using targets, CRDC surveyors walked and biked along the Shenyang rail collecting dense 3D point cloud and crisp images without worrying about GNSS coverage. One person carrying the ergonomic and ultralight Pegasus:Backpack completed the

survey planned route in one hour collecting data from inside of the rail tunnels and outdoors.

"The Pegasus:Backpack is a very powerful measuring tool. I believe this will promote the reform of new measurement methods in the near future," said Chun-xi Xie, rail survey department manager at CRDC.

BEYOND HARDWARE

Efficient technology that increases productivity goes beyond hardware or sensor integration. Of equal importance is the related software workflow and processing speed. CRDC surveyors could visualise in real time the data captured to decide if additional information layers were needed before leaving the site.

Once all data was collected, the team of experts imported the georeferenced 3D point clouds with panoramic images to Leica Pegasus:MapFactory to extract coordinates and features for a wide range of rail applications including:

- Produce topography models and plans of the area
- Draw 2D plan of a railway viaduct in AutoCAD
- Measure height and size of the high-voltage power towers near the railways
- Measure the width and features of the culvert
- Extract coordinates of railway power poles
- Create as-built models of the railways.

The core business of CRDC covers planning, survey and design, engineering consultation, and project management of rail. The workflow provided by Pegasus:Backpack solution fully meets CRDC's accuracy and efficiency requirements for preliminary railway surveys, saving time, cutting expenses, and increasing four times the efficiency in comparison with the traditional survey methods.

OPTIMISING OPERATIONS THROUGH DIGITAL INNOVATION

Penny Boviatsou



Customer Profile

Using digital technologies to simplify and facilitate data acquisition in France

The digital revolution is here and won't leave any industry out of its influence. Technology has changed the way surveyors, engineers and construction professionals work, giving a new vision on how work should be done.

e-Cassini is a start-up company founded in March 2017 by Patrick Maïore, a surveyor with 25 years of experience in the field. It is the result of years of reflection on the digital revolution and its impact on the technical profession and the market that frames it. The e-Cassini solution is an answer to challenges such as Building Information Modelling (BIM), energy transition and smart city.

The company's goal is to simplify the day-to-day management of the space (public domain, buildings, etc.); facilitate the production of all types of plans (street, facade and network plans, interiors, etc.); and assist with the production of georeferenced and Geographic Information System (GIS) data, thanks to the opportunities offered by digital technologies.

To achieve this goal, e-Cassini uses Leica Geosystems technology for its indoor and outdoor documentation projects. Its portfolio includes products such as Leica

Pegasus:Backpack, BLK360, and Leica Geosystems total stations and software.

"Leica Geosystems solutions assure a complete documentation of a building with a level of accuracy that meets and exceeds our customers' expectations," said Maïore.

e-Cassini takes its name from the Cassini map, the first topographical map of the Kingdom of France drawn to scale. This map, created by the Cassini family of cartographers between 1756 and 1815, was truly innovative and a major technical advance for its time.

BEING INNOVATIVE

Today, the e-Cassini platform makes the entire public domain available in the form of a 3D point cloud with centimetric precision. This cloud is obtained using an exclusive surveying technique that combines LiDAR technologies (light detection and ranging) and topographic techniques.

The platform also offers tools for identifying and managing the public domain online and offers tools for online management of built heritage. Its collaborative nature and the guarantee of updated data makes it a revolutionary tool.

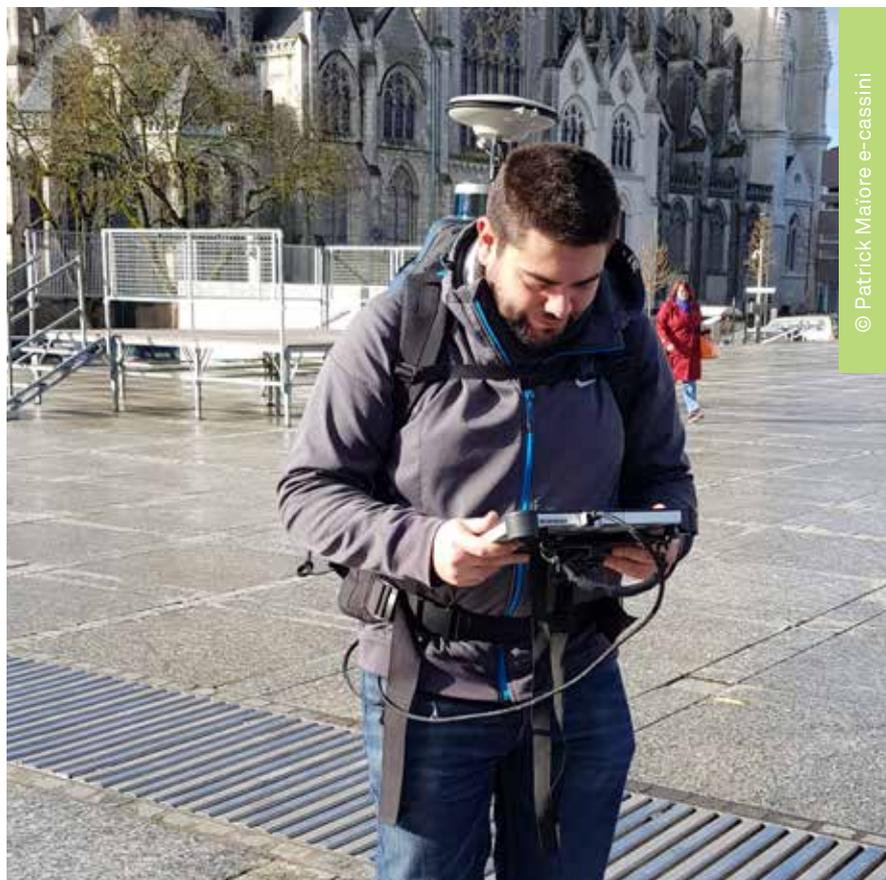


The graphical features and GIS data provided by the platform help to manage:

- Roads: road markings and traffic signs, nature and quality of surfacing, and maintenance work
- Green spaces
- Visible networks or network elements: drinking water, sanitation, street lighting, telephony and cables
- Flood risk areas
- Plans: network detection plans, classic or simplified street plan, facade plans, etc.
- GIS data models
- Urban planning
- 3D local urban planning plan
- Design of urban development projects.

“The benefits of the platform are numerous: time saving, less travel, budget and logistics savings are a few,” said Maiore. “Having a technology partner like Leica Geosystems ensures the quality we look in securing for our projects.”

With the e-Cassini platform, the municipalities and federations of municipalities have an online tool to help with the day-to-day management of the public domain and to simplify the creation of all types of plans, geodata and GIS data. The



© Patrick Maiore e-cassini



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data produced can be exported and saved on the cloud where it can be accessed and implemented by all subscribers.

“Our platform facilitates teams’ collaboration and usability of data; the information entered on the e-Cassini cloud is available to all users, anywhere at any time,” said Maiore.

HANDLING NUMEROUS PROJECTS

e-CASSINI contributes in the management of public space:

- **Roads:** street mapping, network detection plan, network plan, longitudinal profiles, cross sections, horizontal signage management (plans and GIS), vertical signage management (plans and GIS), management of the nature and quality of coatings (maps and GIS), quantitative works (surfaces, linear, etc.), updates following the work done by scan and integration in the e-Cassini repository
- **Green spaces:** maps, linear, surfaces, GIS management, management of landscape parks, cemeteries, updates following the work done by scan and integration in the e-Cassini repository
- **Networks:** integration of the existing network recovery plans, definition of network plans in e-Cassini, street lighting, wastewater and rainwater remediation, drinking water supply, electrical assets, gas assets, air networks, real-time update of network GIS data

- **Subject mastery:** road design, earthworks calculation, calculation of rights of way, Roads, Networks, Diverse (VRD)

The e-Cassini platform is also used in the management of private space by:

1. Capturing of the “as-is information”

The indoor part of the building is scanned with HDS technology level by level. The outside of the building is captured either with HDS equipment or with the Pegasus:Backpack. Point clouds are created in colour or in black and white. The resulting files are assembled together.

2. Surveying a building under construction, at each phase of its construction

The building is captured with a fixed scanner at each floor: the structural elements, roof, technical reservations, facades, networks and the technical ducts at their exact locations, partitions and finished parts.

The outdoor facilities are captured once the building is completed. The files obtained are loaded onto the platform by phase and type of acquisition. Thus, the building is detailed in all the complexity of its construction.

The outside data acquisition is done with a Pegasus:Backpack using GNSS and SLAM mode. Depending on the accuracy of the trajectory, the acquisition is supplemented with ground control



© Patrick Maiore e-cassini



points (GCP). The number of GCPs depends on the final required accuracy. e-Cassini has developed a method to obtain an absolute accuracy of $\pm 4\text{ cm}$ in x, y, z.

The indoor data acquisition is made with a Leica ScanStation P20 or BLK360 with the possibility of using the Pegasus:Backpack depending on the dimensions of the building and final accuracy. For updates, e-Cassini uses the BLK360.

For the fixed scan acquisition, the data is assembled with Cyclone REGISTER. For a dynamic scan acquisition, the company uses the Pegasus Manager suite to obtain an assembled point cloud with centimetre-precision.

The assembled data is loaded from e-Cassini into the cloud. Once loaded, the data is accessible to be exploited with the different e-Cassini modules.

"Picking a technology partner for your business can be a big decision," said Maiore. "Leica Geosystems' technology contributes to our company's growth and profitability."





FINDING ANCIENT PETROGLYPHS IN THE MOUNTAINS OF KYRGYZSTAN

Penny Boviatsou

 Case Study

Geosystems' innovative GNSS technology transforms archaeology in Kyrgyzstan

For thousands of years, humankind has left its mark on the global landscape in the form of petroglyphs—images etched into rocky outcrops, initially with stone tools and later metal instruments. Often carved over the course of several millennia at a singular locale, these ancient markings attest their historical relevance over time. And thus, petroglyph sites can be understood as sacred open-air “history books” rendered in stone.

In this context, petroglyphs are an important complement to archaeological data gleaned from burial sites. In broad terms, petroglyphs tend to provide insight into burial rites, social norms and material culture. They tell us about life events and the mythical ideas associated with them.

While petroglyphs are found on all five continents, the mountainous areas of Central Asia, southern Siberia and western Mongolia are especially rich in sites dating from the Bronze Age, the Iron Age and the Turkic Period. Within this expanse of petroglyphs, the site of Saimaluu Tash in Kyrgyzstan is one of the largest and highest. It lies in the eastern part of the expansive Fergana Mountain Range, some 115 kilometres northeast of the city of Osh.

Due to Saimaluu Tash elevation, which ranges from 2,860 to 3,350 metres, the site is covered by snow 11 months of the year and is only accessible from mid-July to mid-August. In 2017, Esri, a global market leader in Geographic Information System (GIS) technology, helped a mixed team of local and international scientists to overcome the challenges and assisted with their research. Hexagon Geosystems supported their efforts providing the latest GNSS technology.

“Hexagon Geosystems’ technology facilitated the data collection, its high-level of accuracy, efficiency and precision exceeded our expectations for this demanding project,” said Matthias Schenker, CTO at Esri Switzerland. “The direct support for the Leica GG04 Smart Antenna in Collector for ArcGIS made it really easy for us to directly integrate the data collection in our workflow.”

REDISCOVERING HISTORY

The military topographer Nikolai G. Kludov officially re-discovered Saimaluu Tash—meaning

“stones with drawings” in Kyrgyz language—in 1902. However, more than four decades would pass before SM. Zima and Alexander N. Bernshtam conducted campaigns there, in 1946 and 1950, respectively. In the decades since those initial forays to the site, sporadic fieldwork was conducted up until the early 2000s.

The objective of the researchers’ most recent expedition was to thoroughly survey, photograph and map the site with a view to produce a monograph and 3D interactive maps.

Expedition participants included:

1. Three archaeologists and petroglyph experts
2. Two GIS specialists
3. A local ground support team.

Their goal was to establish thematic clusters of petroglyphs within certain spaces. Furthermore, the team hoped to identify what appeared to be traces of as many as nine ancient settlements and burial sites on satellite imagery with 50 centimetres of resolution.





THE EXPEDITION

The petroglyphs are concentrated in two valleys, divided by a steep ridge in the Saimaluu Tash Mountain Range—at the relatively large site Saimaluu Tash I in the western valley and at the smaller, and slightly more recent, site of Saimaluu Tash II in the neighbouring eastern valley. Saimaluu Tash I covers some 1.3 square kilometres while Saimaluu Tash II Covers less than 1 km².

Over the course of three weeks, the team surveyed a total of around 4,500 stones with petroglyphs and between 25,000 to 30,000 single images. The location of each of the petroglyph bearing stones was surveyed using Leica Geosystems GNSS receivers with decimetre accuracy in combination with the Collector for ArcGIS application on mobile devices. The application was configured to allow offline data collection on the basis of a high-resolution satellite image of the area for more timely and informed decisions.

“The Leica Zeno GG04 Smart Antenna was a unique tool for our project considering the demanding environmental conditions of the valley,” said Schenker. *“Given its high precision technology, we were able to accomplish our goal and gather the most accurate data.”*

The orientation (azimuth) was recorded for each petroglyph, together with a photograph and description of it. A digital elevation model (DEM) and orthorectified imagery of the study area were created from aerial photographs taken by an unmanned aerial vehicle (UAV). The Leica GG04 GNSS Smart Antenna was also used to

survey ground control points (GCPs) to improve the horizontal and vertical location accuracy of the DEM and orthophotos. The data were then categorised and stored in a geo-database in order to analyse the spatial distribution of the petroglyphs within the site as a whole as well as of individual categories. The results are best visualised on interactive 2D and 3D applications.

For spatial and statistical analysis, the data was categorised and stored in a geodatabase and evaluated using ArcGIS Pro by Esri. This allowed analysis of the spatial distribution of the petroglyphs within the site as a whole as well as of individual classes of petroglyphs.

From this dataset, various information products are generated as results, in the form of interactive 2D and 3D web applications, as well as in the form of traditional paper maps showing the location and categorisation of the petroglyphs. The web-based maps and applications will be made available via ArcGIS Online and can be used for filtering and further analysis.

Additionally, the data will also be made available for use in the AuGeo app created by Esri Labs. This allows to use this data in an augmented reality (AR) environment.

REVOLUTIONISING ARCHAEOLOGY

“Archaeologists embrace technology, adopt new tools and accept revolutionary techniques that transform archaeology like never before in the past,” said Schenker. *“We are delighted to be part of this transformation.”*

The petroglyphs at Saimaluu Tash represent a time span of almost 3,000 years and reflect a great variety of themes. Since their creators selected motifs from their own surroundings and economies, which in turn were determined by climatic conditions, it is possible to establish a correlation between the petroglyphs, the climate, and the local economy. By revealing of such information of the past we gain a better understanding of the historical context and our social development over the years.

All information about the Saimaluu Tash petroglyph area is derived from the official expedition report by Christoph Baumer, a Swiss scholar and explorer, as it was published in the Fall 2017 edition of “The Explorers Journal”.

IN YOUR WORDS

WELCOMING THE RTC360

Introducing an extensive list of world's-first hardware and software solutions, Leica Geosystems, part of Hexagon, has revolutionised the world of measurement technology for nearly 200 years. Measurement professionals startled once again with the newest 3D reality capture solution introduced at HxGN LIVE 2018 – the Leica RTC360 combines high-performance laser scanner and mobile-device app to capture and pre-register scans in real time. With the push of a button, the RTC360 measures at a rate of 2 million points per second including high-dynamic range imaging, creating coloured 3D point clouds in less than two minutes.

Combined with Cyclone FIELD 360 mobile-device app, users can automatically capture, pre-register and examine scan and image data on-site. The RTC360 takes away the headache of registering and stitching together scans, simplifying reality capture for pros and newcomers. Along with all these features, the RTC360 is lightweight, has an IP54 rating, and fits in a backpack.

Simplifying workflows and opening opportunities for new businesses, this revolutionary 3D reality capture solution has gained the ovation from people around the world. Check how people in social media welcomed the RTC360.



The McAvoy Group

Today we welcomed @LeicaGeoUK @LeicaGeosystems to our manufacturing facility in Lisburn to demo their brand new **RTC360** 3D #laser scanner. We are the first organisation in the island of Ireland to demo this new scanner.



APR Services

Excited to be at the launch of the #RTC360 scanner @LeicaGeoUK HQ yesterday. 2 million points per second and all post processing done automatically! Presentation by one time APR employee @HDSsteven. #LaserScanning #WhenItHasToBeRight #Dolt360 #Future bit.ly/2t90BnJ



Mark King

The #RTC360 has been developed with the forensics and public safety market in mind. Amazing data quality, fast acquisition and streamlined workflow



Global Survey

With Leica's ever-increasing portfolio of scanning solutions, it's hard not to be excited by the evolution of this industry. Have a look at our handy Leica ScanStation comparison chart to understand how the new RTC360 fills the gap between BLK360 & the P-Series.



Dave Langton

There are two types of people in the world. Those that haven't seen the #RTC360 solution at work and those that want to buy one.



Derek D. deBlois

Get to vacation faster with Leica Geosystems part of Hexagon's new, speedy, carry-on, all-inclusive, RTC360 scanner. #leica #rtc #whenithastoberight



C.R. Kennedy Survey

The new RTC360 has arrived in Australia. Exciting times. For more information please email sale@crkennedy.com.au. #whenithastoberight #RTC360 #Leica



M&P Survey Equipment

EVENT | Everyone wants a picture with the @LeicaGeoUK **RTC360** #rtc360selfie #LaserScanning #Construction



ABA Surveying

We are @LeicaGeoUK HQ today to see the big reveal of the #RTC360...and here it is! #whenithastoberight #Dolt360 #bigreveal #future #laserscanning



Geomatics World

Murphy Surveys Invests in Leica **RTC360** bit.ly/2KK1xq1



HEXAGON'S GEOSYSTEMS DIVISION FEATURES CUSTOMERS

AROUND THE WORLD. EVERY DAY. ANY APPLICATION.

Whether it is surveying an underpass in Saudi Arabia or working on a mine in Peru, our users are working diligently to further not only the industry but global society.

At Hexagon's Geosystems Division, we are honoured to be a part of this, supporting them with precise and accurate instruments, sophisticated software, and trusted services. We deliver value every day to those shaping the future of our world, and we thank them for all that they do continuously, tirelessly, decisively. Here, we feature a few of our users in the field doing what they do best - shaping smart change for a better world.

Share with us how you are solving complex daily challenges using Geosystems solutions. Send us your photos at reporter@leica-geosystems.com to be featured in *Reporter*.



Surveying a water drain, Australia

Surveying a storm water drain in Australia using a Leica TS06 by Jace and Tom Pearson



Mine survey, Peru

Surveying the Inmaculada Mine in Ayacucho, Peru using a Leica Viva TS15 by Pedro Mamani Vilca



Surveying an underpass, Saudi Arabia

Surveying the Anas Bin Malik Underpass with a Leica GS14 and CS15 in Riyadh, Saudi Arabia by Raja Sheraz Ahmed



Staking a golf park, Moldova

Staking out a golf park using a Leica Viva GS15 and CS15 Field Controller in Chisinau, Moldova by Veaceslav Plamadeala



Land survey, Iraq

Survey and demarcation of residential land in Sheikhan District, Iraq using a Leica TS06 by Dlovan Waad



Fields survey, Fiji

Surveying fields in Fiji using a Leica TS06 by Ian Truscott

© Leica Geosystems



New Leica iCON construction total stations provide efficient layout solution

The intuitive iCON construction total stations, Leica iCR70 and iCR80, increase efficiency on any building construction site by automatically identifying the prism and automatically relocking to it, should the line of sight be lost, delivering the most reliable, simple and automated setup routine for construction layout.

© Leica Geosystems



Leica Geosystems simplifies heavy construction with all-in-one machine control platform

The new all-in-one machine control platform, consisting of a panel and docking station, Leica MCP80, combined with a new application software, Leica MC1, supports multiple machines for heavy construction. The new solution automatically guides the operator to position the machine, achieving the required design with the highest quality and accuracy.

© Leica Geosystems



Leica Geosystems, RPA partner to increase efficiency in CAP claims

The Leica Zeno GG04 plus will support quicker, more productive farm inspections for the Rural Payment Agency (RPA). RPA's field inspectors will capture land parcels and other key information quicker and more efficiently to increase productivity in managing claims by using GNSS services from the U.S. GPS, Russian GLONASS and European Galileo constellation.

© Leica Geosystems



Leica Geosystems announced new partnership with GeoPal

Leica Geosystems and GeoPal have partnered to support high accuracy asset data capture within the GeoPal mobile workforce management solution. With increased regulatory pressure on utility organisations to provide more accurate location data and asset records, the Leica Zeno GG04 Plus Smart Antenna is now seamlessly supported by GeoPal to provide high accuracy positions within GeoPal's Android and iOS mobile applications.

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