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GEOSYSTEMS

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President's Message

In business, I'm constantly in the front row of technology innovation. I've seen firsthand the evolution of theodolites to total stations, the explosive growth of satellites to support GNSS around the globe, and even the miniaturisation of laser scanners for practical everyday use. All of this innovation though, is only good if it enhances business processes and improves workflows. In this Reporter, we explore the meaning of digitalising workflows.

When making decisions that support urban environments, digital information can streamline the process and bring greater efficiency to city services and development. This was the exact thinking when architecture and design firm C95 Creative created a digital model of Ayacucho, Peru using Geosystems mobile mapping and laser scanning technologies. With this 3D model of the city centre, urban planners, construction companies and government officials can make better informed decisions that support the advancement of the city.

When winter storms in California, USA, overfilled reservoirs and threatening flood waters meant hundreds of thousands of citizens needed to be evacuated. Working with Sensemetrics, a firm specialising in networked sensor applications, the local utility government agency was able to monitor in real time dam and dike crest elevations of their critical infrastructure. Using Geosystems GNSS solutions, officials were remotely and instantly alerted to any hazardous changes, providing them with valuable time to make and implement their emergency plans.

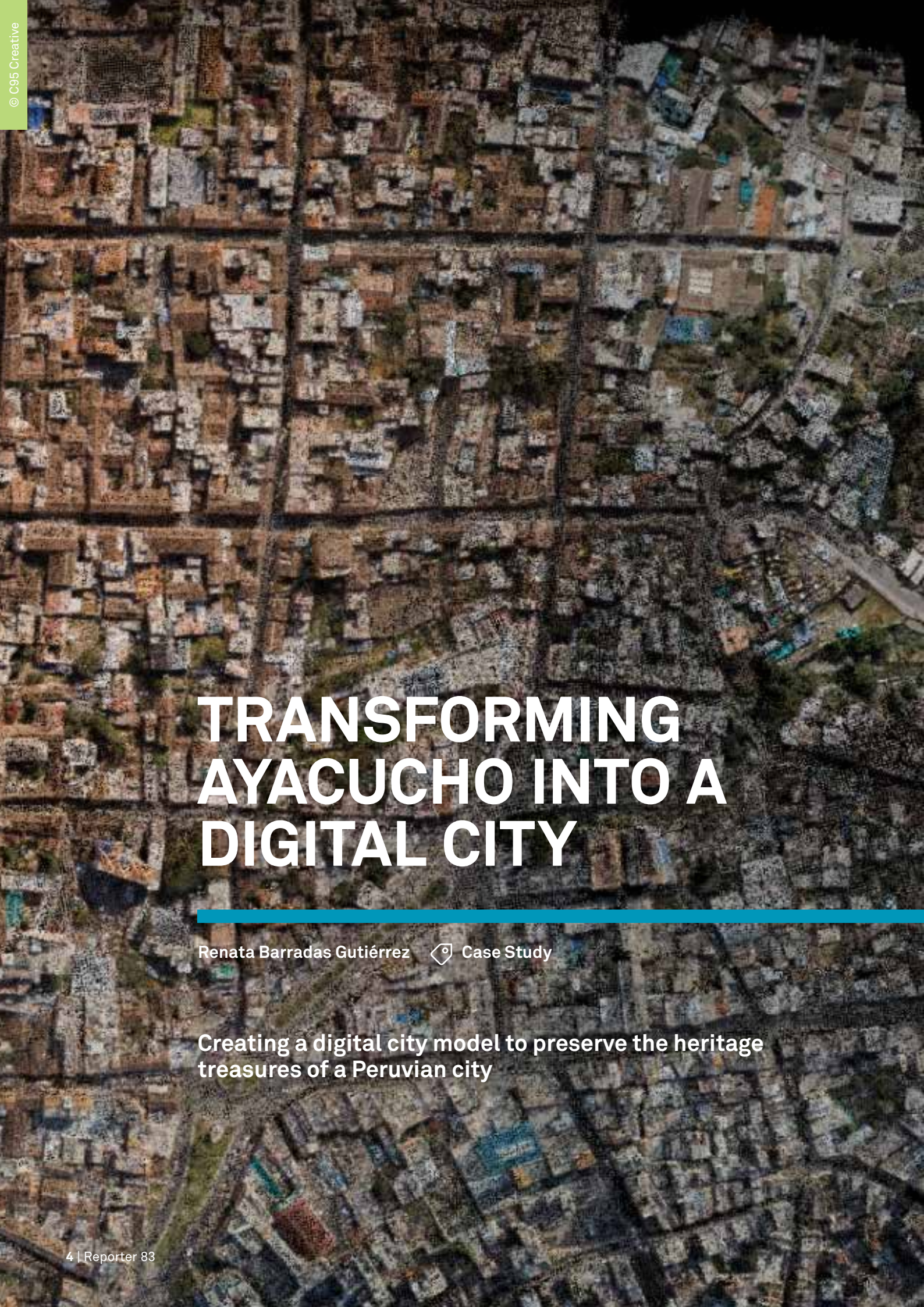
To further enable the digitalisation of workflows, we are introducing three new technology innovations that you can read about in this edition of Reporter. Our latest laser scanning solution, the Leica RTC360 and the Leica BLK3D 3D Imager, use edge computing to provide on-device processing to automatically bring digital data into a workflow. Our newest UAV solution, the Leica Aibot, is fully integrated into an ecosystem of processing software regardless of your application.

When workflows are digitalised, projects are completed faster with less rework, professionals be-come more productive, and businesses are more profitable. At Geosystems, we are not only dedicated to technology innovation but to moving your business and our entire industry forward. Together, the possibilities are limitless.

Enjoy your read.

Jürgen Dold

President, Hexagon Geosystems



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TRANSFORMING AYACUCHO INTO A DIGITAL CITY

Renata Barradas Gutiérrez Case Study

Creating a digital city model to preserve the heritage treasures of a Peruvian city

© C95 Creative

Digital cities initiatives aim to collect valuable data and capture all surroundings in urban settings to generate smart models, supporting decision making processes and facilitating the delivery of new urban services. The mobile mapping, reality capture, airborne and asset management solutions provided by Hexagon's Geosystems Division are used in cities around the globe helping to digitise urban centres.

Aware that 3D models help to inform the perception on reality and provide a georeferenced digital base for operations in a city, Patronato Pikimachay, a non-profit organisation, approached C95 Creative, a leading global architecture and design firm, to create a smart digital city model of Ayacucho, Peru.

AYACUCHO'S SMART DIGITAL CITY PROJECT

C95 Creative specialists started the 3D digital modelling of this Peruvian city in 2017. To undertake a precise digital survey that would be the basis for a digital city model, the project collected georeferenced point clouds with images from 150 blocks in Ayacucho's historic centre. Using a combination of Geosystems solutions, data from a **50-kilometre trajectory was collected in three days** and the entire project deliverables were completed in six months.

"A valuable data base for smart cities is essential during the decision making of future urban interventions. We have been able to generate data bases of great value for cultural heritage, cataloguing, restoration and refurbishment works. We will keep exploring and looking for new ways of applying this technology in our sector with Leica Geosystems," said Irene Ibisate, architect and director for the smart city Ayacucho project at C95 Creative.

Beyond the speed of obtaining and processing data, the quality and precision of the point cloud with overlaid images allowed C95 Creative to:

- Create a 3D model of the entire city centre
- Complete a catalogue of the main city elements
- Develop a study of the current situation and conservation state
- Do a cultural heritage value and conservation study
- Produce updated 3D cadastre and geometric data base of the city with real dimensions
- Generate videos and images of the city to serve as reference for future intervention works.

"To create in BIM [Building Information Modelling] a reproduction of an entire city in a few months was a great challenge. Thanks to the precision and speed obtained with Leica Geosystems products, we have been able to capture reality with complete data in a short amount of time," said Ibisate.

DIGITALISING ENVIRONMENTS

Given the limited time for data collection and great extension of the site, scanning had to be fast. Reality capture systems from Geosystems increase the flexibility and mobility of professionals to map, geo-position, capture and extract features over LiDAR or photogrammetry measurements in restricted areas with millimetric precision in an extremely agile and effective way.

To capture the entire centre of Ayacucho, C95 Creative started the data collection with the Leica Pegasus:Two. With this mobile mapping sensor platform, data from a 50-kilometre trajectory was collected in three days. Laser scanning was done with the Leica ScanStation P40, to increase the level of detail of the pedestrian areas and squares with cultural heritage assets.

“It would be impossible to do this type of project with traditional solutions and tools. The speed and precision that Leica Geosystems products have allowed us to work remotely with a total knowledge of the site,” said Maria Pascual, BIM director at C95 Creative.

The data was processed and exported as imp.pts to Autodesk Revit, a BIM software. Leica Cyclone 3D point cloud post processing software, was used to post process the point clouds. To create a BIM model, the team worked with Leica CloudWorx and Leica JetStream software, allowing the better modelling and inclusion of the point cloud within the Autodesk Revit model.

“To establish the point clouds as the database was the only way to pursue a project of this magnitude. To make our BIM model through powerful products like JetStream helped to speed and invigorate this process. Projects end up with an added value due to the quality and precision obtained from these latest tools, which allow to create a large data base available in different formats and platforms,” said Pascual.

BEYOND CULTURAL HERITAGE VALUE

Urban planners, construction companies or government officials need to have a more dynamic perception of a city with georeferenced data that mirrors reality to produce any application or service and **guide any future interventions.**

3D models allow to document, manage, renew or maintain the assets in a city. To meet UNESCO's standards and have the historic centre of Ayacucho declared as a World Heritage Site, recovery and maintenance works need to be made. A digitalised city model would be the cornerstone to create more sustainable and efficient urban environments critical to social and economic development.

The 3D models delivered by C95 Creative will be the base for any architectural intervention within the area, guiding the cultural heritage evaluations and reconstruction of protected city elements, which could degrade through time.

Beyond the cultural heritage value, the deliverables have also been used for other purposes, such as:

- Virtual reality (VR) and augmented reality (AR) of Ayacucho
- Previsualisation of plans
- Urban simulations
- Touristic applications
- Urban improvement analysis.

UNLEASHING THE FULL POTENTIAL OF REALITY CAPTURE

C95 Creative takes design to the smallest detail. One of the international leading firms in the AEC sector knows quality tools matter, so it has been using Leica Geosystems products for a long time.

"C95 has found with Leica Geosystems reality capture solutions, the perfect tools for its BIM work flow. The Pegasus:Two allows to generate data of big areas in a short amount of time. The P40 is used for interior design, rehabilitation, restoration, refurbishment, engineering and architecture for its scan precision and speed. It is used together with the BLK360 to generate data of different landmarks of a site, and obtain as-built models. In addition, the point clouds are used for any kind of digital surveys, data collection for simulations, reports, VR and AR," said Pascual.

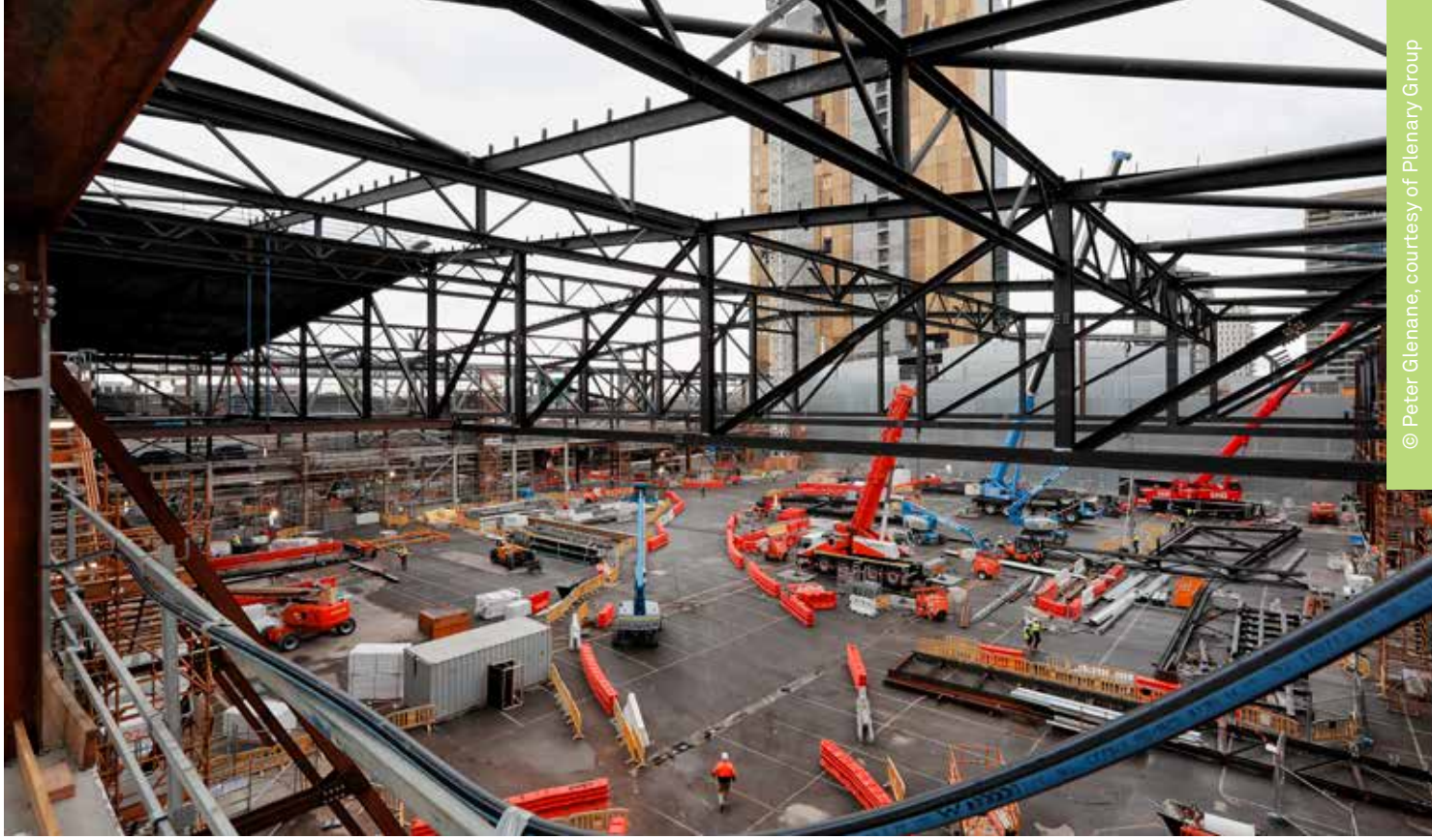
To stay relevant, improve processes, keep increasing the quality, and give an added value to all its projects, C95 Creative keeps introducing Geosystems state-of-the-art technologies and processes in its works.

EXPANDING MCEC – LARGEST CONVENTION AND EXHIBITION SPACE IN AUSTRALIA

Tamara Stakic

Case Study

More than 4,000 tonnes of steel precisely set out for the extension of Australasia's leading meeting and conference centre



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The Melbourne Convention and Exhibition Centre (MCEC), located in Australia, is undergoing an expansion to help the world's most liveable city retain its position as the meetings and events capital.

The **20,000-square-metre expansion** includes 9,000 square metres of:

- Flexible, multi-purpose event space
- New exhibition halls
- Additional meeting rooms
- A banquet room
- A new café and bar.

When completed the new space will cement MCEC's position as the **largest convention and exhibition space in Australia,** with an increased **total size of more than 70,000 square metres.**

The expansion is part of a larger South Wharf expansion project that includes a new **347-room** Novotel Melbourne South Wharf and a **new 1,150-space multi-level car park** – all fully connected and integrated with existing buildings. The car park is complete, and the new hotel recently opened.

The Victorian Government provided $205 million AUD for the expansion of MCEC, and the State's partner Plenary and its partners Flagship Property Holdings and Vicinity Centres are investing more than $150 million AUD in the new hotel and car park.

Melbourne-based steel fabricator Stilcon is one of the many local companies working on the project, engaged by the project builder Probuild to manufacture and install the entire steel skeleton for the new exhibition hall, convention centre spaces and the car park.

Stilcon is providing a complete steelwork package – steelwork processing, cambering and painting, transportation to the site, and finally the onsite erection. All this is done from fabrication at their facility in Melbourne's west.

Central to Stilcon's work is the **fabrication of five 85-metres-long trusses,** weighing more than 70 tonnes each. Each truss is comprised of eight 21-metre modules, ranging from 5 to 10 metres in height.

The finished product, comprising of **4,300 tonnes of structural steel,** combines the highest levels of strength with structural integrity and manoeuvrability for safe, stable installation.

A PROGRESSIVE APPROACH TO DELIVER A COMPLETE STEELWORK PACKAGE

To speed erection times and create better safety exclusion zones onsite in Melbourne's busy central business district, Stilcon employed a more progressive approach to constructing the steel frame for the new four-level carpark.

© Peter Glenane, courtesy of Plenary Group

The method of steel erection proved to be a crucial time saving aspect allowing the façade contractor and concreter to proceed onsite unconstrained and work in parallel with the steelwork contractor. Stilcon site engineer Adam Tierney explained this 'vertical method' focuses on a full-height straight-up build of a section of the structure, which is replicated in turn across the building width adopting the same principal approach.

Stilcon adopted the approach to allow trades to access the full height structure earlier, while the steel erection crew could work a few bays ahead, rather than the more common horizontal floor-by-floor build sequence. Increasing the number of bays built also provides a safety buffer zone between steel erection and follow-on trades, which is an Occupational Health and Safety (OHS) requirement on the site.

"The flatter 'horizontal' approach is how most other multilevel carparks have been traditionally built in steel or concrete which spreads the floor area out wider, limiting the ability for multiple work fronts," Tierney said.

The vertical build method involved firstly constructing a single square grid bay using full-height (13-metre tall) columns with some temporary propping to achieve plumb erection. All primary and secondary floor members are erected starting from the lowest level, resulting in a complete four-level-high bay of steelwork.

Once the initial bay was completed, secondary bay structures were then built in two directions, allowing a block of bays to be completed sooner by Stilcon to be handed over to follow-on tradespeople.

In this case, the metal decking was laid first on level two followed by level one. While metal deck laying was occurring on level one, the reinforcement placement began on level two. The slab was then poured on level two, creating a safety deck between the upper and lower structure.

Then steel reinforcement was installed, and concrete poured on level one as well as the steel decking laid for level three by the installer working off the poured level two.

FROM THE GROUND, UP

To provide crucial time savings and accuracy, Stilcon turned to Madigan Surveyors, a professional surveying firm that provides a

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complete range of services to the construction industry and allied professionals. Madigan Surveyors used Geosystems solutions to precisely set out all steel connections to an existing structure – from ground slabs where the column anchor bolts and base levels are precisely set out to horizontal connections into existing structural slab edges or walls.

Geosystems solutions were used to manage the construction layout for connections to existing structure, ensuring that the construction team were working to the as-built condition rather than the design.

In addition to capturing as-built conditions, as-built surveys captured newly built structures as part of the quality assurance procedures and to also set out existing walls for any member connections.

Due to the higher flexibility and movement in steel structures, the survey scope also included monitoring of the main exhibition hall roof trusses.

Trusses were monitored throughout the entire build cycle. During the monitoring stage, the project team captured the defection of the trusses at initial erection stage when the truss is initially under own self weight. Further monitoring was conducted as the roofing, truss cladding and operable wall systems were loaded onto the trusses.

SIMPLE LAYOUT, EASY SETUP

Stilcon also recently purchased the iCON robotic construction total station due to its ability to tie neatly into established building construction workflows and **rapidly speed up installation preparation and construction tasks.** A solution which Andreas Caleta, Stilcon surveyor, favours for its **simplicity and ease of use.**

The Leica iCR60 has a **simple and guided setup routine designed for minimal use error** to give users the confidence for an error-proof setup routine.

“The iCON robotic total station is the fastest, reliable and easy-to-use layout solution, making it one of the most productive one-person layout solutions for construction professionals who have a need for positioning tasks and bringing design to reality,” Caleta said.

TRANSFORMING THE ACCURACY AND PRECISION OF ON-SITE DATA CAPTURE AND TRANSMISSION

Special to Reporter from AMT-SYBEX, part of Capita plc

Case Study

Building a new mobile solution using high-precision GNSS equipment to measure and map the utilities in the United Kingdom

© Wales and West Utilities

Britain's gas network is the oldest in the world, dating back to the early 1800s, and although its gas mains have been upgraded over time, many thousands of miles of pipelines are still made from cast iron and other ductile metals. Over time, these pipes degrade and may eventually fracture, leading to gas leaks that impact the environment, reduce efficiency, increase costs, and can pose a danger to people and buildings.

Set up as an independent network in 2005 after previously being part of National Grid, Wales & West Utilities operates 35,000 kilometres of gas distribution pipelines that transport gas to 2.5 million homes and businesses throughout Wales and the southwest of England. The company's priority is to keep its 7.5 million customers safe and warm with gas connections and a gas supply they can rely on, and a level of service they can trust.

As Wales & West Utilities replaces old metal gas mains with new, long-lasting plastic ones across Wales and the southwest of England, it wants to be sure that those new pipes are easy to find and maintain in the future.

As it upgrades its pipes, the company also wants to upgrade its data and gain an even more accurate understanding of where its assets are. Wales & West Utilities has worked with AMT-SYBEX and Leica Geosystems to build a new mobile solution that uses high-precision GNSS equipment to measure and map the exact coordinates of each new pipe as it is laid, as well as capturing important metadata about valves, junctions and other components. Capturing the information digitally has numerous benefits:

- Digital data capture saves time for field engineers and back-office teams
- High-precision GNSS increases the accuracy of asset data and reduces the risk of errors
- Asset data can be transmitted from the field to the office in seconds, not days
- Eliminates paper-based processes, cuts costs and reduces environmental impact
- Future maintenance work should be safer and more efficient due to better location data.

PUTTING SAFETY FIRST

Safety is a top priority for Wales & West Utilities. The company invests £1.4 million pounds a week in replacing all old metal gas pipes within 30 metres of buildings with new plastic ones – reducing leakage and improving safety.

Replacing these metal mains with more modern plastic pipes can significantly improve the security and reliability of the network, reducing the risk of leaks and the number of repairs required. For this reason, the Health and Safety Executive has advised all the gas distribution

© Wales and West Utilities

networks to accelerate the replacement of metal main, especially those that are within 30 m of a building.

Wales & West Utilities has taken this advice on board and is already nearly halfway through a 30-year replacement programme. On average, the company replaces more than 400 km of pipe every year.

Beverley Robinson, data records manager at Wales & West Utilities, comments: “It’s a huge programme, and it’s very important for the business and for the regulator. In addition to capturing the information in the field my team is responsible for validating the data that comes in, keeping our asset repository up to date in our SAP ERP business systems, and producing reports for the regulator about our replacement programme progress.”

Part of the effort is to ensure that when the new pipework is laid, the company updates its asset data to keep track of how the pipes, valves and joints fit together, what they are made of, and where to find them. Recording the position of a pipe accurately may seem like a simple task, but it can create complex problems.

PROBLEMS WITH PAPER-BASED PROCESSES

Simon Barrett, records officer at Wales & West Utilities, explains: “In the past, our measurement engineers would go out on site with a paper map, a clipboard and a measuring wheel, and would draw the new pipes on the map with measurements relating to above-ground points of reference. For example, the pipe might run parallel to a road at a distance of 75 centimetres from the kerbstone.

“But what if a few years after we’ve laid the pipe, the road is widened and the kerb moved? Then our reference point is no longer accurate, and our crews could easily end up digging in the wrong place. Or what if we’re laying a pipe somewhere that doesn’t have any convenient reference points nearby, such as the middle of a field?”

After the initial data was captured, the downstream processes were also laborious. The engineers would scale up their field sketches and draw the new pipes on a larger map, which they would post to head office. Then the head office team would review the map and enter the data into the company’s central mapping system, Esri.

“We had to wait days for the latest information to arrive from the field, and processing the

data was time-consuming for everyone," adds Robinson. "We also used a lot of paper, which was wasteful and impractical. Our measurement engineers need to be able to work outdoors in any conditions, and when it's raining or windy, dealing with paper maps can be a big problem."

FINDING A SOLUTION

Wales & West Utilities wanted to find a solution that would take the burden of locating assets away from the user, and provide a precise, unambiguous view of where each pipe is laid. It also wanted to digitise the whole workflow and reduce manual effort at every stage.

"For a few years, our leakage teams have been using a mobile solution called Affinity Geofield from AMT-SYBEX, which gives them access to accurate mapping data while they're working on-site - even if they're in a remote area where they don't have a mobile data connection," says Barrett. "When we saw that Geofield could be used for drawing assets too, we saw its potential to help with some of our paperwork issues."

To solve the other half of the problem, the company decided to use Leica Zeno, high-precision GNSS equipment from Leica Geosystems, to locate each pipe's geographical coordinates to an accuracy of centimetres. However, integrating the Zeno GNSS hardware with Geofield would be a first-of-its-kind project.

"One of the biggest challenges was to ensure that the system would still work even if our measurement engineers lost their data connection," explains Barrett. "Normally, the system works by using HxGN SmartNet Real-Time Kinematic GNSS services. The engineer holds a receiver, which takes positional data from a constellation of GNSS satellites. These readings are then compared with the readings taken by nearby base stations, whose precise locations are already known. By comparing the two, you can correct any errors in the readings and achieve incredible accuracy.

"However, if you don't have a mobile data connection to the base station, you can't compare the readings, so you can't do the correction. Since our engineers often work in remote areas where there's little or no mobile phone signal, this was potentially a big problem."

The project team solved this challenge by building a post-processing feature – if Geofield can't find a mobile data connection, it will store all of the uncorrected readings from Zeno equipment locally until the connection is re-established. Once connectivity is restored, it can then process all of the readings in a batch, and provide accurate, corrected geo-positioned data.

© Groothedde

FROM TAPE TO POINT CLOUD

Arno Kijzerwaard

Case Study

DISTO™ laser distance metre to 3D laser scanning with BLK360 in the Netherlands

To measure is to know.

This phrase is the basis on how we acquire knowledge and improve any method. This phrase, eventually, is also used by people with dimensioning-related professions, such as Pascal Groothedde, owner of the engineering company Groothedde in the Netherlands.

Groothedde specialises in construction, project management, architectural inspections and budgeting. The projects the company undertakes are often in the retail business (shop-fitting) or related to building construction. Reality capture has taken Groothedde to expand his business portfolio, delivering 3D models and CAD drawings much faster and detailed than with traditional methods.

FROM POINT-TO-POINT, TO MILLIONS OF POINTS

In the past, when dimensions were needed, the measuring tape was used. The tape measure was later replaced by a laser distance metre. Since Groothedde works often by himself, a Leica DISTO™ S910 laser distance metre eased the job. As projects gained complexity, the DISTO™ with 3D measurement technology proved to be the right tool. With point-to-point measurement technology, Groothedde could capture accurate measurements in 3D from one single tripod position in, for example, old buildings, measuring the walls and ceilings, which not always are perpendicular to one another.

The DISTO™ S910 is still used when a customer only needs a few dimensions, but recently, Groothedde invested in the Leica BLK360 imaging laser scanner, opening new opportunities for his company.

Using the 3D imaging laser scanning, Groothedde discovered a **fast and uncomplicated way to capture measurements and as-built information.** With the BLK360, combined with an iPad Pro with Recap PRO mobile, an **efficient workflow** is in place to make 2D floorplans, cross sections and 3D models.

“It is always a challenge to capture the right information for each project. You want to measure as much as possible on site to make sure you have everything you need when you arrive at the office, but you can only work within the possibilities of the equipment you have. Previously, the projects were measured with a traditional DISTO™.

”Due to the current developments in 3D laser scanning, and the release of the BLK360, we decided to invest in the imaging laser scanner. Since the BLK360 measures up to 360,000 points per second, we don’t have to worry if we have enough points measured on site. I can now take on different and more complex projects than ever before and better meet the needs of my customers,” said Groothedde.

SMALL DEVICE, BIG PROJECTS

One of the first projects where Groothedde used the BLK360 was an architectural masterpiece of the Tilburg University in the Netherlands. With almost no straight surfaces and curved walls, the BLK360 proved immediately its strength.

The BLK360 is also used by the company to capture the reality of retail buildings. Shops in old city centres have a complex layout and are often built with no straight walls and straight lines in the interior. Using the BLK360, Groothedde was not only more efficient capturing a set of stores in the centre of Nijverdal, Netherlands, but also caused less disturbances to the businesses. The captured point clouds generated 2D floor plans for the contractor. Where a project in the past used to cost a day, now reality capture is done in **one or two hours.**

The 3D imaging laser scanner also made it possible to scan from the outside a **4750-cubic-metres** building to be remodelled in a luxurious apartment. The owner needed dimensions for the planning, and the **lightweight, 1-kilogram** BLK360 proved to be big enough for this task.

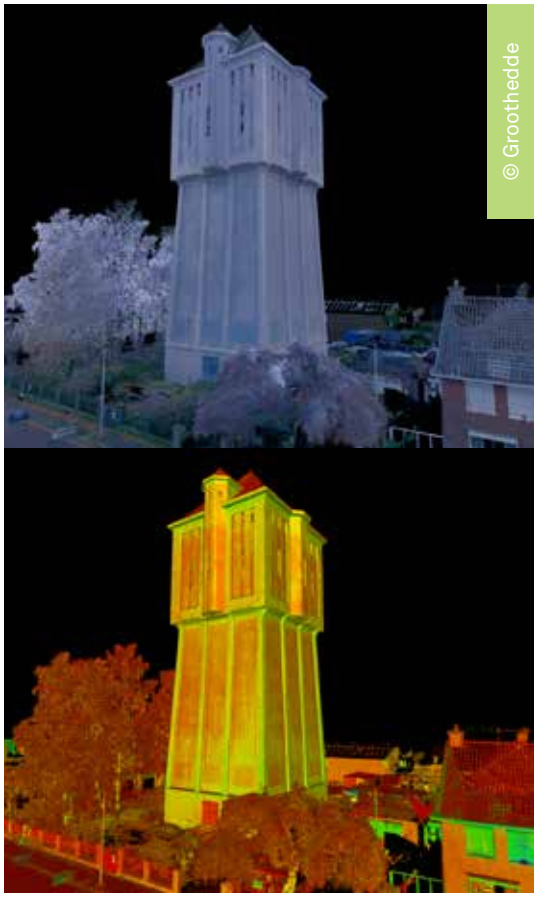
“Due to the small dimensions and the 60-metre range of the laser scanner, it was possible to get in the smallest spaces. Even a few scans from the gutter, at 31 metres above ground level, were made due the small size of the scanner. On the other hand, it was possible to measure the façade from ground level,” said Groothedde.

LOOKING AHEAD

With a DISTO™ S910 and the BLK360, Groothedde covers most of his building construction and retail project needs. Projects can be done faster, and the point cloud data can easily be used to make 2D floorplans, cross sections and complete 3D models in, for example, AutoCAD or Revit.

“The BLK360 offers excellent value for money. In combination with the iPad Pro, it gives immediate feedback in the field – with the tablet you can instantly see what you captured, what you need, and if the scans have enough overlap,” said Groothedde.

For the future, Groothedde wants to grow his 3D measurement business by delivering higher accuracy and cloud sharing detailed point clouds.



DESIGNING A DAM MONITORING SYSTEM

Craig Hewes

Case Study

Intelligent GPS monitoring systems safeguard critical infrastructure in California, United States

In early 2017, winter storms filled and then overfilled reservoirs in California, USA, leading to the evacuation of hundreds of thousands of citizens near Lake Oroville, California's second largest manmade lake.

About 160 kilometres away, the Pardee and Camanche reservoirs also filled from the 2017 storms, reaching 103 per cent of capacity in March, but the dams were not overtopped, and releases were sustainable within the waterways.

Thanks to the installation of one of the nation's most advanced automated GNSS-based dam monitoring systems at these two facilities, along with other instrumentation improvements, East Bay Municipal Utility District (EBMUD) had the technology in place to **monitor crest elevations at these dams and dikes remotely** with improved temporal resolution. Having this type of data available is one more tool in an infrastructure owner's tool belt for monitoring the condition and performance of critical facilities.

DESIGNING FOR BETTER DATA

Consulting with Sensemetrics, a firm specialising in networked sensor applications based in San Diego, USA, EBMUD designed and proposed a sophisticated monitoring system based on:

- 31 Leica GMX901+ GPS sensors
- Four Leica GM10 GNSS reference stations
- A radio network consisting of 900 MHz mesh radios
- 2.4 GHz repeaters and two radio towers
- Leica GNSS Spider and GeoMoS software solutions.

The use of Geosystems receivers is important, according to Cory Baldwin, president of Sensemetrics: "The GMX901+s are purpose-built for remote monitoring applications, with non-exposed, built-in antennas," he says. "They were my first choice here, because other vendors don't really have a good option for monitoring in this environment."

Three of the GNSS reference station receivers are solar powered and one is powered by a 120v AC feed. All are securely fastened inside enclosures installed near the Leica AR20 antennas, which are mounted on concrete pedestals. **The network is largely autonomous, needing only occasional attention.** Data flow is through 900 MHz and 2.4 GHz spread spectrum radios into an existing microwave telemetry link to EBMUD's business intranet at its Oakland headquarters, where a server runs the Spider and GeoMos software necessary to process the GNSS data and results. The results are then presented through software customised by Sensemetrics.

Five of the GMX901+ sensors as well as four seismographs are installed on the Pardee Dam connected via fibreoptic cable directly to the microwave business intranet. **These instruments continuously monitor dam movement and report remotely.** Two of the GM10 reference stations were installed near and on either side of Pardee Dam and are connected to the fibreoptic line by 2.4 GHz radio connections.

Downstream from Pardee Dam, the Camanche Reservoir site consists of one large earth-filled dam and six dikes. The Camanche Reservoir is primarily used to control releases to downstream agencies and maintain flows for the salmon. Twenty-six GMX901+ sensors are installed around the reservoir, and these also monitor and report continuously.

A COMPLETE PICTURE OF INFRASTRUCTURE PERFORMANCE

The State of California Division of Safety of Dams (DSOD) requires semi-annual monitoring surveys. The new system provides **accurate information more rapidly, reduces staff time spent on monitoring,** and is capable of being **tied into state-wide emergency and seismic monitoring systems** as they emerge. After almost two years of service, DSOD monitoring requirements have been met with a more complete picture of overall performance.

"EBMUD's infrastructure is spread out over a vast area and covers multiple counties," says Baldwin. "In particular, the Pardee and Camanche sites are several hours away from main offices, and the semi-annual surveys

[conducted previously] took over a week to complete. This new system provides more accurate data, more or less constantly, and, of course, reduces the time survey crews spend on this task. It's a big improvement, and it is performing beyond expectations."

Baldwin says one important design goal was interconnectivity with existing and future monitoring systems. The potential to **automate and improve emergency responses to seismic events** is a major advantage of monitoring networks.

EBMUD now has more survey information immediately at its fingertips regarding structure performance than at any previous moment in the district's history. By being proactive and automating monitoring systems, EBMUD has greatly improved dam safety monitoring.

"The GPS system at Pardee Dam now gives us a complete picture of the seasonal deformations due to thermal expansion and contraction of the concrete structure," says Steven J. Martin, survey supervisor for EBMUD. "With the Camanche Reservoir portion of the GPS monitoring system, we are able to meet DSOD monitoring requirements without long trips out of town by the survey crew and to check for any possible deformations remotely in near real time."

AUTOMATED DAM MONITORING IN ACTION

A recent example of the benefits of automating a survey monitoring scheme comes from another EBMUD automated dam monitoring project on San Pablo Dam in California, USA. In 2008 and 2009, the dam underwent a seismic improvement to buttress the toe of the dam to bedrock using a cement deep soil mixing process. Increased monitoring requirements from the DSOD, while working on an active dam, were met via an Automated Motorised Total Station System (AMTS), which has been running several times a day since that project was completed in 2009. EBMUD also has a program to visually inspect dams and reservoirs immediately after an earthquake to check for cracking or other visible damage as a quick ground truth.

© East Bay Municipal Utility District (EBMUD)

After a 4.4 magnitude earthquake in January 2018 on the Hayward fault centred in Berkeley, less than 8 km from the San Pablo dam site, EBMUD geotechnical engineers were able to log in to the AMTS automated monitoring system to **review whether there had been any actual movement or slumping on the dam**, and they confirmed that there was no significant movement. This ability to have information immediately and at their fingertips has proven to be a huge asset in managing dam safety at EBMUD.

© East Bay Municipal Utility District (EBMUD)

BEYOND THE VISIBLE

Monica Miller Rodgers Feature

Johannes Hotz discusses the latest innovation, the Leica BLK3D

Johannes Hotz

Business director at
Leica Geosystems

Wouldn't it be nice if you could measure within a photo? Just take the photo on a device, touch the photo between point A and point B, and acquire the exact measurement you need?

The thought of this ideal situation was the starting point for the BLK3D development team. The result is the latest BLK innovation: a handheld device allowing for in-picture measurements. Now capturing multiple accurate measurements at once really is as simple as taking a photo on your smartphone.

The Reporter sat down with Johannes Hotz, business director, to learn more about the new BLK3D.

- **The BLK3D is the newest in a line made for professionals who need simple measurements in their daily work. Can you tell us more about the innovation?**

When we initially analysed the market, reviewed competitive product offerings and conducted several interviews with existing and potential customers, we quickly realised that there is a huge demand for a tool that captures visual information, and provides inspection-grade 3D measurements that are automatically indexed to structural plans as well as location and date stamped.

There are several, image-based collaboration platforms out there. They take millions of photos to document construction site progress, however, not a single of those pictures allows you to determine the exact position of a pipe that now, for example, may be hidden by natural construction site progress.

The BLK3D delivers on all afore mentioned needs. It is a handheld, Android-based, 3D, in-picture measurement system and project organiser powered by photogrammetry and innovative edge computing. It creates a completely new market category for measurement and documentation related devices. It enables professionals who need measurements to carry out their daily tasks to effortlessly capture and manage digital data. Plus, it works both indoors and outdoors. This ensures the support of many use cases across many different industries – from the Architecture, Engineering, Construction (AEC) market, forensics to supporting insurance companies and loss adjusters.

- **When starting the project, what was your target to achieve?**

We wanted to establish a cross-functional, multi-cultural team of specialists around the world to achieve something great. We wanted to use the great technologies we have available within Hexagon and create a product that - at this point in time - simply didn't exist. The entire development team had one major target - bring a vision to life, develop exclusive technologies and make those available to the widest variety of people who never thought this would even be possible – the BLK approach. We used existing technologies, re-invented them in terms of how we use them, miniaturised the system, and made it for real time.

- **How does the BLK3D work?**

If you can take a photo with your smartphone, then you already have all the skills you need to use the BLK3D. Simplicity was the most important design principle throughout the entire project.

To be more precise, the BLK3D uses on-device edge processing to make multiple, 3D image measurements available on the device in real time. Users only have to take the photo, and then they can create 3D measurements in a 2D photo.

Once captured, all visual measurement information is indexed and automatically stored in chronological order, together with all assigned tags. Those measurements can then be exported as pdf and shared with other project team members or sub-contractors. There is even the option to create or digitise 3D objects (points, lines, areas) out of the image and export those into various CAD formats.

Ultimately, there is the possibility to create BLK3D floorplans. Here, the user can attach BLK3D images to each wall of the room and review those images over time. Meaning, users can document entire construction progress and review and measure it at any point thereafter.

Finally, we developed a new desktop application that allows users to comfortably measure in the BLK3D images and easily organise all projects and photos ever taken.

- **Who is the BLK3D made for?**

Keeping in line with the values of the BLK line of simplicity, seamless integration, design orientation and highest quality standards, we designed the BLK3D so it provides quick and precise measurements in the most simplistic way possible.

The capturing, visualising and indexing of the 3D measurement information with on-device edge processing allows for instant interaction. Especially beneficial to those in structural work in the different mechanical, electrical and plumbing (MEP) stages, along with architectural, facility management, window fitting, insurance adjusting, public safety and utility professions, the BLK3D reduces time and resources required to measure and document a job accurately.

- **What benefits will customers enjoy with the BLK3D?**

The main benefits are time savings and simplicity. As mentioned before, there is nothing simpler and quicker than taking a photo of an object and then having the option to measure everything captured in 3D.

The BLK3D combines sensors and software in one handheld device. All captured data is processed on the device itself and measurement information is immediately ready for user interaction, significantly decreasing the time of traditional methods. There is no need to be connected to a network or cloud to access image-based measurements, and the imagery is incorporated into different construction phases, automatically creating a chronological project progress history. Next, there is familiarity and simplicity. The user experience of the BLK3D is based on familiar swiping gestures and straightforward, self-explanatory app functions. No additional training is needed to use the already-familiar device. Then there are precise results.

The BLK3D provides high accuracy, ensuring you have the right information with no need for rework. Finally, there is the all-important safety. From a single image and remotely, users can access all the information needed – height, width, depth and area. No longer needing to access hazardous spaces, crews are kept safer on site.

TAKING INTELLIGENT CONSTRUCTION TO A NEW LEVEL

Karina Lumholt

Feature

Geosystems' machine control delivers game-changing platforms to help companies prepare for the digital disruption

The construction industry, one of the largest and most dynamic industries in the world, is also one of the least digitalised ones. This industry is facing major challenges – on average 80 per cent of all construction projects are over budget and overrun schedule by 20 per cent. In 2014, Surety Information Office estimated that one in four construction companies went bankrupt between 2011 and 2013.

The future of the construction industry seems to demand additional construction work with more complex designs and execution. Environmental concerns and green construction will further push the industry to work in a more efficient way. International trends, such as automation, shortage of skilled machine operators, and millennials entering the workforce and expecting more digital systems, will further create a demand for digital tools.

The construction industry is, in other words, **ripe for digitalisation** and Geosystems' machine control is ready to support by developing new game-changing platforms to help companies prepare for the digital disruption.

AN EVOLUTION IN MACHINE CONTROL

Geosystems has developed a new revolutionising horizontal platform for all solutions. The new Leica MC1 software supports the digitisation of the heavy construction industry by offering one software solution platform to automatically guide and control all heavy construction machines.

The new software smoothens data handling and is open to **all standard data types,** enabling a flexible dataflow to support all workflows on a job site. It is carried by the rugged new hardware platform – the Leica MCP80 panel and MDS Series docking station, ensuring an interchangeable panel between machines on a job site. The new platform is **fully supported** by digital collaboration software tools, such as the cloud-based Leica ConX.

CLOUD-ENABLED DIGITAL COLLABORATION

Personnel and machines on the jobsite need to share the same data and stay in sync with changes so work can be completed on time, on budget and to specification. ConX is an open and user-friendly data handling platform that increases collaboration control operations by:

- Integrating and automating workflows
- Permitting remote control of connected machines
- Enabling real-time data exchange from the office to the field and back.

ConX also allows users to share and visualise positioning, reference model and constructed


© Leica Geosystems

data. Field and machine control solutions connected to ConX can remotely receive and share information and access the web interface for visualising the data anywhere with internet access.

MANAGE, MONITOR AND SHARE CONSTRUCTION AND SURVEY DATA IN REAL TIME

All customers will be able to benefit from the new platform consisting of the MCP80 panel, MDS Series docking station, MC1 software, and ConX data handling tool. Smaller construction companies will benefit from the ease of use of the new intuitive user interface with integrated help functions and remote support via ConX. The new machine control solutions **integrate seamlessly** with older solutions and the customer is supported by the biggest support network on the market.

Claus Agger Sørensen from VG Entreprenør in Denmark explains: “I have the entire dataflow at my fingertips, and via ConX, I can support and help my machine fleet remotely, even when I am working in another part of the country.”

ConX ensures that all machines and personnel **have the same data at the same time in real time.** This minimises errors and costly rework and ensures more uptime.

PRECISION MATTERS

‘Precision matters’, is a key motto for Geosystems – the organisation's long-time solid footprint in the surveying industry has proved it. For larger construction companies, it is important to work with a partner that has a profound knowledge of all workflows in a complex construction process.

“We soon realised that the crucial thing was to have really strong aftermarket service and support. We needed someone we could rely on for guidance and training, but more than that, we needed someone who knew what our work involved and what technology might help us do things even better – someone with innovative ideas, someone we could work with, someone to innovate for us,” said Phil Butterfield, operation manager at JBG Contractors in Australia.

PART OF SOMETHING BIGGER

The long-time use of synergies to leverage technology across divisions and the cooperation with other Hexagon divisions has proved very successful.

To keep people and machinery safe and productive, Geosystems' machine control developed in conjunction with Hexagon Mining the new Leica iCON Personal Alert System (PA) and Visual Aid System (VA) series, which will be implemented in the Leica iCON portfolio by 2019. The iCON PA and VA series will integrate seamlessly with the MC1 and Leica MCP platforms to help prevent accidents.

Machine control solutions leverage cloud and digitalised construction technologies with simpler and intuitive interfaces. This helps users to finish construction projects faster, safer, and with lower costs, higher accuracy and more efficient use of resources.

DISCOVERING THE POWER OF SCANNING

Monica Miller Rodgers

Q&A

Juergen Mayer discusses the latest laser scanner, the Leica RTC360

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Juergen Mayer

Business director terrestrial laser scanning at Leica Geosystems

If you know laser scanning, then you also know the headache of registering and stitching together scans – meticulously spending hours to make sure everything fits just right to obtain the entire picture of a site. The latest 3D laser scanner by Hexagon's Geosystems division uses edge computing to make these pains a worry of the past.

The new Leica RTC360 is a light (only 6 kilograms) and small laser scanner that automatically records moving from station to station to pre-register scans in the field. The Reporter caught up with Juergen Mayer, terrestrial laser scanning business director, to find out the latest on the latest.

- **The RTC360 is the latest in the Geosystems 3D laser scanning line. Can you give us the scoop on what's new?**

JM Leica RTC360 is the optimal solution for maximum productivity on highly challenging and complex site conditions where the environment, the accuracy, the reliability and the speed of operation are of the utmost importance. The RTC360 is tuned for short to medium scan ranges and High-Dynamic Range (HDR) applications, which require the highest possible level of accuracy. It is equally suited for demanding indoor and outdoor applications. We gave particular care to workflow automation, integration of quality checks and real-time completeness checks. Combined with Leica Cyclone REGISTER 360 and Leica Cyclone FIELD 360 laser scanning software, high quality laser scan data is provided quicker than ever before.

- **We've heard a lot about edge computing lately. Can you explain what edge computing is and how does the RTC360 use it?**

The RTC360 solution uses edge computing by streaming in real time scans and automatically processes the scan data to provide real-time quality control and data registration in the field.

Unlike cloud computing, edge computing does not hold critical data centrally. Instead, this new process allows data to be streamed to mobile devices, enabling quicker access and more efficient analysis of data. For our users, this means they can pre-register the scans in the field and provide on-site QA for significant time savings.

- **Who should use the RTC360?**

The RTC360 was developed to make scanning accessible to professionals who need accurate data capture but may not be 3D data capture experts, yet. RTC360 solution is ideal for those working in plants, building construction and public safety.

- **What ROI are customers going to get out of this latest laser scanning innovation?**

The RTC360 was designed with simple and highly automated workflows in mind. This allows immediate productivity even for scanning novices. Innovative technology allows integrated near-real-time quality assurance and completeness checks of your field work. The novelty of automatic pre-registration in the field reduces the complexity and the time of your office work. High quality point clouds become immediately available for your design work. These time savings, workflow simplifications and productivity gains automatically translate into increased profits and accelerated paybacks. In addition, the solution puts you in a position to expand your business activities

pursuing new opportunities with new innovative deliverables. With the faster scanning and high portability of the RTC360, time on site is also reduced and safety is increased. Get in and get out faster with the increased accuracy you receive, affording you the opportunity to plan your work more efficiently off site so your time per scan is reduced by a factor of four.

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THE INTERIOR OF EARTH IN 3D

Special to the Reporter from the European Space Agency

Case Study

Producing the largest 3D scan of a lava tube in the Spanish island of Lanzarote

As a child, Tommaso Santagata, speleologist and expert in 3D cave mapping, would have never imagined that he would test some of the newest and most innovative 3D-scanning technologies for future space exploration. In 2017, he spent five days of intense mapping in Lanzarote, Spain, during the PANGEA-X (Planetary ANalogue Geological and Astrobiological Exercise for Astronauts) an European Space Agency (ESA) Spaceflight Analog field campaign. While the first results from that pioneering course keep flowing in, the adventurous speleologist has produced the largest 3D scan of a lava tube on Earth.

Along with geologists Umberto Del Vecchio and Marta Lazzaroni, he mapped most of the lava tube system as part of a project supported by the Cabildo of Lanzarote and the University of Padova, Italy. The resulting map comes alive in great detail, helping local institutions to protect this subterranean environment. It also provides scientific data to study the origins of the tube and its peculiar formations.

THE TERRAIN

The PANGEA-X expedition ventured into the "La Cueva de los Verdes" lava tube in the Spanish island of Lanzarote, one of the world's largest volcanic cave complexes with a total length of about 8 kilometres. The cave has both dry and water-filled sections.

The 6-km dry portion of the lava tube has natural open skylights, or *jameos* as the locals call them, that are aligned along the cave pathway. Some of the caves are large enough to accommodate residential streets and houses.

These formations are similar to those found on Mars and on the moon. Being underground structures, they offer good shelters from radiation. This similarity makes Lanzarote a great environment to train astronauts and simulate space exploration.

WHY 3D MAPPING INSIDE A CAVE?

When a new environment is discovered, mapping the area is always a first starting point of exploration. This also applies to missions to other planets, where one of the main objectives will be to choose places to setup base camp.

Lava tubes are environments with a constant temperature, shielded from cosmic radiation and protected from micrometeorites, providing safe habitats for humans.

Precisely measuring the geometry of lava caves will allow scientists to improve their models and better understand their evolution on other celestial bodies.

For these reasons, learning how to map lava tubes on Earth is helping exploration off Earth. ESA astronaut, Matthias Maurer, joined the expedition to test two different instruments developed by Leica Geosystems, the Leica Pegasus:Backpack and the Leica BLK360.

MOBILE MAPPING

Leica Geosystems mobile mapping team trained Maurer on how to operate the Pegasus:Backpack in just 20 minutes.

The astronaut walked through the difficult terrain and checked the results on the spot through a tablet. He performed his cave-mapping mission by walking along the tube and back to compare the accuracy of the data.

"Hiking and performing geological mapping with the high-tech backpack was easy and efficient. I can perfectly see it integrated in our spacesuits for future exploration missions to the Moon or Mars," said Maurer.

The Pegasus:Backpack synchronises images collected by five cameras and two 3D imaging LIDAR profilers, the laser equivalent of radar. It enables accurate mapping where satellite navigation is unavailable, such as in caves.

THE MISSIONS

The team did two different acquisitions with the Pegasus:Backpack to test all the positioning technologies embedded in this solution.

Both missions were processed with the Leica Pegasus Manager software.

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A version of this story first appeared in the European Space Agency blog.

1. THE FUSED SIMULTANEOUS LOCALISATION AND MAPPING (SLAM) MISSION

Starting from the outdoor with good GNSS conditions then going indoor in challenging GNSS conditions with very low or zero satellites coverage and finishing the mission outdoor with good GNSS conditions. For this type of mission, the team used multiple positioning technologies: GNSS + Inertial Measurement Unit (IMU) + SLAM. The processing software recognised automatically the different phases of the mission.

The Pegasus:Backpack, the first position-agnostic solution, could track Maurer's movements during the data acquisition, and the IMU recorded them 125 times per second. This way, the team obtains a first good trajectory with greatest accuracy at both the beginning and the end of the mission. The team needed to re-enforce the calculation for the part with zero satellites coverage using SLAM. At this stage, no pictures or point clouds are created. The part of the mission without any GNSS information used the trajectory obtained in the previous step as an input value to process the SLAM algorithm. The result is an improved trajectory with an estimation of the positioning error where point clouds, pictures orientation and spherical views are generated.

2. THE PURE SLAM MISSION

A pure SLAM mission is typically a mission in GNSS-denied environments, like buildings, caves and tunnels. The main positioning sensors used for this type of mission are the compass, the IMU and SLAM Only LiDAR (So LiDAR). Putting the parameters correctly, the complete mission could be **processed in one single click.** A basic trajectory of the Pegasus:Backpack was processed using information from the compass and the IMU. The complete mission uses this first trajectory as an input value to process the SLAM algorithm. Point cloud and pictures orientation and spherical views are generated with this trajectory.

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3D LASER SCANNING

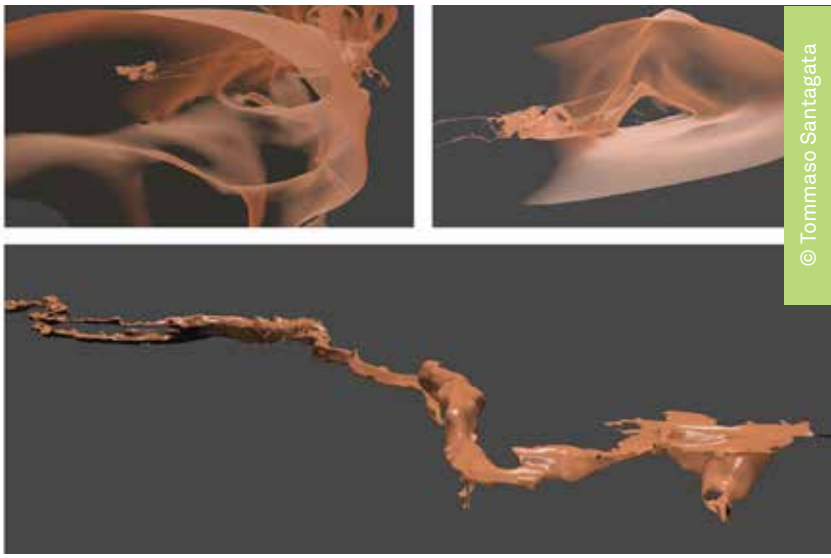
In Lanzarote, lava tubes generally develop along tunnels on different levels due to lava flowing over multiple eruptions and following cracks and crevasses left from previous eruptions. It is not always possible to access the upper levels without climbing equipment.

As part of the CAVES 2016 training course, the team used photogrammetry – getting precise measurements and 3D data from at least two photographs – as a good alternative. However, photogrammetry cannot always guarantee good results, especially without the right light conditions.

To solve these problems, the PANGEA-X campaign tested the BLK360, the smallest and lightest imaging scanner on the market. The Leica Geosystems team operated it in set positions, obtaining **360° images of the environment in just three minutes** by pressing one button and aligning the scans directly through a tablet app.

In less than three hours, data from both instruments obtained a complete 3D model of a **1.3 km section of the lava tube.**

The PANGEA-X campaign used two of the latest Leica Geosystems technologies for a demanding mission. Both technologies provided valuable information and accurate data to map areas in a short period of time where satellite navigation was unavailable.



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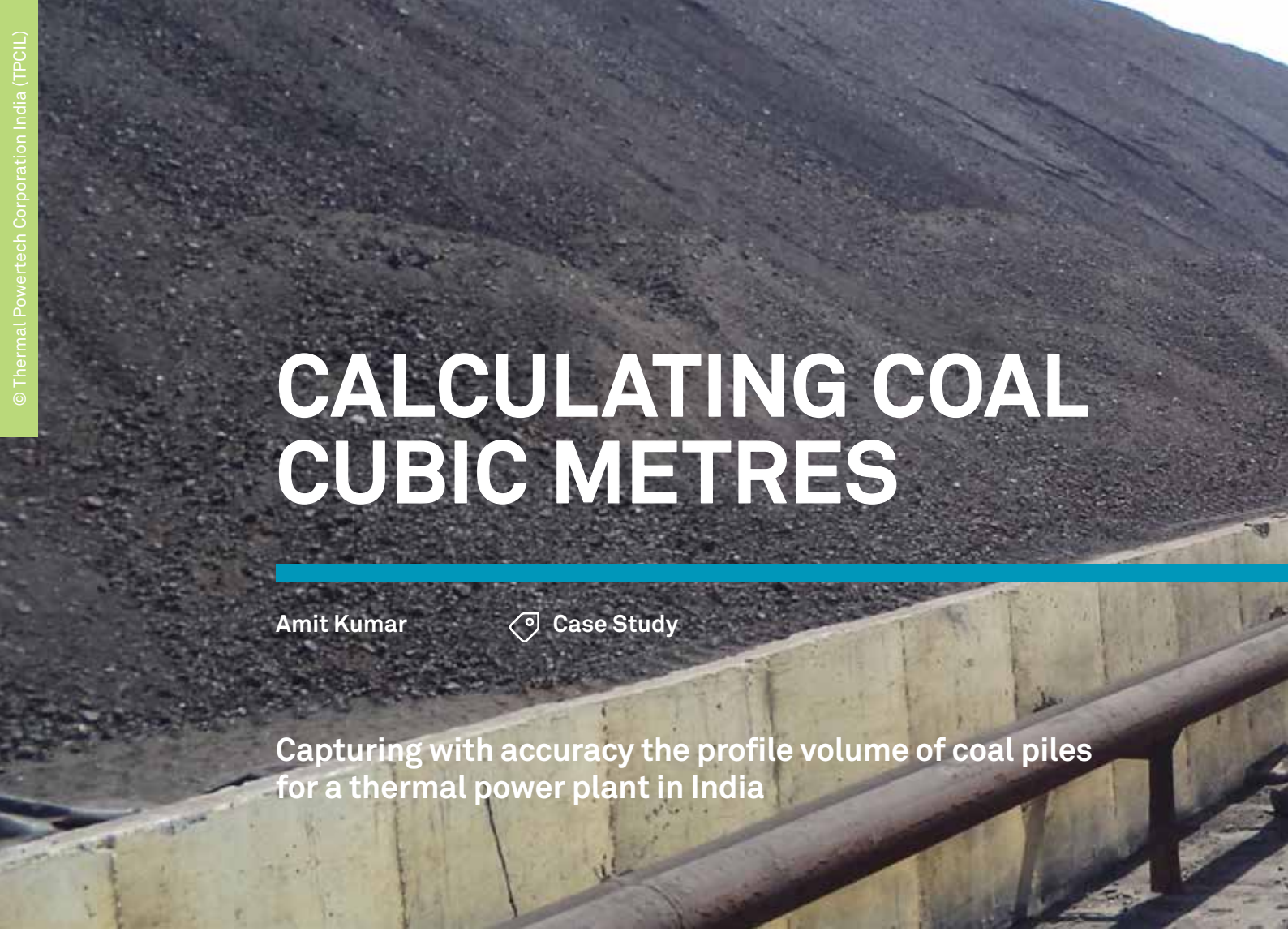


CALCULATING COAL CUBIC METRES

Amit Kumar

Case Study

Capturing with accuracy the profile volume of coal piles for a thermal power plant in India

Power generation is one of the most critical components for the economic growth and wellbeing of nations. Due to accelerated economic expansion and increase in global energy demand, India has one of the world's fastest growing energy markets. Although the power sector is diversified in this South Asian country, 62 per cent of India's electricity demand is met through the country's vast coal reserves.

Sembcorp, a leading energy, water and marine group operating across five continents worldwide, entered the Indian energy market in 2010. The company is now responsible for thermal and renewable assets accounting for more than 3,500 megawatts of power capacity in operation and under development in seven states. As part of Sembcorp, Thermal Powertech Corporation India (TPCIL) operates a **1,320-megawatt coal-fired coastal power plant in India.**

Thermal power plant specialists at TPCIL used in the past conventional surveying methods to find out the coordinates and shape of the coal piles. Surveying the coal storage yard every quarter to do the physical verification was a big challenge. Using Leica Nova MS50 MultiStation, the challenges of measuring the exact profile of the coal piles belong to the past.

EXPANDING POSSIBILITIES WITH POINT CLOUDS

Capturing the site conditions in a 3D environment is the most effective way to calculate volumes and ensures best quality control directly in the field. Using the world's first self-learning MultiStation, the company captures the accurate profile and volume of the stock and verifies the quantity during reconciliation.

A small variation in volume accuracy would lead to tonnes and tonnes of coal deviation in physical stock quantity. Accuracy in the measurements is, therefore, one important benefit TPCIL valued when capturing the profile volume of the coal stock piles.

"We choose Leica MultiStation MS50 instead of a total station because we were able to achieve the accurate volume of the coal stock yard, and the report generation process is easier using Leica Infinity software. Time and cost saving was one of the main factors in this project. Optimised coal volume calculation can be achieved using the MS50," said Nandagopal Kesavan, assistant manager of operations at TPCIL.

The physical verification survey of approximately 600,000 – 800,000 tonnes of the coal storage yard used to take seven to 10 days with conventional surveying methods. Using the MS50, the same work can be done in two days. Surveyors were able to see all setups merged flawlessly directly on the unit and determine the scan quality in the field right on the instrument.

Experts processed the information with Infinity geospatial software, allowing to work with the scanned point data and manage data in the 3D viewer.

AN ONGOING JOB

The coal survey project started July 2015 and has been continuing every year once a quarter. TPCIL receives coal from international and domestic coal mines and does the coal stock physical verification test to:

- Ensure book stock and consumption of coal is matching with the physical stock available on date;
- Ensure sufficient domestic and imported coal stock is physically available even when book stock shows sufficient amount;
- Calculate the amount of coal loss during the conveying by matching the ship vessel draft survey report with the physically verified stock available for the ship consignment.

Geosystems provided a **technical solution optimised for coal volume calculation** developed for this project and for the company.

Given the success with the MS50, Sembcorp has procured a MS60 for coal volume estimation.

SPEEDING UP BIM RECONSTRUCTION OF HISTORICAL BUILDING WITH LASER SCANNING

Mikhail Anikushkin, Sergey Kotelnikov

Case Study

Reconstruction of historical building with laser scanning and BIM modelling in Russia

It is challenging to meet quality requirements for reconstruction and modernisation of complex buildings projects. The more complex the building, the more time architects spend measuring. Manual measurements are, moreover, usually inaccurate and incomplete if access to certain parts of the structure is difficult to reach.

But, is there a better way to measure and obtain up-to-date as-built documentation?

The **reconstruction of a 100-year-old historical building,** located in the centre of Moscow, would have been a long and winding road if real estate developer, KR Properties, had not turned to 3D laser scanning experts at Trimetari Consulting. The laser scanning firm was able to obtain **up-to-date as-built documentation** with point cloud data, creating 3D models that allowed the reconstruction of a neglected two-storied building, with a former wine store on the first floor and wine stock in the basement, into exclusive loft-apartments.

HISTORICAL BUILDING: 3 STEPS TO BIM WITH LASER SCANNING

Architecture and engineering bureau Alllevels, the general reconstruction designer, noticed the basement floor of the historical building has a complex layout, and walls are uneven and deviated from the vertical. With Building Information Modelling (BIM) experience since 2013, Alllevels choose laser scanning as an effective measurement tool and Trimetari Consulting LLC as a service provider.

The project has been implemented in three steps:

- Laser scanning of the building
- Data processing to obtain a 3D BIM model and panoramas
- Reconstruction work of the project.

FIELD WORK AND PRE-PROCESSING: 10 TIMES FASTER

With a surface of **7,000 square metres,** the basement, two floors and roof were **laser scanned during three days** by two terrestrial laser scanners. The Leica ScanStation P20 was an excellent solution thanks to high speed, accuracy and panoramic images. According to the architects' calculations, traditional measurements would have taken at least a month.

Afterward, Leica Cyclone REGISTER, software for registering and georeferencing laser scan data to a common coordinate system, data were exported both as spherical panoramas to Leica TruView and as coloured point clouds to Autodesk design software packages.

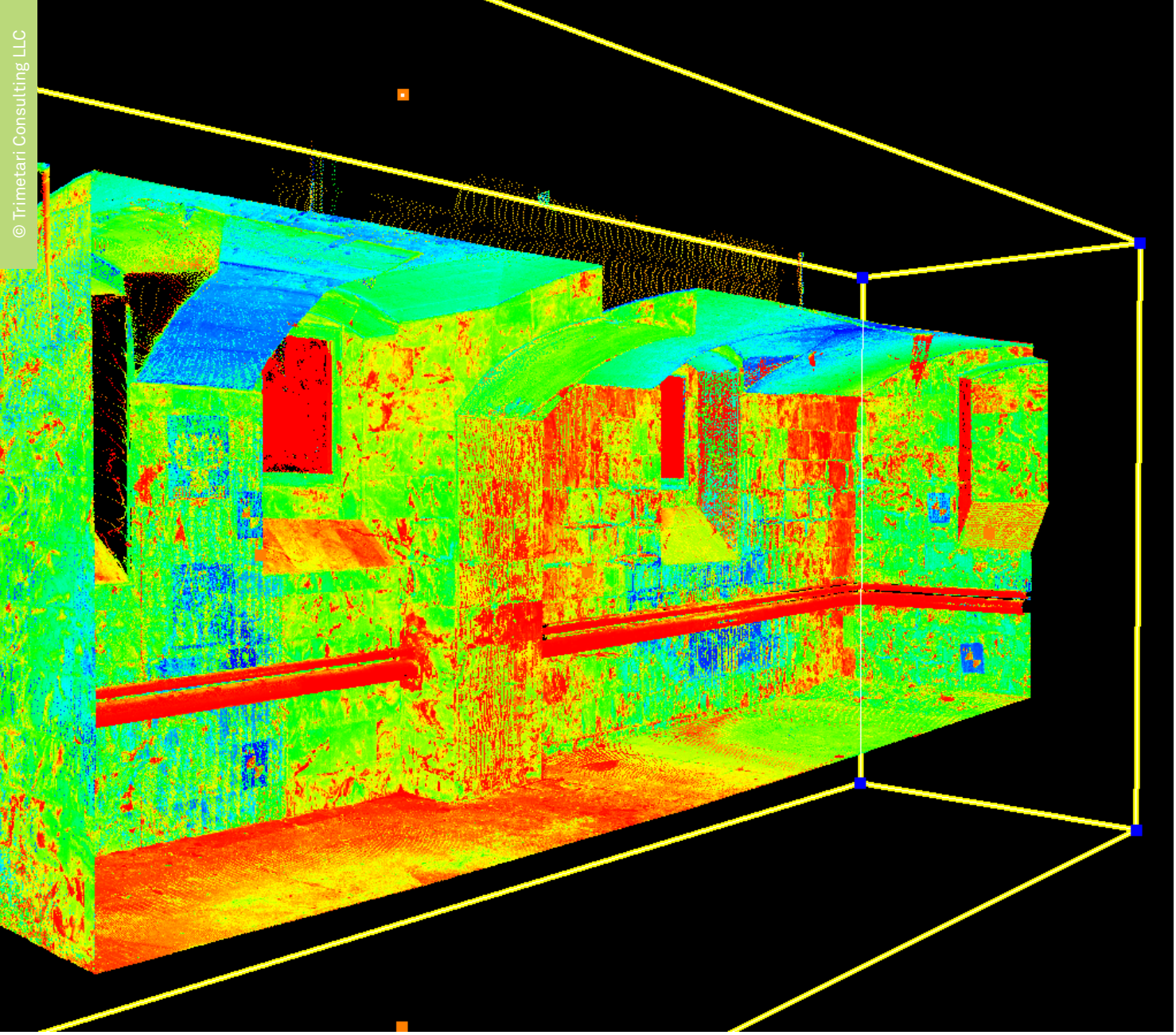
3D MODEL FOR DESIGNERS, TRUVIEW PANORAMAS FOR ENGINEERS AND TEAM

The first and most important task for data processing is to get an actual as-built model of the building in Autodesk Revit. To accelerate the process, Leica CloudWorx for Revit plug-in was used to automate the structures modelling, and efficiently visualise and create BIM models from large point cloud data sets, creating 2D and 3D drawings with Autodesk Revit.

Point clouds and as-built models allow to calculate reconstruction works costs. For the reconstruction in Autodesk Revit, a very useful 'stage tool' allows to specify in the project the key stages of the work and to link the erection and demolition of objects to them. A complete BIM model of all types of works is, thus, formed in one file with exact documentation and specifications. All the constructed objects are created on the new construction and all existing objects receive the stage of 'existing', and, if necessary, demolition can be indicated. This makes it possible not only to document different stages, but also to receive specifications and three-dimensional views with any element display settings.

Many simple measurement tasks were, furthermore, solved by using only spherical panoramas in TruView. The software to access, view, analyse and collaborate using digital reality data was especially useful for analysing existing utilities located in the basement.

"It was the first reconstruction project, in my practice, that does not require any additional final measurement. If we need something, it was



enough to open TruView or use the point cloud. No need to go onsite more than one time," said Alexander Sokolov, main architect of Alllevels bureau.

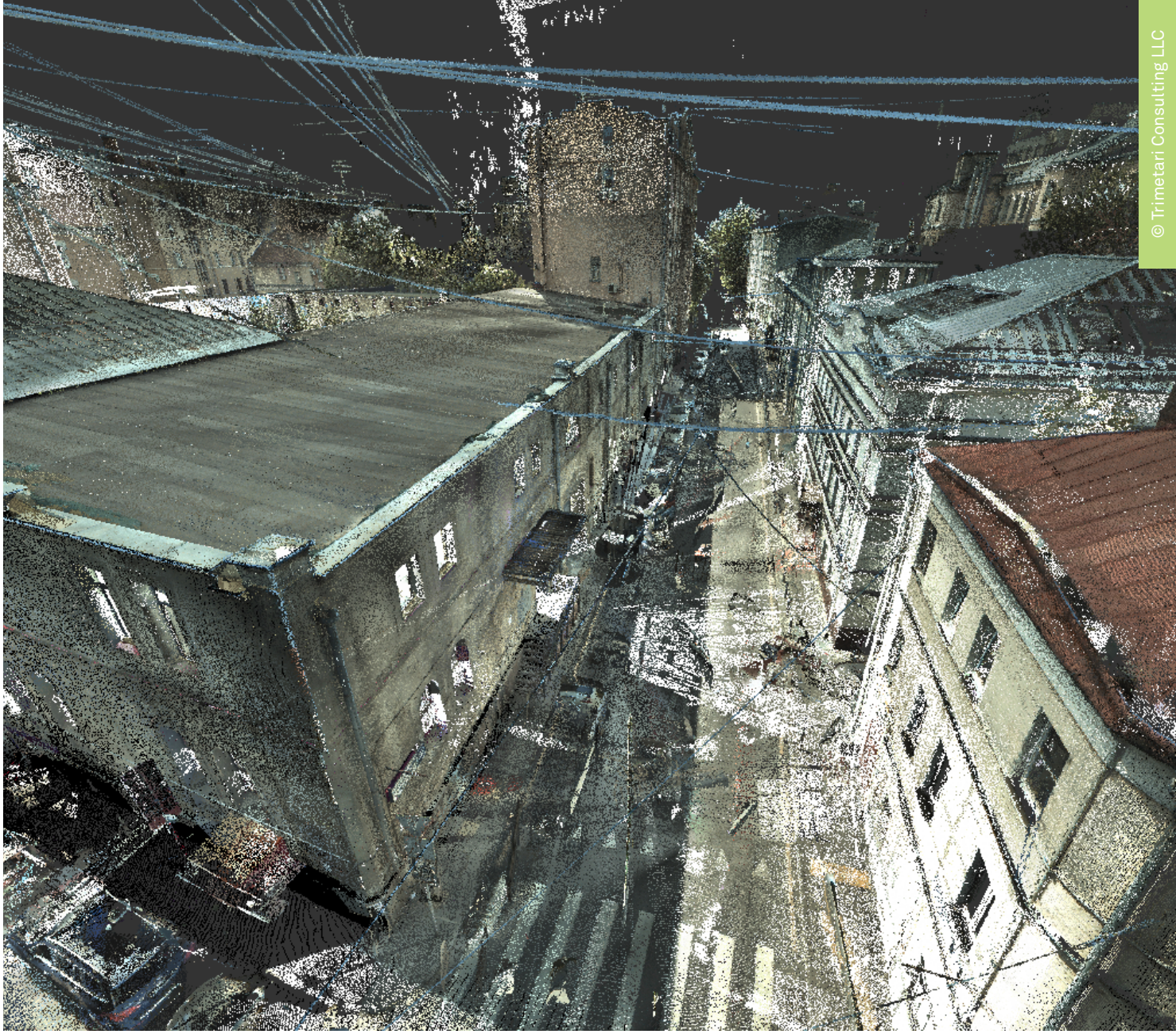
The software allows to view panoramas from any laser scanner, make measurements and insert annotations, simplifying interaction with the customer and teamwork. Engineers can look and measure in detail using spherical panoramas in the office, significantly reducing labour costs.

NEW TIME SCHEDULE FOR RECONSTRUCTION WITH LASER SCANNING

The reconstruction of this historical building is a clear example on how geospatial surveying technologies can speed up reconstruction works. Thanks to laser scanning and point cloud software, the **project was completed in only three months,** which is significantly faster than a traditional approach:

- Field work was completed in three working days instead of a month
- 3D model creation took 30 days instead of three months
- Design was completed in two months instead of four months.

The final stage of data processing and the creation of drawings and models is a long time-consuming process, especially if additional measurements and recalculations are required. These problems are solved by laser scanning, allowing not only to automate the measurement process, but also to provide the output data in an appropriate format.



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Laser scanning is the most suitable technology for designers and architects, offering the following advantages:

- Accuracy and level of detail
- Speed
- High automation during the field work
- Strong interaction with CAD environment.

A BIM reconstruction and modernisation project, based on laser scanning data, is not only fast and accurate, but also enables a new level of design workflow and interaction between all project stakeholders.

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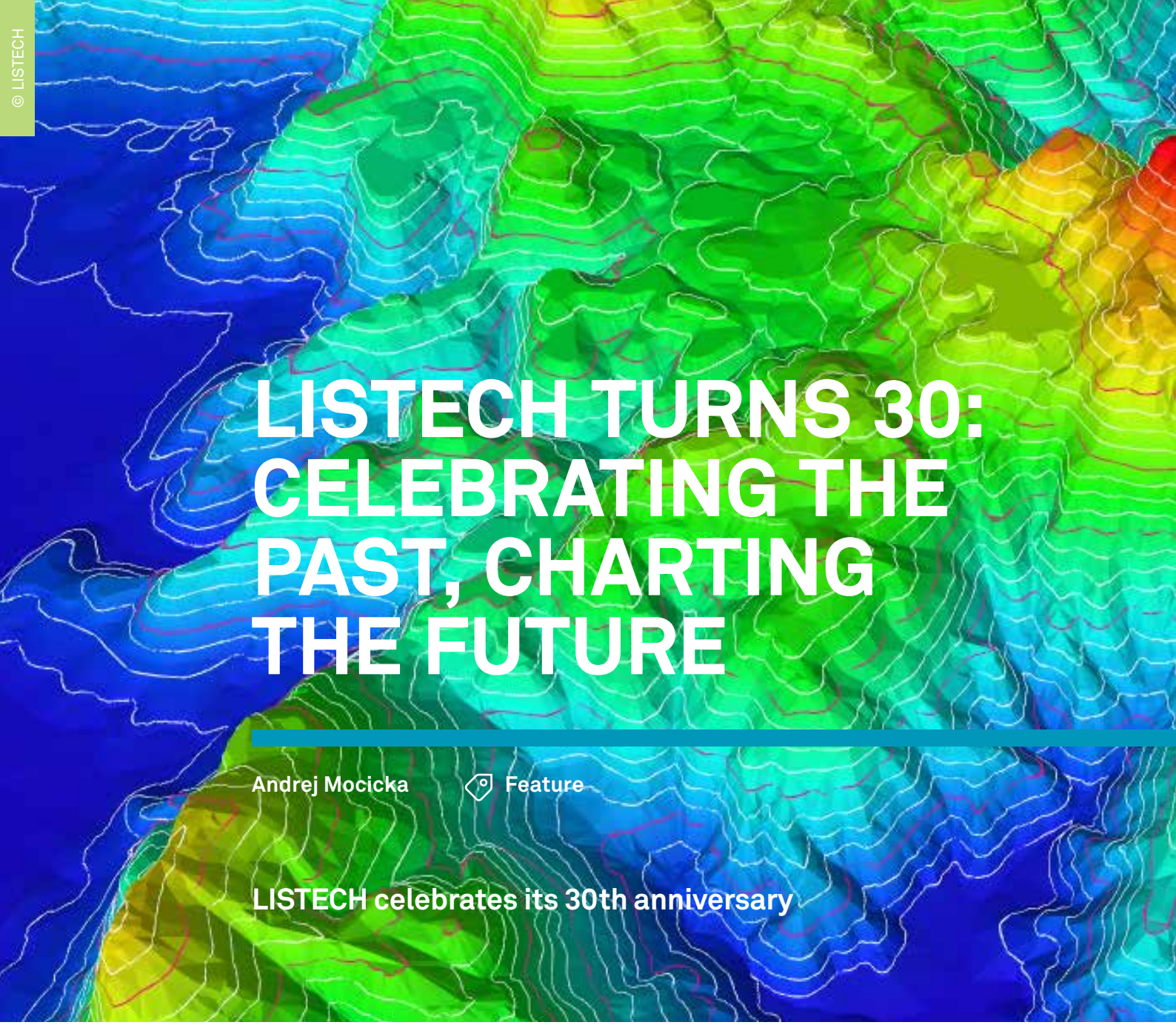


LISTECH TURNS 30: CELEBRATING THE PAST, CHARTING THE FUTURE

Andrej Mocicka Feature

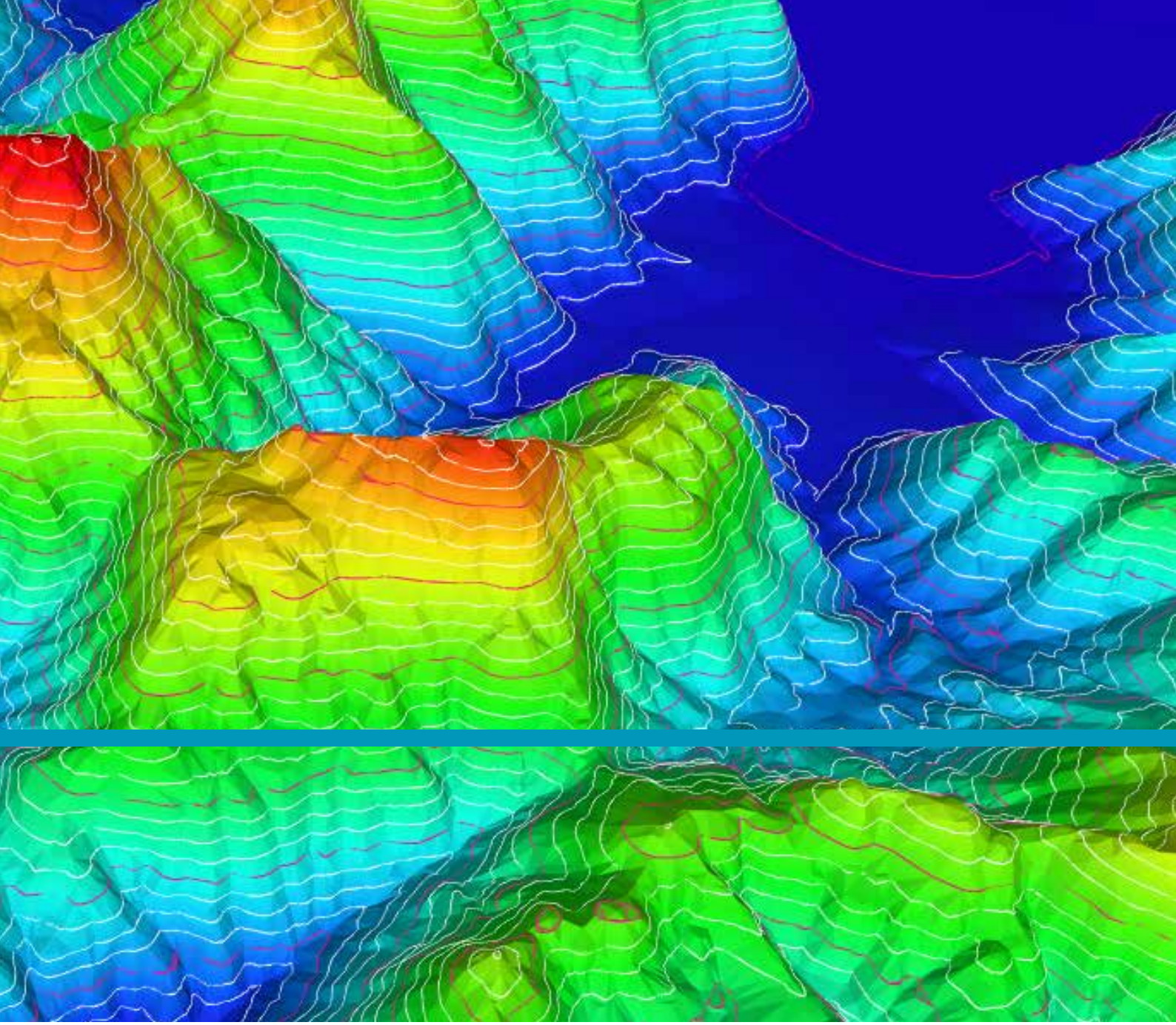
LISTECH celebrates its 30th anniversary

Thirty years ago, LISTECH was founded with a vision to create ground-breaking software solutions for the surveying, civil engineering and land related information industries.

Today, that vision is as clear as ever – it has guided us for the last 30 years and will remain the foundation as we explore new heights in the years to come. From its modest beginnings to its position today as an international organisation part of Hexagon, LISTECH can look back on a history of **steadfast product development and innovation, empowering surveying and geospatial professionals** to reach their full potential with solutions that simplify their most complex jobs.

"Thirty years is an impressive achievement for LISTECH. This is a result of unswerving customer focus and developing first-class software, while serving the needs of the global marketplace. LISTECH's success has been built through the character of its people, who work collaboratively and creatively to provide innovative solutions for our customers," said John Da Mina, president of Hexagon's Geosystems Division for Australasia.

In 2018, our 30th anniversary year, we're proud to reflect on the evolving success through LISCAD and Neo software solutions. Thirty years ago, LISCAD was born out of a vision to create an all-in-one geospatial software solution integrated with CAD components that produced a finished product for surveying professionals. Since formation, LISCAD has grown exponentially and evolved into what we refer to today as a field-to-finish software solution – a portfolio of integrated land surveying and civil engineering



software modules used by thousands of customers worldwide.

While LISCAD is the backbone of our business, over the years it has allowed us to develop the **next generation of surveying and geospatial software.** Neo is our vision for the future of spatial software where surveying, engineering, asset collection, BIM and photogrammetric workflows can all be efficiently handled within a single integrated 3D environment that manages very large 3D datasets with ease.

Since formation in 1988, LISTECH has grown exponentially and evolved into a provider of choice for surveying and geospatial professionals worldwide. We put our success down to a solid reputation for innovative, flexible and comprehensive solutions, coupled with exceptional levels of customer service and support.

While we have come a long way, our work is not done. Right now, we're working hard to deliver smart software solutions. Building upon our industry expertise requires further dedication and innovation to continue developing software that leads the pack in scope, ease of use and efficiency.

Our success story remains incomplete without the support of our customers. We thank you and look forward to your continued support.

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FITTING 360° OF STEEL WITH 3D MEASUREMENTS

Cornelia Dietz

Case Study

Measuring in 3D to build a 360° railing for a helipad with 3D DISTO in Germany

© Schmid Metallbau

Schmid Metallbau, founded as a classic metal workshop in 1993, offers today perfectly crafted products and solutions in the fields of metalworking, stainless steel processing and metal construction. To serve customers on large construction sites or commercial and industrial buildings, a total of 15 employees focus on metal construction and design where high-quality work and a high attention to detail is of utmost importance.

In the spring of 2017, the company was given an exciting new project – to design and construct an outward-facing railing for a newly-built helipad on the rooftop of a hospital in Ravensburg, Germany. To install the helipad's built-in components, the railing was positioned along the edge of the structure in a circular way. To avoid all pre-installed components facing different directions and twisted or tilted, each individual holder was required to be measured and modelled individually.

CLOSING THE STEEL BELT

It was labour-intensive to manufacture a railing running around the helipad's platform in a circular way. Metal was bent with a special tool, so everything could fit seamlessly when installed on site. A misfit would have caused the circle's steel pieces not to match.

"It's just like when you can't close your belt anymore because you've gone past the widest hole," says Markus Schmid owner of Schmid Metallbau.

In addition to the outward facing railing, a steel net was installed. In a worst-case scenario, the net must withstand catching a falling helicopter.

A TRIP TO BAU TO FIND THE RIGHT SOLUTION

Schmid Metallbau decided to visit the BAU exhibition in Munich, Germany, with the goal

of finding a solution to these complex 3D measurement needs. The company found the 3D DISTO and approached a colleague who already owned the product. After listening to the colleague's positive feedback and receiving a more detailed explanation of the product, the firm ordered the 3D DISTO right away.

The high-precision survey was taken from one position only using the 3D DISTO with the aid of an adapter plate mounted on site. The company designed a simple target plate where foremen could mount the tilted, pre-installed, outward facing components of the railing. The 3D DISTO was set up in the centre of the helipad so it could **measure all 54 structural components at once.** After repositioning the 3D DISTO only twice in line with the three-point method, measurements were quickly completed, and all data was **transferred to CAD.**

A CROSS BETWEEN A SURVEYOR'S ROBOTIC TOTAL STATION AND A HANDHELD DISTO

It would not have been possible to complete these measurements using conventional

methods, such as a tape measure or a laser distance metre. The 3D DISTO was able to measure the 54 skewed components with **millimetre accuracy from one position** and measure each component in relation to one another.

“Data transfer is easy and straightforward, so you can start working straight away with the captured measurement data,” says Schmid. “As the person responsible for implementation, I want to be certain that the data is transferred one-to-one into CAD. The measured points are clearly transferred into CAD making easier the preparation of the work and making sure each piece will fit.”

In upcoming projects, Metallbau Schmid already sees many different use cases for its new 3D DISTO, from the installation of glass, metal cladding of outward facing staircases to staircase shape, height and depth.

CUSTOMISING FOR TODAY'S CITY MANAGEMENT

Penny Boviatsou

Customer Profile

Providing personalised solutions with LiDAR and UAV solutions in Hungary

The world is changing and becoming increasingly complex. Cities face great challenges as most of world's population lives in urban areas, and city management is becoming more demanding. In light of new challenges, municipalities and local governments are looking for efficient management - solutions to provide detailed information, data and analysis for effective city management.

Envirosense Hungary Ltd. is a remote sensing specialist that emphasises on the process of aerial sensed inputs. Understanding city management needs, the firm offers varied advanced products for surveys that are impossible to be conducted by traditional on-field surveys or need large resource inputs. Focusing on aerial hyperspectral imagery, airborne laser scanning (LiDAR), unmanned aerial vehicle (UAV) applications and aerial digital imagery, Envirosense Hungary Ltd provides personalised solutions that fulfil the customer needs.

The company's goal is to provide local governments with smart products adapted to their needs. Most local governments don't have an in-house team of remote sensing experts or geographic information system (GIS) experts who can process data or develop methods to tackle specific challenges.

"In many cases, the problems exist but the link with airborne technology is not made or the technical solution has not been developed yet. We aim to be innovative; we develop user-ready products and solutions and deliver them to local governments," said Peter Enyedi, manager of the LiDAR division at Envirosense Hungary Ltd.

USING THE LATEST LIDAR TECHNOLOGY

"Our products have to achieve high accuracy, high resolution, and conform to the latest standards in the photogrammetry and LiDAR market," said Gregory Lucas, manager of the photogrammetry division at Envirosense Hungary Ltd.

Envirosense uses Leica Geosystems ALS technology combined with the Leica RCD30 medium format RGBN camera for the aerial surveys and the Leica Viva CS15 field controller for ground surveys. Based on this technology, Envirosense responds to customer needs with custom-made solutions.

"Some of the products consider trees and vegetation so a four-channel camera was a need. Radiometry and light sampling is important for the segmentation issues. We are also working intensively with LiDAR-hyperspectral data fusion. The choice of a photogrammetry and LiDAR system is fundamental for our projects," said Enyedi.

"We have used the Leica Geosystems airborne dual sensor and camera for all the airborne missions requiring LiDAR or imagery since 2012," said Enyedi. "It's the high quality, cost efficiency and performance of the LiDAR system that make us a committed Leica Geosystems customer all these years."

INTRODUCING AIRBORNE TECHNOLOGY

Envirosense uses Geosystems' sensors in a variety of applications to effectively support local governments in city management, such as:

- Terrain models for water authorities
- Flood modelling
- Vegetation mapping
- Land use classification
- Agricultural applications
- Forestry (invasive species mapping biomass estimation)
- Nature conservation
- Archaeology
- Urban planning
- Vinery application.

Instead of just generating basic datasets, Envirosense extracts the information and offers it to its clients. The company gave a presentation during the 2018 Airborne User Group Meeting in Lisbon, Portugal, based on a research the team did to classify urban objects and surface types based on LiDAR point cloud and aerial multi- or hyperspectral imagery. With object-based feature extraction methods, a series of products can be generated from urban surface types to tree cadastre. This offers the basis of decision making and further analysis.

In addition, it opens the way to detailed and varied database maintenance, allowing inventories and cadastres tasks. The data can be integrated with aerial hyperspectral data, satellite data and data collected by UAV platforms.

The data is used for detailed building modelling and structural change detection. Cities can check whether construction permits were issued, and insurance companies can assess values of the houses.

There is a wide use of the data for forestry mapping management. The trees can be identified, and the tree health can be detected to avoid the spread of diseases. Damages from falling trees are the city's responsibility. This technology allows local governments to ensure that all the trees are in good condition.

In addition, roof objects, such as climate units on houses, can be detected to define insurance values of the house. Solar potential of the city can also be identified; LiDAR technology helps local governments define the areas that are best for installation of units and calculate how much of the power can be economised.

"The multitude of objects we extract and map reflects the quality of the data acquired by the aerial system and the advancement of our methods for mapping and classification," said Enyedi.

Among the features Envirosense can extract are:

- Roof types
- Chimneys
- The type of surface cover (streets)
- Road signs

- Solar panel elements
- Potential places for placing solar panel elements
- Objects on the ground
- Features in cemetery
- Trees and vegetation
- Surface water networks
- Power lines.

MAKING IT PERSONAL

Envirosense's strategy is to develop custom-made products for clients who are not experts in remote sensing and GIS fields, but their needs require aerial remote sensing technology.

“It is the direction where we see the biggest potential for development; the opportunities are unlimited,” said Enyedi.

Envirosense recently created Open Street View, a new solution for its orthoimagery product line. The solution allows local governments to identify ground-located objects, useful for any organisation’s inventory tasks. Envirosense uses the same airborne survey equipment, but the planning and processing is adapted to the project’s specific needs.

LOOKING AHEAD

LiDAR solutions and imagery technology in combination offer incredible and flexible capacities for mapping and classification.

“We expect to extend our offerings for city management purposes in the future,” said Lucas. “We will continue working with Geosystems airborne solutions and cameras as they offer the maximum efficiency for this type of projects.”

© Leica Geosystems

INTEGRATING AERIAL REALITY CAPTURE

Monica Miller Rodgers

Product Insight

Discovering the latest UAV solution from Leica Geosystems

Even just a decade ago, mapping, inspecting or any other type of surveying from the air would have been unheard of in the industry. Today, though, using an Unmanned Aerial Vehicle (UAV) has become almost standard for various geospatial applications, such as volume calculations, powerline inspections and as-built documentation. UAVs are even making appearances in accident investigations, special effects development and other non-traditional applications.

UAVs have several benefits, such as reaching difficult areas and increasing safety, and capturing a unique perspective of any project with great accuracy. An UAV, though, is only as good as its ability to integrate into the overall workflow for the entire lifecycle of a project. This thought is at the centre of Leica Geosystems' latest aerial reality capture solution.

INTRODUCING FULL INTEGRATION FOR COMPLETE UNDERSTANDING

Leica Geosystems has recently announced its latest UAV, the Leica Aibot. After entering into the UAV market in 2014 with the acquisition of Aibotix, a pioneer in professional UAV systems, Leica Geosystems, with its early market entrance, has learned many lessons in developing aerial reality capture solutions and applied that earned knowledge to its latest offering.

"As we revamped our UAV program, we focused on integrating entire processes into one comprehensive Leica Geosystems ecosystem," said Valentin Fuchs, Leica Geosystems UAV program manager. "From surveying to inspection, the Aibot solution enables user to operate in one workflow while still offering open source compatibility."

The complete workflow uses the M600 PRO by DJI, an industry leader in UAV manufacturing,

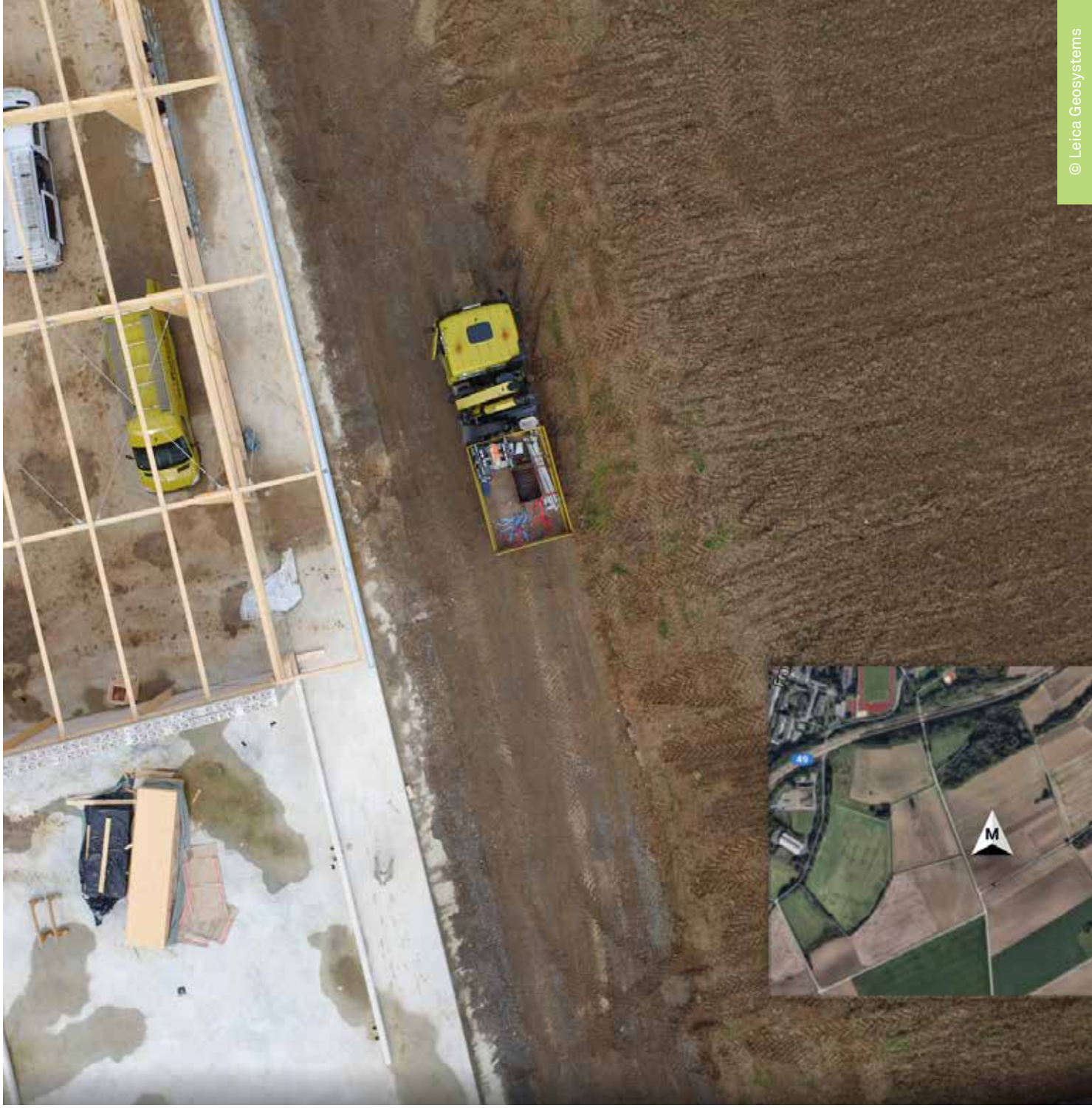
while the software and sensor integration comes from the trusted Leica Geosystems offerings of Infinity for surveying, Cyclone for laser scanning processing, third-party 3D Reshaper for point cloud processing, and eventually ConX for construction. From flight planning to execution followed by processing with integration from other reality capture instruments to analysing, the user will end with an actionable data set. In less time with less costs, the comprehensive and innovative interface keeps the user in a familiar environment throughout the entire workflow.

PERSONALISED SOLUTIONS FOR SEGMENTS

The new UAV solution has been developed with segment professionals in mind, and it will be released in two versions:

1. Leica Aibot SX

For surveyors working to capture infrastructure and assets, the Leica Aibot SX specifically works within a workflow that combines other surveying technologies, such as total stations, laser scanners and GNSS.



2. Leica Aibot CX

For construction professionals on site, the Leica Aibot CX provides a level of accuracy previously unknown in the industry to capture a transparent view throughout the construction lifecycle of planning, designing and constructing.

"Professionals in surveying and construction have differing criteria, but what they do have in common is the need for quick access to accurate data," said Fuchs. "With solutions designed to their particular needs, while also keeping our overall commitment to easy visualisation and digitisation of results, the new UAV solution has a unique place in all workflows."

Fuchs also confirms more segment personalised UAV solutions are in the works. As these solutions continue to develop with the professional in mind, including UAVs in projects will become even more routine. Inside of one common interface, operators will find more efficiency and accuracy to grow their businesses and gain an entirely new perspective.

ROUTE MAPPING AT EMLICHHEIM WIND FARM

Christoph Babilon Case Study

High-precision GNSS surveying in Germany using the Leica Zeno Smart Antenna

Westnetz GmbH is the largest distribution network operator in Germany with more than 5,000 employees and a coverage area of 51,000 square kilometres. The company supplies approximately 7.5 million people with electricity, gas, water and district heating. This includes being responsible for the planning, construction, maintenance and operation of a 182,000 km electricity grid and a 24,000 km gas distribution system.

The Emlichheim wind farm project, on the border between Germany and the Netherlands, recorded the **21 km route of cables** serving existing and new wind turbines. The cables will supply existing turbines and be ready to serve new ones. The existing turbines are 95 metre high, whereas the new ones will reach an overall height of **up to 143 m.**

Up to **400 points needed to be surveyed each day** during the one-year project. Topography, such as roads, hydrants, slopes and buildings, were added from the land registry at the start of the project. The extensive field work was carried with a one-person surveying unit – the Leica Zeno GG03 Smart Antenna.

CARRYING OUT THE WORK IN THE FIELD

Numerous project participants and construction companies were working on the project site at the same time. At peak times, there were up to four drilling companies on-site, operating four drilling rigs next to each other. Surveying, therefore, was done partly on open trenches and needed to be done at the same time. To reduce costs and increase efficiency, coordination and management tasks needed to be carried out in the field.

Measuring, monitoring and surveying could all be done simultaneously on-site thanks to the flexible Zeno Smart Antenna paired up with FX Survey, a third-party and cadastral software. Designed for versatile use, the upgradable GNSS Smart Antenna allows users to choose the field software and setup to suit each workflow and budget and embed custom applications. The entire system, consisting primarily of the tailor-made Frox-IT software and Zeno, was ready to use straight away.

The surveying system served as a central data hub, bringing together distinct types of information from current planning to boundary identification and topographical details.

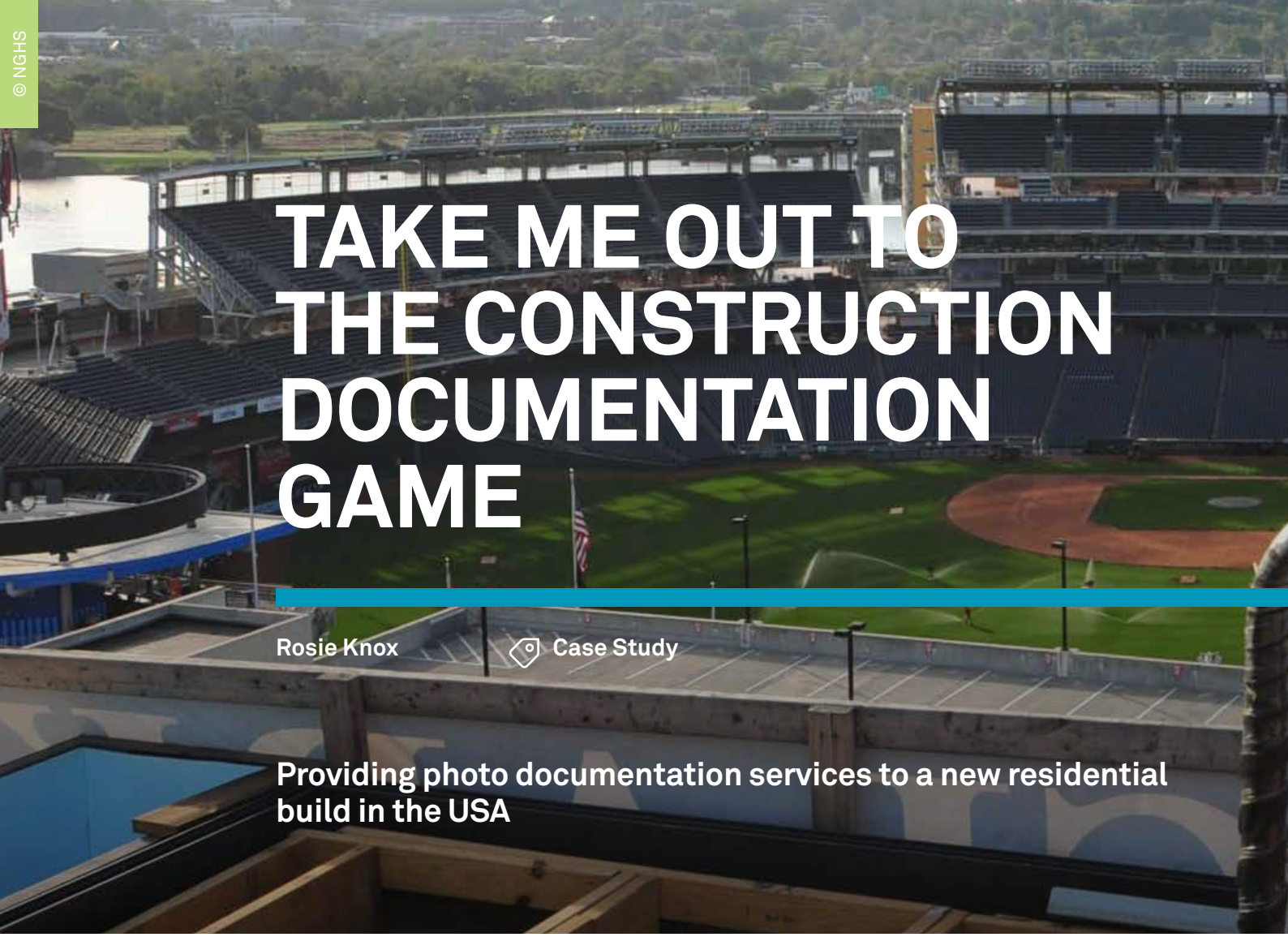
“Using the graphic field book made it possible to plan and coordinate building operations on-site and in real-time. The cost advantages of having information immediately available on-site are obvious. Combined with the high precision Leica GNSS Zeno Smart Antenna it was possible to control, adjust and rerecord the planning down to the last centimetre,” said Markus Focks, network documentation and rights at Westnetz GmbH.

Plan preparation needed to be done alongside surveying and be completed without the need for post-production. All planning data out of the FX Survey was transferred to the field into the Zeno Smart Antenna controller without the need of reworking the data. Further processing of the surveying data by the back-office team was provided as a DXF output, hence, the entire survey was available as a CAD graphic.

HIGH ACCURACY, EVERYWHERE

By using Zeno Smart Antenna at its highest surveying quality, there was no need to use a tachymeter. A measuring tape was not required either. The system delivered reliable positional accuracy within at least 3 centimetres.

The latest Leica Zeno GG04 Smart Antenna has a compact and lightweight design with enhanced tracking performance and precise point positioning without a mobile data collection. The GG04 can be used on Apple, Android and Windows smartphones or tablets. The newest Smart Antenna has extensive software support to be used with most data collection apps and software, making geospatial data collection easier than ever before.



TAKE ME OUT TO THE CONSTRUCTION DOCUMENTATION GAME

Rosie Knox

Case Study

Providing photo documentation services to a new residential build in the USA

In a busy urban centre, such as Washington, D.C., USA, staying on top of the building process is critical for a successful completion – especially if you're across the street from Nationals Park, home of the Washington Nationals Major League Baseball team.

Verity Commercial, one of the nation's fastest growing commercial real estate companies, is more than equipped for the challenge. Verity Commercial has worked on some of the most complicated projects in the Mid-Atlantic region. Providing construction management services, the company has the experience to simplify the complexities of technical projects, ensuring it will meet all expectations in terms of scope, budget and schedule.

To make certain the project met the highest of standards, Billy Frye, Verity Commercial's senior construction manager was assigned to the team. Frye's 15 years of experience in construction project management offers expert level insight into complex conditions like this.

He turned to Multivista for help. Multivista provided visual documentation and tracked the construction process from start to finish on two multifamily residential projects in the Ballpark District.

PLAY (CONSTRUCTION) BALL

With more than 700 residential units and nearly 800,000 square feet (243,840 square metres) of space, Frye understood the challenge of not just completing this project on time and within budget but also the impact of complex logistical circumstances. Due to its proximity to the stadium, heavy traffic and dense population, he had to coordinate with the Nationals, District Department of Transportation, and adjacent developers/contractors for vehicular and pedestrian traffic modifications, and road closures.

"Additionally, this area of D.C. is extremely busy with many construction projects occurring simultaneously," said Frye. "Coordination among the various development and construction

teams is a must to make each project function efficiently."

The appropriate technology on complex projects is essential, and the integration of Multivista's photo documentation services were crucial to staying on target, according to Frye.

"Multivista delivers relevant project photos that are correlated to the building plans, where the construction process is documented and tracked from construction start until completion. This is a key tool to assist with progress tracking."

"Documenting the project during the building process is a valuable tool for property management and maintenance staff," said Frye. "They have the ability to determine what and where items are located within walls and ceilings."

HITTING A TRIPLE

For these two buildings overlooking Nationals Park, Verity Commercial wanted to have a complete record of the outside of the building as it went up as well as the Mechanical, Electrical and Plumbing (MEP) on the inside. The services included:

- Waterproofing Exact-Built®
- MEP Exact-Built®
- Elevation Exact-Built®.

Maintaining quality over a large quantity of living units is crucial and can be a difficult task for all involved.

Subcontractor trade resources are spread thin in this booming market and can be overextended. Using technology tools to help manage trade resources and project schedules should be considered on every job. Multivista provides the necessary oversite with full-service photographic documentation.

Multifamily residences are one of the largest segments of Multivista's customer base, contracting on more than 2,450 projects and 460 million sq ft (140,208,000 sqm) of space since 2003.

HEXAGON MINING ANGLOAMERICAN JOURNEY TO SAFER MINES

Neville Judd

Case Study

Hexagon Mining and AngloAmerican Kumba Iron Ore worked together to develop a safety vehicle intervention solution in South Africa

© AngloAmerican Kumba Iron Ore

The art of mining is to balance safety and productivity. Success today depends on improving both. Integrated solutions are helping to ensure that this is possible. In January, *Mining Magazine* announced Hexagon Mining and its customer, AngloAmerican Kumba Iron Ore, had won its 2017 Safety Award for the launch of HxGN Mine VIS, the world's first vehicle intervention system for mining.

Mining Magazine readers vote annually for nominees in a variety of award categories, celebrating those they believe have demonstrated outstanding commitment to advancing the face of mining.

Fabien Kritter of Hexagon Mining and Mzwandile Buthelezi of AngloAmerican Kumba Iron Ore worked together to develop a vehicle intervention solution that would create an additional layer of safety around Hexagon Mining's Collision Avoidance System (CAS). CAS protects more than **25,000 vehicles in mines around the world,** including AngloAmerican Kumba Iron Ore's Sishen mine in South Africa.

VIS is now being installed at the mine, well ahead of government regulations compelling mine operators to install such technology on vehicles by June 2019.

PARTNERSHIP KEY TO PRODUCT DEVELOPMENT

By working directly with mining companies, Hexagon Mining ensures product development responds to customer needs. AngloAmerican Kumba Iron Ore contacted Hexagon Mining after conducting an extensive risk assessment of its operation at Sishen mine in South Africa.

"We've done a lot of work to identify where our risks are," said Buthelezi. "We needed to comply with regulations in South Africa by June 2019. Vehicle intervention systems must be in place to ensure we have a safe operation."

Together, the companies defined a step-by-step approach to develop VIS. The product **detects and prevents collisions** by automatically slowing down or even stopping a haul truck if an imminent collision is detected.

VIS takes control of a machine in certain situations if the operator does not react appropriately to a CAS warning. Depending on the situation, VIS can automatically cut the propulsion, apply the retarder or activate the service brakes.

Integrated with CAS, VIS uses the same sensors and user interface thus protecting the customer's initial investment. CAS gives vehicle operators **360-degree proximity detection at any speed and in all conditions** via unobtrusive cabin display units. For operators, CAS

represents peace of mind. It helps operators work more confidently and productively, especially in poor visibility caused by rain, snow, and fog. It also helps at night when the system becomes invaluable, **helping drivers to work more smoothly and efficiently.**

"VIS is the ultimate contingency in the event an operator does not respond appropriately to a CAS alert," said Kritter. "It manages the traffic in your pit and, by reacting when and if operators do not, it ensures safety rules are followed. It's an additional layer of safety on top of CAS, and can save you millions of dollars by avoiding incidents, injuries and fatalities.

"It is also the only Level 9 system currently tested in field operation on the market."

Level 9 refers to technologies that automatically intervene and take some form of machine control to prevent or mitigate an unsafe interaction.

PRODUCT DEVELOPMENT – 'A JOURNEY'

Kritter described working on VIS with AngloAmerican as a journey.

"It's very valuable as a product manager to have the feedback from the customer, to know and to work with them. Anglo has done a fantastic job of looking at 'where do I have a problem?' It identifies a problem in the operation. [...] which technology you can apply to solve this problem. There was a lot of interaction and to get direct customer feedback has helped a lot to develop this product."

VIS is now being installed in AngloAmerican's Sishen and Kolomela mines where the product is expected to improve more than just safety.

"It's been a very fruitful relationship," said Buthelezi. "We're continuing on this path with Hexagon Mining to ensure we have safer

operations. But there's a production aspect to it. Wherever you have a decline, we've got stop signs to make sure vehicles actually stop at every stop sign and not run out of control.

"But with systems that we're planning on developing and deploying, that can be a smooth process; we can remove some of these stop signs therefore improving productivity. Although safety is top of mind, production is something we also value."

Kritter is convinced that VIS is a model for future product development.

"I think this is how you can successfully develop products," he said. "It's not being in the office between four walls that you will develop a successful product; it's really through interacting with the customer."

Buthelezi agreed. "It's been a very interesting journey," he said. "We had the ability to exchange ideas. Sometimes we agree, sometimes we don't, but that's part of the process. But one thing I must say – I appreciate Hexagon Mining is flexible to some of the requirements that come because we'll be on one journey path and from what we've seen, what we learn during the journey, we change the end goal, but we're able to manoeuvre to accommodate some of those requirements.

"Some other suppliers would have said, 'this is what you wanted, this is what we're going to give you, and nothing else'. So, there's been a good relationship in terms of making sure we get to a product that we're all happy with."

HEXAGON'S GEOSYSTEMS DIVISION FEATURES CUSTOMERS

AROUND THE WORLD. EVERY DAY. ANY APPLICATION.

Whether it is surveying international airports or working on a prehistoric archaeological excavation, our users are working diligently to further not only the industry but global society.

At Hexagon, 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 in *Reporter*.

Archaeological excavation, Italy

Prehistoric archaeological excavation survey of a rock shelter in Italy using Leica FlexLine TS06 by Gianmarco Loddi

Building a shopping centre, Poland

Building a shopping centre in Poland using Leica TS15 by Paweł Plata

Airport survey, Switzerland

Frischknecht Jürg from Acht Grad Ost surveying Zurich International Airport in Switzerland using a Leica TCRP1201

Motorway survey, Macedonia

Site survey at motorway A4 in Macedonia using Leica Viva GS15 by Antonio Radevski

Hydro power project, Malaysia

Survey for hydro power project in Malaysia using Leica Viva TS11 by Sameer Sharma

Surveying an international airport, Iraq

Surveying at Duhok International Airport in Iraq using Leica GPS1200+ by Zerevan Binavi


© Leica Geosystems

Leica BLK360 3D scanner recognised for outstanding innovation at Irish Construction Excellence Awards

The BLK360 imaging laser scanner, the world's smallest 3D reality capture solution, was named best 'Construction Product Innovation' at the Irish Construction Excellence (ICE) Awards ceremony in Dublin for its product innovation and impact on the construction industry. To date, the BLK360 has earned several prestigious industry awards in Europe as well as globally including the '2017 Product Innovation of the Year' recognition at both the London Construction Awards and the Building Awards in the UK and the best 'Digital, BIM & New Technology' at the Mondial du Bâtiment Innovation Awards in France.


© IDS GeoRadar

IDS GeoRadar launches compact safety monitoring radar for mining

HYDRA-X, a radar-based technology solution specifically designed to support geotechnical engineers, increases safety in mining. HYDRA-X supports the diverse types of mine site needs, ranging from strip coal mines, tailing dams, small open pits, quarries and sub-benches monitoring in huge open pits. HYDRA-X is a compact radar solution that is easily transportable for quick deployment in critical areas. The radar provides high-resolution, high-accuracy early warning and real-time monitoring.


© Leica Geosystems

Leica Geosystems introduces latest GNSS technology smart antenna for construction

The Leica iCON gps 70 T smart antenna makes handling easy with permanent tilt compensation, resistance to magnetic interferences and calibration-free usage. With the iCON gps 70 T, construction professionals can measure and stakeout points quicker than ever before without the need to keep the pole vertical to level the bubble. The combination of the latest GNSS technology and inertial measurement unit (IMU) makes stake-out jobs on any construction site easy.

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Leica RTC360
3D Reality Capture Solution

The Leica RTC360 3D laser scanner is highly portable, highly automated, intuitive and designed for maximum productivity. This laser scanning solution efficiently combines a high-performance scanner with a mobile-device app to capture and automatically register scans in real time and industry-leading post-processing office software to register scans seamlessly to complete your entire workflow.

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