

An aerial view of a complex highway interchange with multiple levels of overpasses and ramps. The image is overlaid with a digital interface featuring glowing green and blue circular patterns and lines, suggesting a digital twin or data visualization. A vertical bar on the left side transitions from light blue to green.

REPORTER

Geosystems Division
2022

Metaverse meets
business

What will be the next
world wonder?
Ask a surveyor

Germany's digital twin:
toward a Smart
Digital Reality

The greatest
construction project
in history

Powering Connections & Collaboration

Supporting the world's transition toward an autonomous future where business, industry and humanity sustainably thrive.



HEXAGON

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President's Message

Thomas Harring
President at Hexagon's Geosystems division

2022 is another year with challenges: The pandemic has not yet been defeated worldwide; geopolitical tensions have reached a new intensity; insecurity marks the economic framework conditions; and the climate crisis remains unresolved. Resilience is still the name of the game.

At HxGN LIVE Global 2022, Hexagon CEO Ola Rollén spoke about sustainability challenges in a post-lockdown world. Quoting the former Roman emperor Marcus Aurelius, he explained that “what stands in the way, becomes the way” — autonomy will provide solutions. HxGN Live Global hosted 3,000 customers live in Las Vegas and reconfirmed the power of connecting people and face-to-face conversations. A simultaneous, well-attended virtual event enabled those unable to join in person to be involved as well.

Hexagon is all about forging connections — between people, but also between data and platforms; between the field and the office; between the real world and its digital reality. Interconnected devices, seamless and automated workflows that bridge hardware and software, cloud-based collaboration — our solutions ensure the uninhibited flow of insights improving collaboration and enhancing decision making. These connections power the autonomous future where business, industry and humanity sustainably thrive.

Hexagon's business initiative R-evolution is leading the way toward that vision. It invests in profit-driven projects that have a positive impact on the environment. Its solar park in Spain uses our sensors and software to optimise operational efficiency. Read more in the article by Erik Josefsson, CEO of R-evolution.

Many think of the metaverse as a digital hub of immersive, interconnected and interoperable spaces — for entertainment and gaming experiences. But businesses and the environment, too, stand to benefit tremendously from these digital worlds. Burkhard Böckem outlines in his article the vast potential of Hexagon's Smart Digital Realities, where “Metaverse meets business”.

We marvel at the historic architectural gems and sometimes forget the contribution of its unsung heroes: surveyors. Smart Digital Realities are the future wonders that will empower us to protect the planet. Surveyors are the innovators who will lead the way. In a world of technology, people make a difference. Read more in Craig Hill's article. Speaking of ambitious projects: Did you know that we are in the midst of the “Greatest construction project in history”? Find out how Hexagon is re-imagining construction from the ground up and empowering the industry to be exponentially better. A case in point? Read how “AI-empowered construction progress documentation and real-time site control benefit construction.”

In this issue of the Reporter magazine, we feature customers that use our innovative sensing and software solutions to build connections among people, assets and data to facilitate better collaboration, faster decision making and safer work environments. It makes us proud that our solutions are used to make national road networks safer, capture data for sustainable decision-making in entire countries, help protect marine ecosystems, make mines safer and smarter, and protect people on construction sites. Your projects make our technologies and solutions shine.

We look forward to more challenging and rewarding projects with you.

Enjoy the read

Thomas Harring

President, Hexagon's Geosystems division


METaverse MEETS BUSINESS

☰ Editorial



Burkhard Böckem is Chief Technology Officer at Hexagon

The latest wave of Smart Digital Reality innovations leverage artificial intelligence, robotics and other technologies that empower customers to sustainably create and manage real-world systems in a digitally immersive environment.



The metaverse is already interwoven with our real lives today. It will affect beyond imagination how we live and work. The key to unlocking the true power of the metaverse is data — be it hyperrealistic visualisations of spaces and objects or insights that were previously inconceivable without artificial intelligence (AI).

Peter Drucker's quote, "You can't manage what you can't measure," encapsulates Hexagon's journey into digital reality. We built our technology on reality capture. Through our acquisition of Leica Geosystems, which has transformed the world of measurement and surveying (and continues to do so), and NovAtel, a leader in global positioning technology, Hexagon has paved the way for cutting-edge digital reality solutions.

A NEW ERA OF AUTONOMOUS REALITY CAPTURE SYSTEMS

Hexagon has set out to create a digital mirror world using autonomous robots and platforms. The Leica BLK ARC – with ARC standing for "autonomous reality capture" – is an autonomous perception, navigation and reality capture module for robotic and autonomous

platforms. As a module, it can be integrated with many different robotic platforms and used in a broad range of applications.

With BLK2FLY, Hexagon has created the world's first autonomous flying laser scanner. The BLK2FLY enables users to capture complex buildings and structures from facades to rooftops, bringing reality capture to previously inaccessible spaces. BLK2FLY creates its own scan path and flies around structures while capturing reality in 3D. It automatically uploads the data to Hexagon's cloud-based, digital reality visualisation platform HxDR, where users and collaborators can view and share data in real time.

The fusion of LiDAR with oblique imagery creates photorealistic city models, even in urban canyons and hard-to-see areas. Mesh models offer an intuitive method to visualise planning and context, and derive 3D city models automatically. But we go a step further: We are on a mission to merge airborne and streetview data to create a "Supermesh," which enables you to see a city in all its detail, from above and below, under trees, canopies, doorways and bridges.



TOWARD A SMART DIGITAL REALITY

At Hexagon, we see an opportunity to go way beyond the digital twin. Digitalising the physical world opens the door to creating Smart Digital Realities. By applying various AI techniques, we can autonomously extract all layers of semantics, from sealed surfaces to green areas, and from rooftops to complete buildings. One of our AI-based workflows is called auto-tagging. It combines pipe routing from 3D laser scans with plant and instrumentation drawings, and merges asset information with deep learning.

We have advanced air-based insights to make digital realities smart. Hexagon's R-evolution, for example, is creating a multidimensional intelligent map of seagrass vegetation off the coast of The Bahamas — a crucial first step for protecting some of the world's most significant blue carbon sinks.

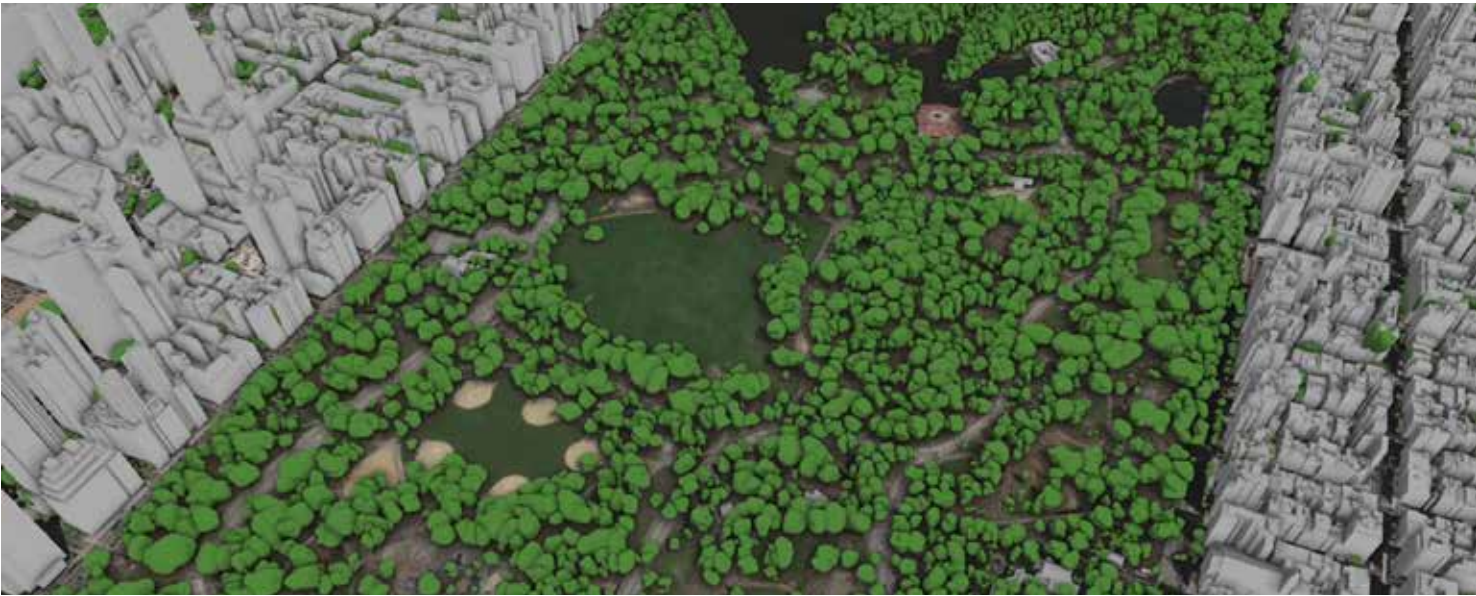
Next, we want to visualise what does not exist. That way, we will change how we

design, plan and create. Imagine you are an architect. You are designing a future landmark in Lower Manhattan — an ambitious project. You design in BricsCAD and then, magically, with the push of a button, you build your project autonomously. But now you want to go photorealistic. You create a new reality by placing your project within HxDR's Supermesh and bringing it to life by simulating various scenarios such as various weather conditions.

Smart Digital Realities can also visualise fictional scenarios. You can scout a location, design a film set and plan movie scenes on your device. The digital world becomes your set at your fingertips!

SMART DIGITAL REALITIES FOR A BETTER FUTURE

How can we put data to work to make our cities more sustainable? We need fact-based information. AI now helps us know precisely where the green areas are, down to a single tree, and how much carbon dioxide each green



space absorbs. The technology allows city planners to simulate wind and air exchange scenarios to tackle urban overheating. We can also find out which rooftops are already equipped with solar panels, where green rooftops exist and, more importantly, where they do not.

Innovation can create a sustainable, new reality. Seamlessly connecting the physical with the digital worlds will enable the emergence of the true Internet of Things. Hexagon is building a spatial web, the business version of the metaverse, seamlessly connecting the physical with the digital worlds and enabling multiple users to have the same experience in reality and in real-time, anchored to an actual physical location. Users can immerse themselves in a wealth of information based on what they see.

Spatial anchoring is the first step to connecting our vision and sense of direction to the metaverse. Our technology, such as Immersal, HxDR and Xalt, are the connective tissues. In the future, we may be able to connect all of our senses, even

our minds, and create a truly immersive digital experience that lets us communicate the most complex ideas instantaneously. You can focus on your purpose and let our technology run quietly in the background. Again: The metaverse will fundamentally change how we interact and collaborate.

The metaverse and the interplay between the digital and the physical world will help us create a more sustainable planet. We can't change what has already happened, but we can (and must) take action to protect the global ecosystem. We have no time to spare.

**Scan to watch the HxGN LIVE
Global 2022 keynote by Burkhard
Böckem, CTO at Hexagon**



R-EVOLUTION IN PROGRESS: DIGITALISING SOLAR ENERGY PRODUCTION

☰ Editorial



Erik Josefsson is CEO at R-evolution

R-evolution focuses on reinventing how industry addresses complex environmental challenges, leveraging multiple Hexagon technologies to construct and operate its cutting-edge solar farm.



Hexagon’s business venture R-evolution has a far-reaching vision for putting data to work to reverse trends that overwhelm Earth’s systems. It leverages Hexagon’s global leadership in sensors, software and autonomous solutions to run profit-driven, sustainable projects.

The first phase of R-evolution’s photovoltaic (PV) power production initiative is operational and growing. The solar park project portfolio kicked off with the acquisition of a 40-hectare site — equivalent to 60 football fields — in Archidona, Spain. The site hosts our first 8.24 megawatt peak (MWp) photovoltaic solar park, which contains 20,592 solar panels that convert the sun’s energy into clean electricity and connects to the grid.

An adjacent second park that was finished earlier this year doubled the park’s capacity to 16.44 MWp. The total capacity is enough to power close to 6,000 households each year.

The completed solar park includes almost 40,000 bifacial (double-sided) panels mounted on horizontal axis trackers, which together enable energy absorption from both sides

and automatic tracking of the sun to increase efficiency and output.

R-evolution will expand the park’s efficiency by putting data to work using Hexagon’s hardware and software monitoring solutions, including visualisation platforms and sensors. The technologies will combine to create a Smart Digital Reality of the entire solar park that can be remotely and autonomously monitored to detect solar panel anomalies, improve maintenance, aid inspections and more.

Solar energy is a high-growth sector with a lower cost of entry in recent years: The price of solar panels has fallen 70% since 2017. Solar power accounts for nearly 60% of the expected growth in renewables.

Major markets, such as the United States, China and the European Union are predicted to add an average of more than 125 gigawatt of capacity per year through 2025. Solar tech innovations will continue to drive down costs while improving efficiency, a trend forecasted to continue for the next decade. R-evolution will accelerate this trend by leveraging Hexagon’s solutions.



These Hexagon innovations are already in place at the Archidona solar park:

OXBLUE'S PROFESSIONAL CONSTRUCTION CAMERAS

Two professional construction cameras by OxBlue, part of Hexagon, are deployed at the Archidona site. These highly accurate cameras capture the entire Archidona II building process with high-definition time-lapse technology and AI-powered image analysis. Running on solar power, the OxBlue cameras provide immediate access to geospatial data with an intuitive, responsive interface.

LEICA RTC360 REALITY CAPTURE LASER SCANNERS

The Leica RTC360 laser scanners record even the smallest details in 3D for a complete digital twin representation of the module

strings. Remarkably accurate and portable, these sophisticated scanners create a Smart Digital Reality of the site for use in ongoing construction, maintenance, and monitoring.

LEICA BLK247 SMART SURVEILLANCE SYSTEM

The Leica BLK247 smart 3D surveillance system accurately detects security breaches. Its LiDAR with 360- by 270-degree coverage constantly scans designated areas for real-time 3D change detection. A twin video camera system with onboard video sequence recording visually monitors the area, and four thermal cameras check for temperature changes. Together, this innovative surveillance system guards the space with unprecedented accuracy. At the same time, it reduces the occurrence of false alarms and saves time investigating harmless changes that would trigger less sophisticated systems.



LEICA BLK2GO HANDHELD IMAGING LASER SCANNER

The Leica BLK2GO is a handheld imaging laser scanner that creates a 3D digital twin as you walk through a space. It's the fastest and easiest way to scan a large building, structure or environment. This cutting-edge technology uses real-time LiDAR scanning and SLAM tracking for mobile mapping of 3D spaces. While you walk, the IMU (Inertial Measurement Unit) senses your movement to calculate the BLK2GO's change of position in 3D space.

HXDR AND HXGN CONTENT PROGRAM VISUALISATION AND COLLABORATION

Hexagon's HxDR cloud-based visualisation and collaboration platform provides a view of the Archidona site and terrain in the context of its larger environment. The detailed model is placed within an accurate 3D map of its precise geographic

location, including access to the HxGN Content Program's temporally consistent, high-resolution aerial imagery and elevation data. This highly detailed geospatial context promotes optimal insight and planning at the site.

CRADLE CFD FOR SIMULATION

Hexagon's Cradle CFD technology leverages design and simulation in real time. This software optimises thermal and fluid performance on the solar plant; simulates wind, thermal and energy usage; and supports weather forecasting for accurate spot price trading.



Introducing the Leica AP20 AutoPole – the world's first tilt pole for total stations

The Leica AP20 AutoPole is an innovative solution for automated total stations that boosts productivity to the next level through tilt compensation, automatic pole height readings and unique target identification. It complements Leica Geosystems' robotic total stations by extending reliable sensors onto the surveying and construction pole. The technological convergence in the AP20 addresses core pain points in today's total station workflows by making it possible to measure with a tilted pole, to automate height readings in the software and to prevent the station from locking onto unwanted targets. Leica Captivate and iCON field software provide full control and visual guidance thanks to sophisticated 3D visualisation. Integrated into the overall measurement workflow on survey and construction sites, the AP20 turns the total station and reflector pole into an interconnected solution that increases flexibility and productivity.

Core features of the AP20:

- **Automatic tilt compensation:** This feature saves time by eliminating the need to level the pole and hold it steady during point measurement. Furthermore, it increases safety on site as users can fully focus on their tasks instead of the level bubble.
- **Automatic pole height readings:** The AP20 automatically measures the current length of the reflector pole and applies the detected changes in the Leica Captivate and iCON field software. This eliminates time-consuming post-processing to fix incorrectly manually entered or forgotten target heights, saving time in the office as well as the field.
- **Automatic target identification (TargetID):** This feature enables the total station to identify your target during search, preventing you from accidentally locking onto other targets. It is particularly useful when multiple surveying and construction crews are working on a site together.

For surveying service providers

The AP20 AutoPole speeds up surveying measurement and layout tasks. AP20 users can easily and accurately measure previously inaccessible points thanks to the tilt compensation. Automatic updating of reflector height in the field software gives surveyors confidence that the recorded height is always correct. This prevents errors, avoids cumbersome post-processing and eliminates the need to return to the field for a re-measurement. In addition, the unique identification of the AP20 AutoPole ensures that the user's instrument always finds the correct target. Coupled with a robust design, the AP20 fits flexibly into Leica Geosystems' automated total stations survey setup.

For construction professionals

The AP20 boosts efficiency and productivity, even on the busiest of projects, by removing the last analogue steps in robotic total station workflows. Layout and measurements work accurately on uneven surfaces, around obstacles and in previously difficult positions, such as concrete column edges or utility pipes in a trench. Flexible measuring options and confidence that the instrument is only locked to the right target enhance worker safety on construction sites, along roadways and in other potentially hazardous settings workers face every day.

Boosting workflows in the construction industry

The AP20 enables skilled professionals to complete more work in less time. At the same time, it lowers the technical entry barriers for newcomers. The AP20 helps transform the measurement professional's processes within automated total station workflows. By preventing waste and mistakes that result in rework and unnecessary journeys, the AP20 improves construction efficiency and enhances sustainability. The innovation is another step toward autonomous workflows in line with Hexagon's mission to develop autonomous solutions leading to increased productivity, safety and sustainability.

NEWS

Latest Geosystems happenings



Introducing the all-new, next generation Leica BLK360

Meet the all-new, next generation Leica BLK360! A supercharged imaging laser scanner, the new BLK360 captures a full-dome laser scan with spherical images in less than 20 seconds — five times faster than the original BLK360 G1. With 4 HDR cameras, it also includes VIS technology to combine separate scans automatically in the field — saving even more time on- and off-site. The new BLK360 is the best way to rapidly speed up your reality capture workflow, and it's available now.



Major performance increase for airborne bathymetric surveys

The Leica Chiroptera-5 bathymetric LiDAR increases the depth penetration, point density and topographic sensitivity of the sensor compared to previous generations. The new sensor provides 40% higher point density, a 20% increase in water depth penetration and improved topographic sensitivity for generating more detailed hydrographic maps. The system delivers high-resolution LiDAR data supporting numerous applications such as nautical charting, coastal infrastructure planning, environmental monitoring as well as landslide and erosion risk assessments.



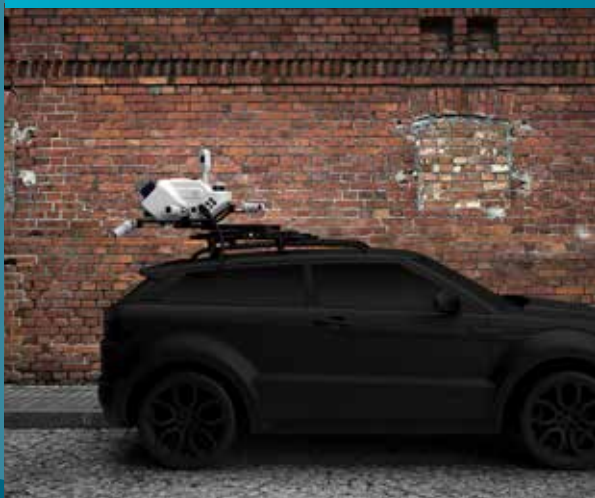
Substantial safety awareness solution enhancements

Heavy construction consistently ranks in the top three industries worldwide for serious injuries and fatalities. The enhanced safety awareness technology from Leica Geosystems is helping to prevent incidents on construction sites. The modular safety awareness solutions, the Leica PA10 and PA80, provide better visibility, greater feedback to operators and field personnel, minimising the risk of injuries, near-misses and site shut-downs. For construction sites, safety awareness is a sound investment, ensuring that everyone gets home safely.



We have you covered. Everywhere.

Exclusive to Leica Geosystems GS smart antenna and receiver users, the new HxGN SmartNet Global — including SmartNet Pro, SmartNet + and SmartNet PPP — combines Hexagon SmartNet services with several trusted regional and global reference station networks. To enable centimetre-level accuracy at unrivalled speeds everywhere in the world, it automatically selects the optimal correction service whether that is network RTK, RTK bridging or precise point positioning. Because of our NRTK solution, you can still benefit from HxGN SmartNet regardless of your smart antenna or receiver type.



The new Leica Pegasus TRK makes mobile mapping smart, autonomous and easy

The new Leica Pegasus TRK solution utilises artificial intelligence capabilities to transform mobile mapping. It is an advanced dynamic laser scanning and expandable imagery system for recording, measuring and visualising environments. The Pegasus TRK solution features an AI-enhanced camera and automatic camera calibration. To comply with privacy regulations, its AI can identify and blur identifiers, such as people and vehicles, in real time. The Pegasus TRK solution enables long-range mobile mapping for applications in asset management; road construction; rail and critical infrastructure; oil, gas and electricity industries and more. The system is also ideal for creating high-definition base maps for autonomous vehicles.



Shaping Sustainable Change

Driving profitable business value helps to ensure economic growth, but should never come at the expense of the planet or people. Hexagon's new customer recognition program, Shaping Sustainable Change, recognises customers that are driving sustainable outcomes. Among the inaugural class of honourees are two customers of Hexagon's Geosystems division: The Dutch company Knoop uses the iCON system to help its customers find the right location for anchoring solar panels that float above water. French company Accsys uses Hexagon solutions to capture and analyse buildings that will be demolished. The data helps assess what material can be recycled, thus reducing the need to extract natural resources for new buildings. Congratulations to all the winners!



AiMaps for fast detection of underground utilities

AiMaps for the utility sector offers intelligent cloud-processing of Ground Penetrating Radar (GPR) data to provide clean uncluttered information for faster detection of underground utilities. The HxDR-based SaaS solution leverages artificial intelligence to reduce time and workload in radar data processing and interpretation.

HEXAGON'S GEOSYSTEMS DIVISION FEATURES CUSTOMERS

AROUND THE WORLD. EVERY DAY. ANY APPLICATION.

At Hexagon's Geosystems division, we are honoured to support you with a comprehensive portfolio of digital solutions that capture, measure and visualise the physical world and enable data-driven transformation across industry ecosystems.

Here, we feature a few of our users in the field doing what they do best — ensuring a scalable, sustainable future. Share with us how you are solving complex daily challenges using Hexagon solutions.

Would you like to be featured in Reporter magazine or on social media? Tell us about you and your work: Send your photos to reporter@leica-geosystems.com or tag us in your social media posts.



Ukrainian-based laser scanning specialists from Skeiron digitise historical heritage sites across the country. Using the Leica ScanStation C10 and Cyclone REGISTER 360 point cloud software, the team creates digital twins of Ukraine's most treasured historic buildings for future preservation.



Ladina Steiner, Earth Observation Researcher, is installing a Leica GS Reference Antenna to measure snow density, mass and accumulation on the Antarctic ice shelf to help understand climate-relevant processes as well as to enhance regional climate models and their predictions. Photo by Ladina Steiner.



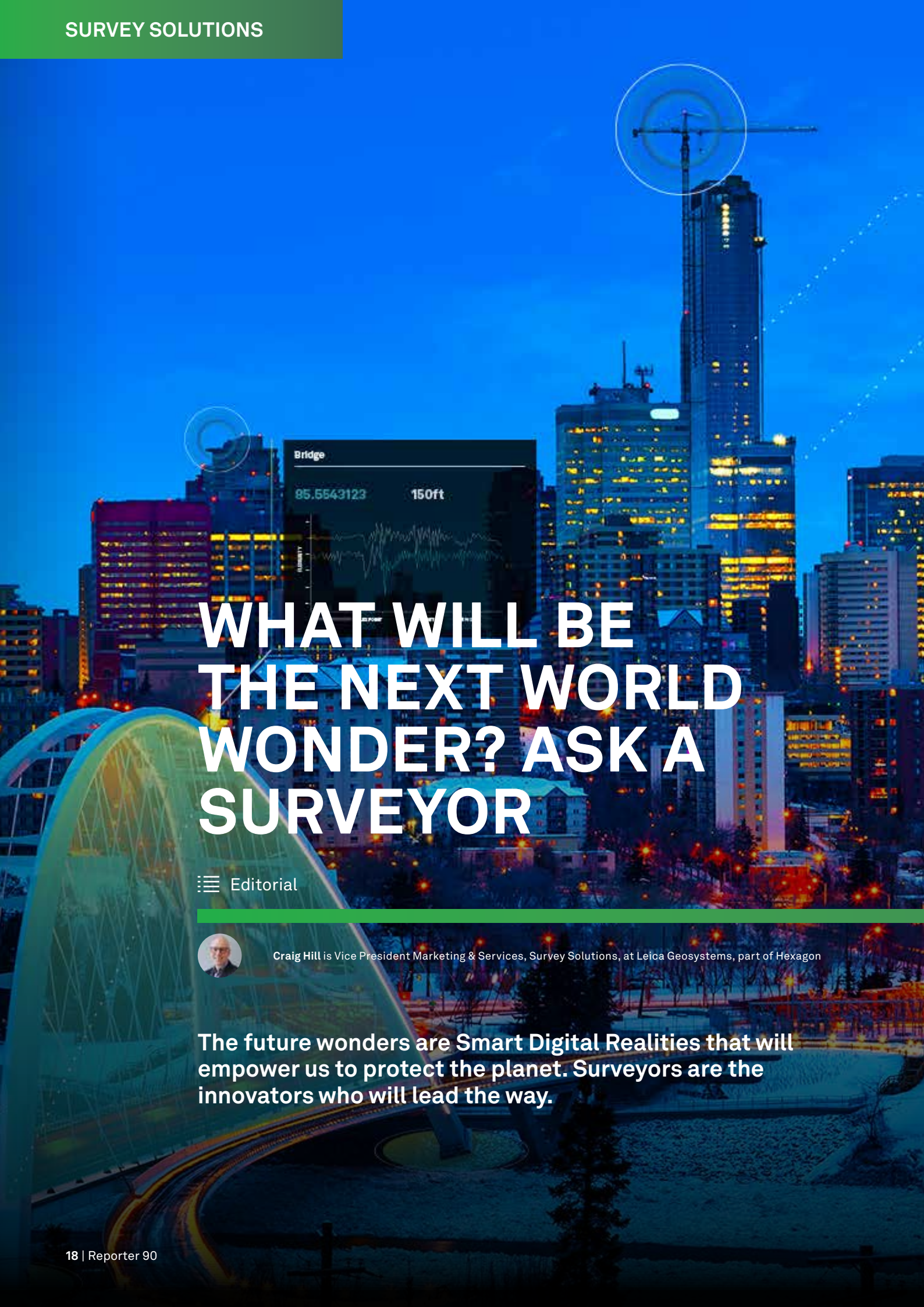
Glaciologist Luc Moreau and a team of scientists from the University of Savoie Mont Blanc CNRS help to measure the deformation of ice in the Mer de Glace glacier to monitor climate change using handheld and lightweight mobile 3D laser scanning technology, the Leica BLK2GO with support from team of Leica Geosystems. Photo by Monica Dalmaso.



ACEA company is performing extensive utility detection in the centre of Rome with the all-in-one specialised GPR system RIS MF Hi-Mod. Photo by BOVIAR srl.



Fabian Nebel, Head of Construction and Engineering Surveying at Trigonet AG uses the Leica AP20 AutoPole to measure on the construction site of the steepest cog rail in the world, the Pilatus Cog Rail by Lucerne, Switzerland.



WHAT WILL BE THE NEXT WORLD WONDER? ASK A SURVEYOR

☰ Editorial



Craig Hill is Vice President Marketing & Services, Survey Solutions, at Leica Geosystems, part of Hexagon

The future wonders are Smart Digital Realities that will empower us to protect the planet. Surveyors are the innovators who will lead the way.



Production efficiency

Consider the greatest human endeavours, the ancient and modern wonders of the world: Stonehenge, the Great Pyramid of Giza, the Great Wall of China, Chichen Itza, Mt. Rushmore, the Golden Gate Bridge, and the Chunnel, to name just a few. The unsung heroes of these marvels are surveyors. Although they are often overlooked, surveyors have always been a critical piece of every structure in the built environment.

While the earliest surveyors relied on ropes, water levels and astronomy for measurement and positioning, today's professionals use total stations, GNSS, laser scanning, autonomous systems, advanced software, artificial intelligence and edge computing. They are known by many titles, including geomatics engineers, geometricians, geospatial scientists, geospatial professionals. The technology and nomenclature have changed, but the need for professionals who understand both the art and the science of surveying and who exemplify the discipline has never been more critical.

Today, the biggest challenge we all face is protecting the planet. The next wonders are not just physical constructions; they are massive projects to construct data-driven models of the world that will empower us to solve our most urgent environmental crises. We call them Smart Digital Realities. Surveyors are essential in these endeavours.

THE DAM THAT HOLDS BACK CARBON EMISSIONS

To create a world that is free from the bonds of human-caused climate change, we must effectively manage carbon dioxide and eliminate toxic waste. Achieving this goal requires efficient factories that go beyond digital twins to embrace a Smart Digital Reality — intelligent systems that reduce or eliminate human intervention. Geospatial data is fundamental to unlocking more applications from digital twin ecosystems, and surveyors hold the keys to understanding the needs as well as capturing and applying this data correctly.



We also need renewable energy parks, modernised power grids and well-managed green spaces. Geospatial professionals capture, create and manage the data sets to build a Smart Digital Reality for everything from construction projects and mining sites to sustainable communities.

THE ROAD TO AUTONOMY

Autonomous systems increase safety and efficiency and free workers to focus on more creative tasks. These systems learn from the real world to understand what was and what is, and to see what could be, what should be and what will be. By harnessing the power of autonomy in sensors, systems and software, surveyors quickly and safely gather highly intelligent geospatial data that will be used to map the metaverse and set the stage for a world that efficiently and effectively runs itself.

THE BRIDGE THAT CONNECTS OUR DATA TO KNOWLEDGE

To make more informed decisions and better serve our future, we need knowledge based on accurate data collected with an eye to the future. Surveyor with their problem-solving expertise and the help of autonomy, machine intelligence and edge computing, can provide a complete line-of-sight to ever-changing situations for more insight and effective collaboration as we map the best path forward.

THE RUNWAY TO SUSTAINABILITY

For our planet to continue to host and sustain life, we need a comprehensive understanding of how every natural and human-influenced action affects humanity and the world around us. Geospatial professionals gather real-world information and measurements, and apply domain knowledge to sustainably design, build or maintain the structures that shape our world.



BUILDING THE NEXT WONDERS

For more than 200 years, Hexagon has enabled the evolution of the geospatial industry, and we remain fully dedicated to providing autonomous, connected solutions that empower geospatial professionals to build a new legacy. Believing in the future of surveying, we as geospatial enthusiasts aspire to be role models, leading by example and demonstrating what can be done.

Today's surveyors are much more than expert measurers who determine property boundaries. They are the pioneers, explorers, and thinkers who will solve some of our biggest problems and harness the data that is required to change our world for the better.

Together, we can spread awareness, generate enthusiasm, and share the passion and purpose that will inspire a new generation to build the world's next wonders.

Scan to watch the HxGN LIVE Global 2022 keynote by Thomas Haring, President at Hexagon's Geosystems division, and Craig Martin, President North America, at Hexagon's Geosystems division.



EFFICIENT MAPPING OF DANISH HIGHWAYS

☰ Editorial



Simon Hall is Content Marketing Executive at Leica Geosystems, part of Hexagon

A national road network is among the most important pieces of infrastructure a country builds and maintains. Ensuring that these public highways are kept to the highest possible standard results in a dramatic increase in public safety.

The Danish Road Directorate (Vejdirektoratet) contracted Getmapping after a tendering process to survey the road state network. High-density terrestrial point cloud data and matching high-resolution panoramic imagery would be collected using the state-of-the-art Leica Pegasus:Two Mobile Mapping Ultimate equipment.

With more than 20 years experience in the capture and delivery of high-resolution aerial imagery, LiDAR, digital mapping and web-based services across Europe and Africa, Getmapping PLC is a leading global provider of geospatial data and survey solutions. Its goal is to facilitate the timely and cost-effective provision of geospatial data, creating digital replicas of the world. Getmapping collects, transforms, stores and delivers scalable geospatial data, mapping and modelling solutions to enable better decision making and to empower customers and partners to solve challenges businesses and the planet face.

Vejdirektoratet, or the Danish Road Directorate, is responsible for the national road network of Denmark, which comprises motorways, several main roads and many of the country's bridges. Balancing mobility, the environment and road safety, it develops, plans and constructs Denmark's infrastructure to create coherence for road users.

ABOUT THE PROJECT

The goal of Vejdirektoratet was to scan the 11,000 kilometres of road networks across the country using the Leica Pegasus:Two Mobile Mapping Ultimate solution, enabling it to collect high-density terrestrial point cloud data and matching high resolution panoramic imagery.

"This is an exciting project for Getmapping. Denmark is a new market for us and expands our presence as the leading supplier of aerial and mobile mapping services across North-West Europe," says Gavin Sullivan, deputy head of Europe at Getmapping.

CHALLENGES

The mobile mapping project was one of the largest Getmapping had ever undertaken. In addition, it required extensive data processing and classification, including image anonymisation and four LiDAR classifications. Within six months of the contract award, Getmapping was scheduled to have delivered a

fully processed data set of 3D laser point clouds and 360-degree photos to the Danish Road Directorate, covering all state roads and their immediate surroundings.

"The biggest challenge for this project was the tight deadline to capture, process and classify such a large amount of data in such a short amount of time: something that has never been done before! The project was made possible by identifying the duration and dependence of each task and dedicating adequate team management to each one of them," says Alexandre Alves, European operations manager at Getmapping.

Despite the challenges, Getmapping delivered to the client's expectations:

- Highly efficient data capture meant it only had to capture the data once to meet the project specifications.
- Hundreds of line kilometres captured per day ensured all mapping was completed within three months of the project start date.
- The mobile mapping data, including classifications was processed and delivered in phases, providing usable and relevant information for immediate analysis.
- The full data set was delivered within the six-month deadline.

MOBILE MAPPING SOLUTION

Thanks to the Leica Pegasus:Two Ultimate mobile mapping solution, Getmapping was able to use the laser scanners in combination with GNSS receivers, inertial measurement unit (IMU) and a distance measurement instrument (DMI), acquiring accurate and precise spatial data with cameras mounted on its vehicle.

The innovative mobile sensor platform captured the required point cloud and imaging data. The multisensor approach allowed Getmapping to increase its ROI by collecting more data in one pass, decreasing the time in the field and generating higher results with the same resources. The reality capture solution is completely vehicle-independent, making it a competent solution across multiple applications without limiting users to road and rail.

Getmapping only needed to capture the data once and surpassed the project specifications with respect to point density and expected data accuracy. The Pegasus:Two captured the full 360-degree spherical view imaging and LiDAR



together, which meant that Getmapping did not have to return to a specific project site once the data had been captured.

A VIEW TO THE FUTURE

The Leica Pegasus:Two Ultimate was the best option for the project. Because of this mobile mapping system, it took less time and was more cost effective than any other surveying method to achieve this level of detail and accuracy. The data also drove operational efficiencies, enabling the Vejdirektoratet employees to carry out visual inspections and measurements from the office, mitigating the health and safety risks of site visits. The new data will also allow the Vejdirektoratet to develop completely new methods and applications in a wide range of areas.

“Getmapping have a strong focus on collaboration. For projects like this, the benefits of this consultative approach went beyond the provision of best-of-breed technology, to how we collectively provided our customer with high quality business insights, effectively and efficiently,” says Helen Wattie, European sales manager at Getmapping.



By connecting the field and the office, Hexagon solutions enabled the Vejdirektoratet employees to carry out visual inspections from the safety of their office rather than amid hazardous conditions on site. By providing high-quality, easy-to-understand access to data, our solutions supported the customer's collaborative and consultative approach.

Getmapping are now actively marketing for other bespoke survey opportunities using the Pegasus:Two, and this project showcases the extent of the surveying that it can provide.

It works with a rapidly increasing number of customers who are looking for a faster, safer and cost-effective alternative to traditional topographical survey techniques. Its mobile mapping solution is used in a variety of new and innovative ways, including highways planning, asset management, change monitoring, parking apps and 3D modelling.

THE NEW LEICA PEGASUS TRK NEO SOLUTION



Alessandro Nuzzo is Product Manager for Mobile Mapping Systems at Leica Geosystems, part of Hexagon



Leica Geosystems has now launched the new Leica Pegasus TRK Neo solution.

■ Alessandro Nuzzo, how does the Leica Pegasus TRK Neo solution utilise AI to transform mobile mapping?

The Pegasus TRK Neo leverages AI in various workflow areas: It blurs personal data of pedestrians, vehicles and other traffic participants in real time during acquisition for GDPR compliance. In post-processing, the point cloud is automatically classified into roads, sidewalks, buildings, vegetation and various other categories. The trained AI models are capable of much more. Our initial focus was preserving privacy, but customers will benefit from more AI features, making Pegasus TRK Neo efficient like no mobile mapping system before.

■ The Pegasus TRK Neo is so light that it can be operated by one person. Why is that important?

Making great technology accessible is one of the main goals we pursue at Hexagon. We put the user in the centre of the product development and analysed the main pain points while using mobile mapping systems. The goal was to develop a system that can be installed and operated by a single person. This reduces personnel costs and eliminates the entry barrier for those new to the technology. We decreased the system weight from 49 kilograms to 18 kilograms and developed a unique rotational-tilt mount that facilitates the installation. It reduces the system lifting height by 36cm, avoiding risky lifting operations.

■ Could you please give another example of the system's user-friendliness?

We look at the entire user experience: Experiences are the sum of emotions a user will feel when adopting the Pegasus TRK. Small details matter in making things intuitive. This applies to the system installation, but also to the process of guiding the users from project setup to data collection to data processing. Wherever possible we implemented fully automatic workflows, reducing the complexity novices face when first using mobile mapping systems. It is about real-time feedback,

eliminating the grey zones during usage, the ability to plan an acquisition route, get guided and routed while the system autonomously triggers the sensor to collect according to the project requirements.

■ Please describe how and when the Pegasus TRK Neo connects with Leica Pegasus FIELD software and Leica Cyclone Pegasus OFFICE.

Pegasus FIELD is the “operating system” running on the system. It manages the hardware, triggers data capture, performs various real-time operations and makes sure the job is performing according to the project settings. Cyclone Pegasus OFFICE is the suite running in the office. It processes the collected data and delivers georeferenced 3D point cloud and imagery. Various refinement tools enhance the trajectory quality, for example, SLAM (simultaneous location and mapping) calculation in GNSS denied areas or multi-pass adjustment in case of repeated passes over the same area.

■ Do you have some more info available on the sensor capabilities and specifications (such as accuracy) and could you explain what is meant with a single line point cloud pattern?

Pegasus TRK Neo was designed from scratch and took into consideration the single sensor characteristics to make them work at their best. The result is an unmatched accuracy level both in RTK (Real Time Kinematics) and PP (Post Processing). While the TRK500 is equipped with a single ToF (Time of Flight) scanner, the TRK700 has two embedded scanners. The TRK500 collects with a continuous rotating scan head at a frequency of 250Hz half a million points per second. The scan line is vertical to the driving direction. The TRK700, having a dual scanner, collects one million points per second in a crossed point cloud pattern (left, diagonal, right diagonal) offering a better coverage of the point cloud and higher point density.

5 WAYS TO UNLOCK YOUR BUSINESS' SURVEYING POTENTIAL WITH 3D LASER SCANNING

☰ Editorial



Amanda Troth is Marketing Manager, Global Product Marketing Communications, at Leica Geosystems, part of Hexagon

Many surveying and engineering firms invest in 3D laser scanning technologies to expand their services with rapid and comprehensive data captures. It is easy to see why: Incorporating 3D laser scanning services can open new revenue streams and market segments as more applications for point clouds emerge.

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However, investing in scanning technology alone is not enough to succeed. Without a clear plan and strategy for selecting and integrating 3D laser scanning hardware and software, you miss a crucial component of optimising your surveying portfolio's potential.

One company that has cracked the code to unlocking successful integration and business growth with 3D laser scanning is the US-based engineering and geospatial services firm, Thouvenot, Wade and Moerchen, Inc. (TWM). Prior to 2012, TWM's land surveying division primarily functioned as a support service for their engineering projects. Today, their geospatial division makes up more than half of the firm's staff with revenue growth of approximately 900% from 2013 to 2021, when they focused on 3D laser scanning as a stand-alone service.

In this article, Derek Twente, Director of Geospatial Services at TWM, shares lessons learned and five key strategies that helped TWM expand with reality capture services.

1. RESEARCH AND CREATE A CLEAR PLAN FOR REALITY CAPTURE WORKFLOW INTEGRATION

Twente recommends managing investment risks long before you complete your first scan: To begin, research and plan how 3D laser scanning technologies will fit into your existing business.

"Taking the risk is a critical part," Twente explains, "but we spent a lot of time making sure we understand how to integrate the technology

into our workflow and what the return on investment will be."

Research competitors, define segments you can serve and identify the technologies that will be most beneficial for those segments. Additionally, define what you need to become proficient and profitable. For example, how many field and office staff will perform data capture and processing tasks, and what training will they need? What marketing campaigns and associated costs will be necessary to make customers aware of your new services?

Finally, Twente recommends growing gradually into larger projects as you add 3D laser scanning technologies into your workflow and building a solid groundwork to ensure you can deliver valuable services at scale.

2. INVEST IN THE RIGHT HARDWARE AND SOFTWARE FOR YOUR PROJECTS

Deciding on the right technology is critical to success. TWM currently has the technical capabilities and capacity to take on a wide range of projects.

"Our company growth is a result of our commitment to invest in technology," says Twente. "A lot of our overall success was generated from our initial investment in reality capture."

TWM first invested in the Leica ScanStation C10, and their fleet of laser scanners has grown with capacity and client needs. Along the way, they added two high-speed Leica ScanStation



P40 scanners, two portable and automated Leica RTC360 3D laser scanners and the Leica BLK360 G1 imaging laser scanner, with all six scanners used daily. Most recently in 2019, they added the Leica Pegasus:Two Ultimate mobile mapping platform to accommodate capacity issues for large captures, freeing up staff and other scanners for additional work.

“Make sure you understand your equipment and what you want to use it for,” Twente recommends. “When determining which scanner or UAV to buy, a lot depends on what you want to do with the data. Don’t let your final decision be driven solely by cost.”

Rather, Twente suggests making hardware and software choices based on the size and scope of captures and technical specifications, along with the type of work and the corresponding data management you will need. Factor in the software that enables you and your clients to work with point clouds and create deliverables, like the Leica Cyclone point cloud processing and management software family or the range of Leica CloudWorx plugins for a variety of CAD tools and applications.

3. TEACH YOUR CLIENTS HOW TO WORK WITH THE POINT CLOUD DATA

Instead of exclusively offering deliverables with extracted data from point clouds, teach your clients how to work with the point clouds

to ensure they understand the value of the data you’re providing.

“Initially, we were running into issues where we didn’t see many repeat clients, and that was a result of our approach. We extracted the data and provided it in the deliverable, but we held on to the point clouds,” Twente recalls. “Ultimately the problem was that the clients weren’t seeing the value because we weren’t providing them with the point cloud data.”

In early 2016, TWM modified their model by identifying clients’ software needs and learning the software well enough to pass along instruction. Rather than retaining the data, TWM delivered the point clouds to their clients and taught them how to work with the data using readily accessible software.

“Even when the client didn’t need us for additional data on an individual project, they wanted us to scan their next projects,” Twente explains. “This new approach really sparked growth because our clients could clearly see the value in the data.”

4. LEVERAGE YOUR REALITY CAPTURE INVESTMENT TO ATTRACT THE NEXT GENERATION OF SURVEYORS

TWM’s investment in reality capture hardware and software has helped them attract the next generation of survey professionals to their company.



“Workforce was one of the larger hurdles we faced early on. We underestimated the office staff that was needed for processing and extracting the data, so we started training our field crews in virtual surveying and data extraction in the office,” says Twente.

While training existing staff has helped, attracting new hires who have grown up in the 3D environment is a huge benefit and an essential solution for capacity issues.

“We’ve been able to make some key hires at TWM because of this technology,” reflects Twente. “Recent college graduates are interested in reality capture. When they have the opportunity to use these technologies with us, TWM has the upper edge to attract the right talent.”

5. BE OPEN TO OPPORTUNITIES AND WAYS OF WORKING OUTSIDE OF TRADITIONAL LAND SURVEYING

Investments in reality capture technology help enhance what you can do in traditional surveying contexts and open up new opportunities.

“Now we have many projects outside of traditional land surveying. For example, we work with mechanical contractors doing modelling, piping design and clash detection. Things we are doing in the mechanical world are far beyond what we had anticipated. This technology has opened the door for teaming opportunities with other firms –

something that was not in our initial plan,” says Twente.

TWM is also able to bring more valuable deliverables to clients, helping them visualise projects and streamline information delivery with almost all walkthroughs taking place virtually. “It’s phenomenal that we can set up a virtual meeting and if there are clash detection or design issues, we can work through them immediately. This brings significant cost savings to our clients because, in a 20- to 30-minute meeting, they can address issues before construction starts rather than identifying them in the field, where they are more time-intensive to address.”



3D laser scanning solutions from Leica Geosystems, part of Hexagon, connect the field to the office by enabling a seamless field-to-finished workflow. Easily capture, register and examine scan and image data on site and publish directly to the cloud for data that is ready to process as soon as you are at your desk. Reality capture technology has also helped TWM connect generations: Innovative technologies help traditional surveying companies attract young talent to the industry.

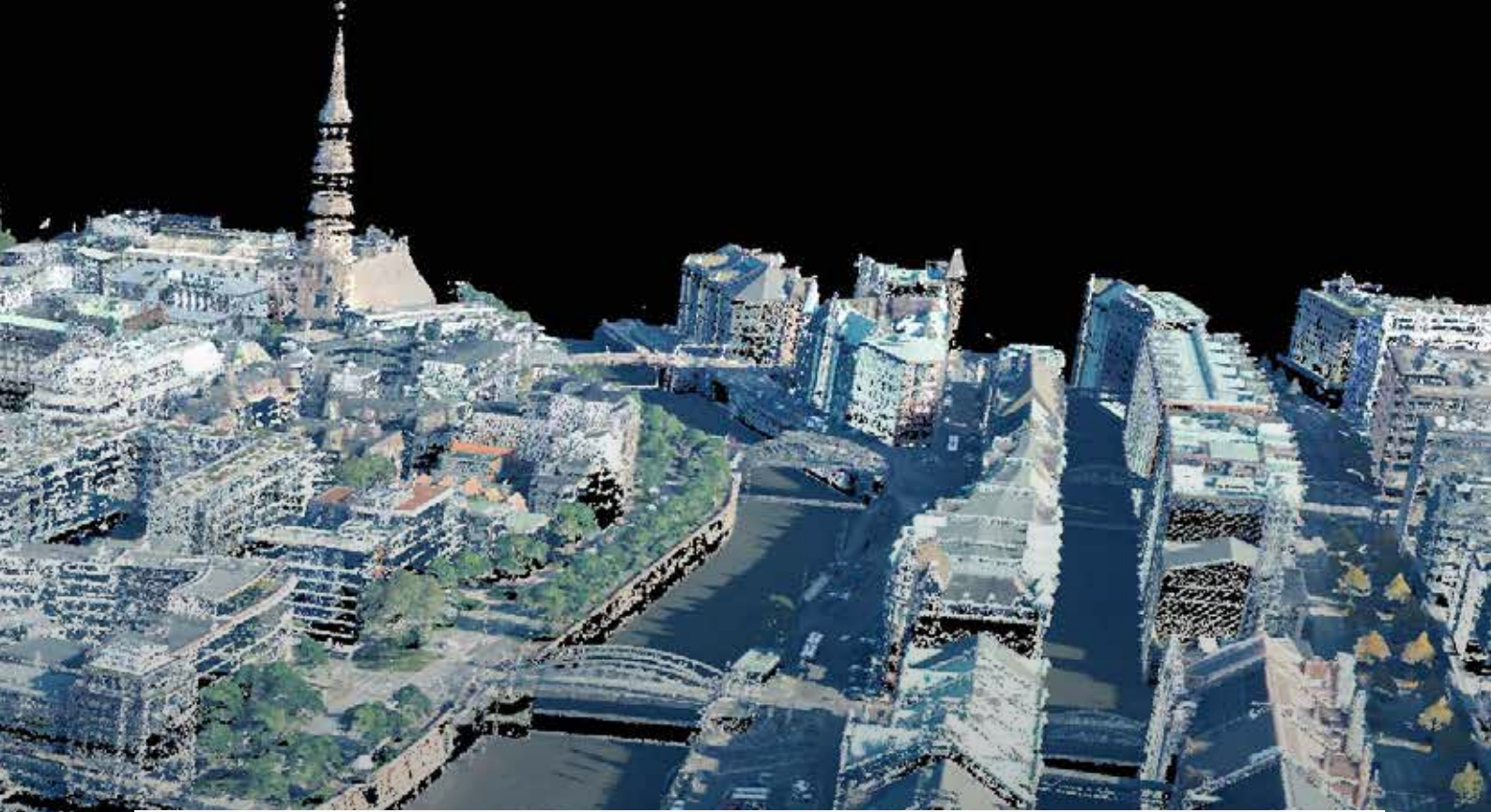
GERMANY'S DIGITAL TWIN: TOWARD A SMART DIGITAL REALITY

☰ Thought leadership



Jürgen Dold is Executive Vice President at Hexagon

The world has undergone tremendous change in recent years. We've learned that significant world events are utterly unpredictable. Our planet's major ecosystems are buckling under the strain of human activity.



The human population has doubled since 1975, and so have carbon dioxide emissions. In summer 2021, Germany experienced the impact of climate change first-hand: Massive floods claimed the lives of many and caused immense property damage. The COVID-19 pandemic caught us off-guard and tested the resilience of our society and systems. Yet the pandemic also spurred wide-scale digital adoption and showed the potential of digital collaboration and productivity.

The pandemic experience has given rise to a new era of digital twins and, consequently, the Mirror World — a fundamental element of future digital collaboration. With the rise of the internet, information became digitised and machine-readable, enabling algorithms to find answers to questions from an almost infinite amount of data. The next step is digitising our physical world to make it machine-readable. The internet is becoming a multidimensional space that supports collaborative decision-making through data analysis and simulations. At Hexagon, we talk about creating a Smart Digital Reality.

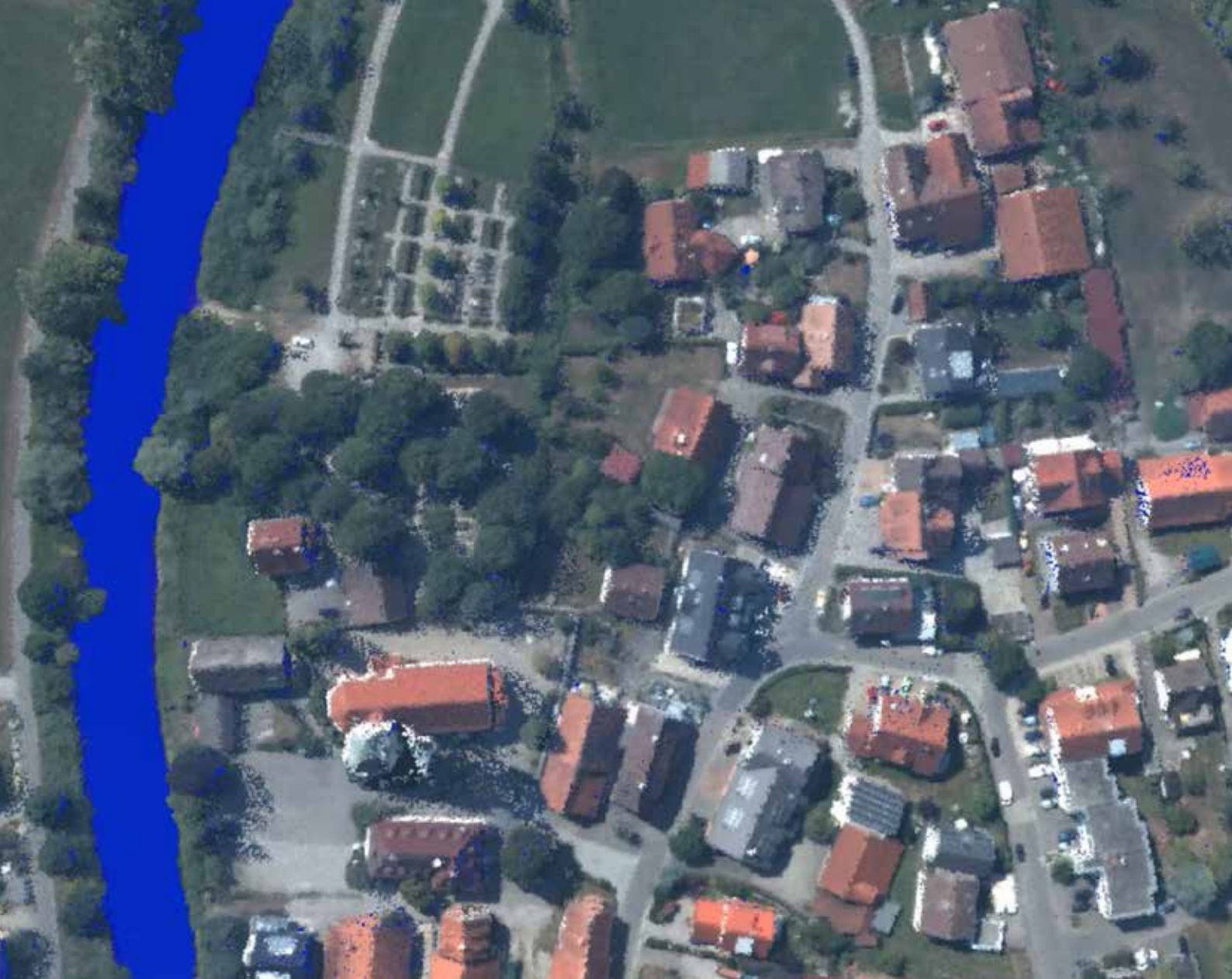
WHAT YOU CAN'T SEE, YOU CAN'T MEASURE

As management guru Peter Drucker famously said, “If you can't measure it, you can't manage it.” An extrapolation of this statement applies to

the Mirror World: What you can't see, you can't measure. Let's take flood mitigation as a case in point.

We know that water always seeks its lowest level — so what if we knew in advance what areas would be immersed in water in case of a flood? State-of-the-art reality capturing solutions allow us to create a high-resolution topographic model that visualises infrastructure, buildings and vegetation of an entire country, such as Germany, in great detail. Thanks to single-photon LiDAR technology, such 3D models are now economically viable.

Our solution is four to ten times more efficient than conventional LiDAR methods while at least quadrupling image resolution. Using a single airplane, it enables us to survey all of Germany in only five months, easily meeting the required height accuracy of ten centimetres. Single photon LiDAR and Geiger-mode LiDAR enable us to cover large surface areas while maintaining the high resolution necessary to detect objects reliably and create a realistic mirror image that can even include terrain beneath vegetation and details below infrastructure, such as bridges, and up to ten metres underneath the water. The result is a highly detailed and consistent topographic model — a unique, previously unavailable source of information.



For simulating flood scenarios, the riparian areas are particularly important. These are usually vegetated, but planners can remove the trees in the model to see what lies underneath. The underwater terrain is a crucial parameter for the runoff behaviour of streams and rivers. With the help of algorithms, we can predict how much and where water will spread in case of heavy rainfall — which scientists predict will be 3%-19% more intense and up to nine times more frequent in Western Europe due to climate change.

A national, unified and consistent topographic model would be a valuable source of previously unavailable information for a range of industries. Digital twins will become an indispensable tool for companies and local authorities to design, plan and manage connected infrastructure and assets; for energy companies to plan and maintain power lines; and for telecommunications firms to roll out 5G coverage. Other sectors poised to

benefit from the technology include forestry, hydraulic engineering and the aviation industry.

WHAT SEEMED LIKE A FANTASY A DECADE AGO IS BECOMING A REALITY

In densely developed areas, such as cities, we use hybrid sensors to create a complete, photorealistic mirror image of the physical world. By combining multiple types of datasets, such as aerial scans and street view data, Hexagon creates a Supermesh model that allows urban planners to visualise planning relationships quickly and easily. A Supermesh enables us to see urban space in all its details, from both above and below.

Moreover, AI enables the automatic labelling of objects, such as roofs, solar panels and rails, at an up to 99% accuracy rate. AI algorithms can extract semantic image data and assign attributes to each pixel in the



mesh. This enables us to detect up to 20% more sealed surfaces and determine the exact inventory of green space, including trees. These data points help urban planners, for example, to assess the amount of space available for new structural measures. Recapturing these areas in regular intervals will help track and assess progress.

TO MANAGE COMPLEX SYSTEMS, CONNECT THEM

To extract meaningful information from data in complex challenges, we need to combine data. Such connectivity culminates in the metaverse, or what we like to call Smart Digital Realities.

The Smart Digital Reality enables policymakers to find solutions to complex challenges, such as tackling urban overheating. Our models let us simulate various wind and air exchange scenarios and recommend structural measures that will improve the urban climate long-term. Moreover, real-time data from 3D surveillance sensors can be

fused with the digital twin of critical infrastructure to enable security teams to coordinate safety-relevant decision-making.

Hexagon's response to the metaverse is its Smart Digital Reality solution HxDR — a cloud-based storage, visualisation and collaboration platform for reality capture and geospatial data — where mirror worlds of entire cities and countries are merged. HxDR is becoming our marketplace for Hexagon aerial data and for Metro HD. The first cities to be added to our Digital City Models data program include Munich, Cologne, Stuttgart, Frankfurt, Vienna, Milan, Amsterdam, Stockholm, Dallas, New York and Tokyo. Hexagon is dedicated to making urban digital transformation more efficient and sustainable. We look forward to the challenging yet rewarding projects ahead.

3DNL — THE NETHERLANDS FROM EVERY ANGLE

☰ Editorial



Lynda Duffy is a geospatial specialist and content writer at Apropos Research

Cyclomedia and Hexagon collaborate to create a first-of-its-kind photorealistic 3D model of an entire country.



Smart Digital Realities that replicate real-life geoinformation provide valuable insights, and support the analysis and interpretation of infinite data inputs from the real or digital world. Commercial and government customers can use them to improve work processes and planning.

3DNL is a first-of-its-kind photorealistic digital twin of the entire Netherlands. It is based on aerial imagery and LiDAR data, collected with a Leica CityMapper-2 airborne sensor and made accessible through Cyclomedia's Street Smart web viewer hosted on HxDR, Hexagon's cloud-based storage, visualisation and collaboration platform.

3D DIGITAL REALITIES ARE CHANGING THE GAME

Cyclomedia has provided 360-degree street-level visualisations for decades. Aware of the increasing demand for 3D data and wanting to maintain its position as a preferred content supplier, Cyclomedia recognised the benefits of creating an innovative hybrid data set, offering both price and product delivery advantages. By creating 3DNL, the company has produced a multipurpose digital twin. In addition to its direct use in Street Smart, users can also stream or download the 3D data for third-party applications.

"We are making a big impact by creating a new way for customers to interact with data and develop insights to create smarter cities, achieve more efficient construction and derive

information from the data to provide knowledge," says Thomas Pelzer, product manager at Cyclomedia.

The Leica CityMapper-2, a state-of-the-art hybrid airborne sensor, is perfectly suited for efficient and accurate urban mapping. The simultaneous acquisition of oblique imagery and LiDAR point clouds produces perfectly registered consistent data. The narrow field of view minimises occlusions while the oblique scan pattern captures building facades from all angles. One flight instead of two reduces environmental impact, decreases data acquisition costs and takes advantage of limited flying windows.

The most important benefit of using a hybrid system lies in the quality of the data products. Image-only systems struggle to provide accurate data in shadows, urban canyons and under vegetation. The LiDAR data perfectly complements image data to fill the gaps. As an active sensor, it does not require light to create accurate data points and can provide returns from underneath vegetation. At the same time, the image data is crucial for the generation of textured 3D models. A hybrid sensor provides more information, more-accurate measurements and smoother surfaces in the mesh.

"Adding a LiDAR sensor to an oblique camera, as found in the Leica CityMapper-2, is a game changer. We have a strong preference for hybrid data and there are many advantages to joining forces on acquisition and development with a large global corporation such as Hexagon," says Pelzer. "We are always looking for new ways



to bring best-in-class products to market and Hexagon shares our enthusiasm for innovation."

Hexagon also leverages the one-of-a-kind sensor technology for the HxGN Content Program's Metro HD city data offering. Hybrid data of major cities are captured with the Leica CityMapper-2 and used to produce a full stack of exceptionally accurate, temporally consistent 2D and 3D data sets to satisfy even the most demanding applications. The Metro HD city data will be hosted and made available on HxDR.

UNMATCHED 3D MESH QUALITY

To capture the Netherlands in its entirety under favourable conditions and to produce the best data set possible, Cyclomedia partnered with Hexagon to capture aerial data each year between February and October. After processing with Leica HxMap software, the aerial imagery and LiDAR data as input are converted into a mesh and added to 3DNL. The 3D data is hosted on HxDR and fully integrated into Street Smart.

HxDR enables users worldwide to unlock the data within 3DNL and to take advantage of a range of functions and features to explore and utilise 3DNL. Features include 3D city mesh measurements (distance, height, volume), asset management, sun and shadow analyses, and building cross-section analysis. The platform is also ideal for visualising projects for public review and allowing the virtual collaboration of professionals in any field.

PRACTICAL APPLICATIONS

Hexagon and its partners have made great strides toward creating a digital environment in which stakeholders and citizens can plan, visualise and simulate developments. Tasks such as importing CAD and BIM data, importing reality capture data, automeshing reality capture data, as well as virtual tours and flythroughs, annotations and photosphere locations are possible.

The broad range of applications appeals to government and commercial customers. For example, a solar company may download the model of a specific house, calculate the pitch and slope, create a solar plan and present a proposal to the house owner. Construction



and engineering companies can download an area of interest, design a new build and determine the most efficient access and logistics for the construction phase. A governmental agency may calculate how many trees are in a neighbourhood, plot heat pockets and perform a shade analysis.

"We envision 3D to be part of a solution to accommodate users in a variety of work processes that need highly accurate data, as we offer through reality capturing," says Pelzer. "We continue to improve the quality of both the input and the output data, and to leverage the classification of the point clouds to identify objects in the mesh models. By producing multiuse data sets, a variety of sectors such as local government, construction and engineering, infrastructure, and wind and solar energy all benefit from better information."

Cyclomedia's and Hexagon's collaboration on this ground-breaking 3D digital twin project demonstrates the potential for the large-scale simultaneous collection of imagery and point clouds with the Leica CityMapper-2.

A version of this case study was first published in GIM International as part of the Aerial Mapping & Earth Observation Weeks 2022.



Smart Digital Realities support the analysis and interpretation of the real and digital world, connecting users to valuable insights that improve work processes, planning and collaboration. 3DNL, a photorealistic 3D model of the Netherlands, is based on aerial data collected with the Leica CityMapper-2 airborne sensor and is accessible through Cyclomedia's Street Smart web viewer hosted on Hexagon's HxDR platform. Seamless data flow and processing ensure stakeholders have the information they need when they need it.


SHARKS, SCIENTISTS AND TECH INNOVATORS TEAM UP TO PROTECT MARINE ECOSYSTEMS

☰ Editorial



Andy Waddington is Vice President, Bathymetric Services, at Hexagon's Geosystems division

Hexagon's sustainability business venture R-evolution is leading the way in accelerating the transition to a sustainable global economy by identifying and attracting capital to finance business opportunities that benefit the environment and society.



For one project, R-evolution takes advantage of cutting-edge bathymetric solutions from Leica Geosystems, part of Hexagon, to promote decarbonisation, the protection of coastal ecosystems and the preservation of biodiversity.

The world has seen an exponential increase in carbon emissions, resulting in drastic changes to the climate and threatening life on Earth. One powerful resource nature has at its disposal for keeping carbon dioxide levels at bay are carbon sinks. For too long, however, the carbon discussion has centred around land-based carbon sinks, such as forests, while neglecting the largest global storage depot of the planet: the ocean.

Blue carbon ecosystems refer to coastal and marine vegetated habitats, such as seagrass meadows, salt marshes and mangrove forests that sequester and store carbon from the atmosphere and ocean. Seagrass, in particular, captures carbon dioxide more efficiently than forests on land. And, since most carbon is stored in soil and sediments, it can remain there for millennia if left undisturbed.

Despite their crucial role in mitigating climate change, seagrass meadows remain among the least recognised and least protected ecological habitats. The lack of data on the distribution of seagrass meadows poses a significant obstacle to conservation and restoration efforts.

YOU CAN'T PROTECT WHAT YOU DON'T MEASURE

In the Bahamas, home of a large seagrass ecosystem and a designated shark sanctuary, scientists studying sharks' movements on behalf of conservation NGO Beneath the Waves made an unexpected discovery: Tiger sharks spend a large portion of their life patrolling and foraging dense seagrass meadows. Using this insight, the organisation leveraged a combination of sensor-tagged sharks, satellite data, marine vessel surveys and scuba divers to drive the ongoing discovery and map the extensive seagrass meadows of the Caribbean.

The conservancy's mapping project was an essential first step in learning more about the little-known ocean habitat. Yet to protect and restore the blue carbon sinks, the conservancy's findings needed to be validated

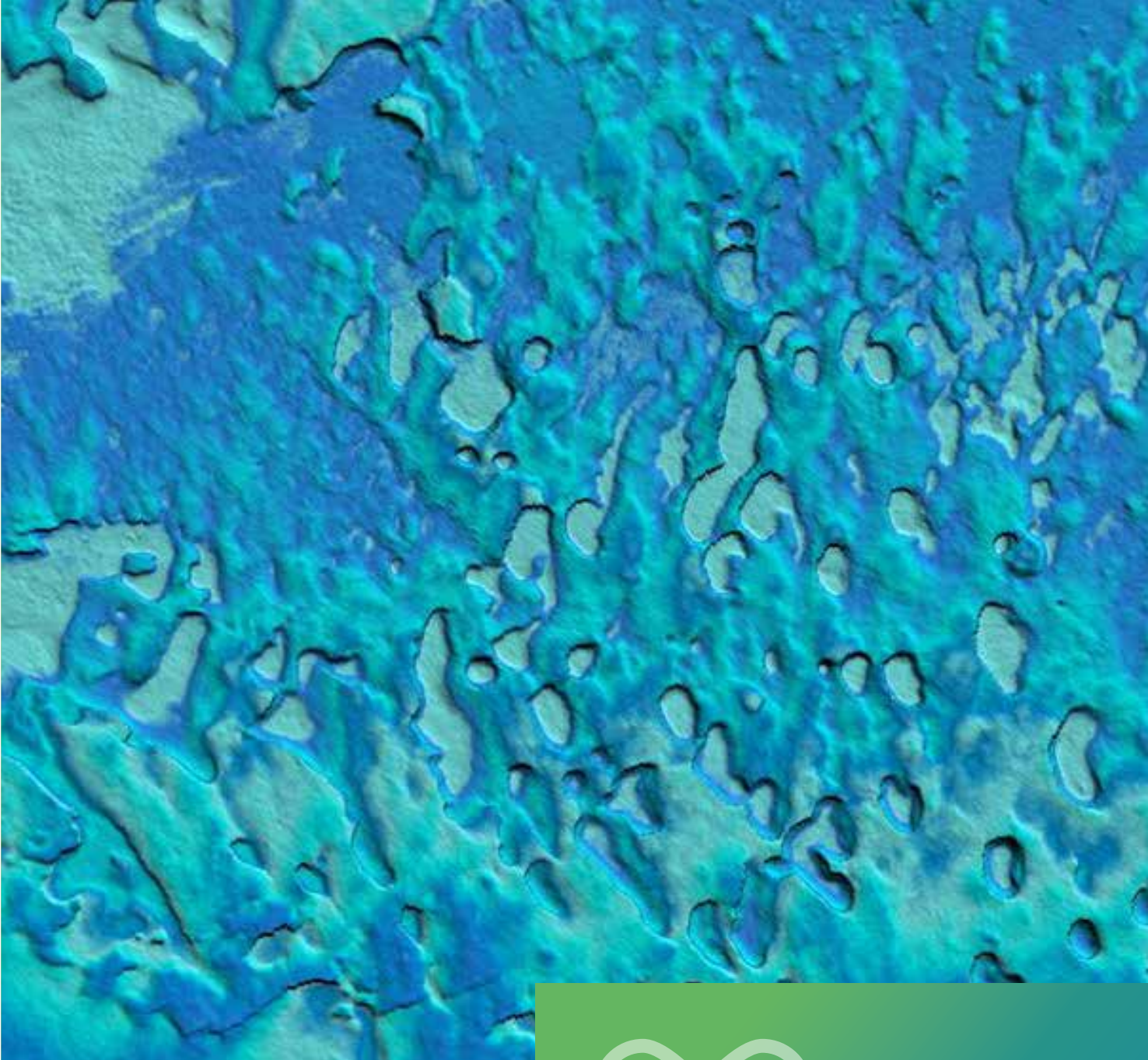


with high-positional accuracy and datasets that can provide efficient, year-on-year change detection and monitoring. Hexagon's sustainability business venture R-evolution has thus teamed up with Beneath the Waves to map, study and quantify the threatened seagrass meadows of the Caribbean islands at scale.

Bathymetric surveying supports environmental monitoring by mapping and classifying submerged vegetation and habitat to assess aquacultures and study marine ecology and hydrodynamics. R-evolution is leveraging Hexagon's airborne bathymetric LiDAR technologies to capture details about the vital habitat, including its extent and

composition. Thanks to the Chiroptera 4X, Leica Geosystems' airborne bathymetry solution for cost-effective and rapid surveying of large areas, thousands of square kilometres of seabed habitats at up to 30 metres of water depth could be accurately mapped in just a few days. The high-resolution point clouds provide 3D elevation and land classification information with higher positional accuracy and spatial resolutions than the 2D coverage of satellite data.

The recently launched Leica Chiroptera-5 combines superior resolution, depth penetration and topographic sensitivity to generate even more detailed hydrographic maps. This new sensor provides an invaluable



source of information for various applications that support better decision making for environmental monitoring and management. Repeated bathymetric LiDAR mapping provides an excellent basis for year-on-year change detection and monitoring.

By combining the marine expertise of Beneath The Waves with the innovation and technological know-how of Hexagon, the collaborative project expects to yield groundbreaking results for blue carbon conservation. The project offers an opportunity to stop degradation and generate new value streams simultaneously.

A version of this article was published in Hydro International #3 in August 2022.



Apart from connecting three disparate actors, this project links sustainability with profits. Mapping and classifying the seabed at scale is a crucial first steps toward preserving seagrass meadows that provide blue carbon storage. Hexagon's Geosystems division normalises the data by fusing various sources of information and thus enables feeding algorithms that can automatically identify sea-bed types, vegetation species and density.


HOW AI-POWERED PROGRESS DOCUMENTATION AND REAL-TIME SITE CONTROL BENEFIT CONSTRUCTION

☰ Thought leadership



Fabio Ponzio is Executive Vice President at Hexagon's Geosystems division

New advancements in video capture technology using AI and machine learning allow for better documentation and tracking of the construction site. This information can be shared among all stakeholders to keep everyone updated on the status, to easily adapt to new situations and become more efficient and cost-effective.



Everyone working in construction knows that there are always many moving parts on the job site. Understanding construction progress, verifying schedules, assessing quality, identifying project delays and ensuring safety compliance are essential to keeping a project running smoothly and delivering on time and budget.

Stakeholders would like to have complete visibility of what's happening on-site to be able to address issues, optimise performance and ultimately meet or exceed planned expectations. Recent advancements in technology, particularly gaining insights from machine learning and AI, provide this high visibility to make construction much more time-efficient and cost-effective.

How are these technologies being used to capture construction projects on an ongoing basis and as-built; from the initial stages and throughout the project life cycle.

HIGH-DEFINITION TIME-LAPSE PHOTOGRAPHY AND LIVE VIDEO STREAMING COMBINED WITH AI INSIGHTS

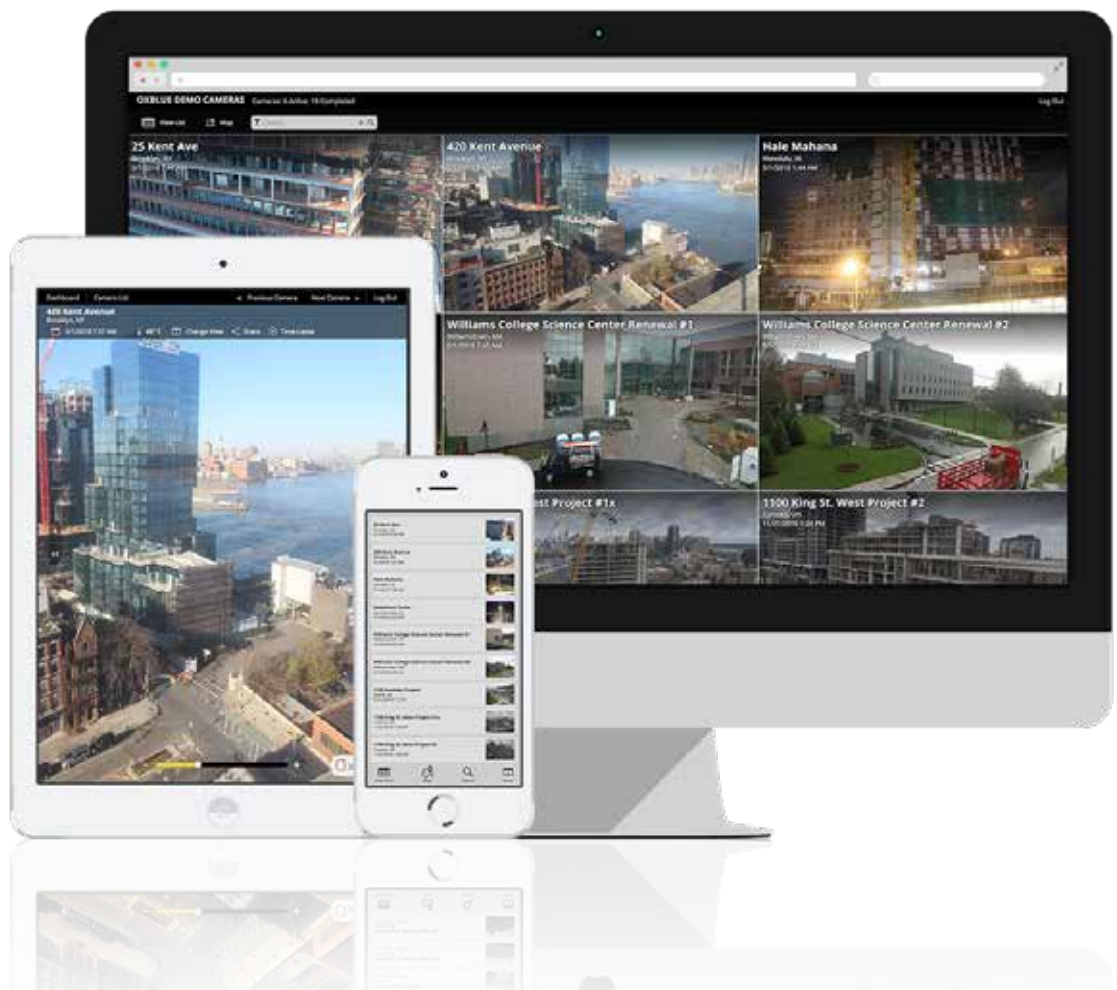
For real-time documentation of everything that happens on a project site, both on the exterior and interior, owners and contractors

can now deploy high-definition time-lapse photography and live video streaming systems, such as those provided by OxBlue, part of Hexagon. By combining the latest AI-powered camera technology and machine learning algorithms, stakeholders can connect to the site from anywhere, at any time and get instant access to up-to-date information about the progress and critical milestones of a project. This could include quality assessments, overall performance and even risk detection and management.

You can view an entire project and take snapshots in real time. For example, by capturing images every ten minutes, a project can be viewed day by day or on any particular day and time throughout the project life cycle or at significant project milestones along the way. Even the smallest changes can be seen. Progress can be shared with team members via the website and integrated into project management software.

AI INSIGHTS FOR ACTIVITY TRACKING AND SAFETY MONITORING AND MUCH MORE

AI can track and analyse on-site project activities like the moving of machines and other equipment, concrete pouring as well as other



events that occur during the construction phase. AI analysis detects incidents like pouring concrete during cold weather, missing site activities correlated to rain or cold weather, safety-related issues and much more.

AI identifies which employees on site are not wearing the required protective equipment. Using that data to benchmark safety incidents compared with other construction sites and overall helps make sites safer.

CLOUD-BASED CONSTRUCTION PROGRESS DOCUMENTATION MAKES THE INVISIBLE VISIBLE AND IMPROVES COLLABORATION

Throughout the entire life cycle of a build asset gathering and also while managing the ongoing progress, documentation is critical for maintaining visibility of the construction progress. Visual construction progress documentation including still images, video, reality capture, UAV and webcam can be used to provide progressive digital records of ground-up development, shared via a cloud-

based platform such as the one Multivista provides.

For example, with 360 photo construction documentation, project teams can update schedules and demonstrate progress to stakeholders. HDR-enabled 360 cameras capture both the exterior and interior views of the entire site and make them available to the project team via interactive floor plans. Integration with data captured of real-world objects and environments is used to create accurate point clouds and measurements, for example, using Leica RTC360 3D laser scanners and Leica TruView software to share point cloud data, design models and mark-ups.

This combination can create a complete record of a site at significant milestones or current conditions and progress to document underground and in-slab utilities, exterior weatherproofing, and mechanical, electrical and plumbing systems during the critical period between inspection and completion. In addition, the use of AI analysis provides insights into construction work progress and possible safety issues.



360 'WALKTHROUGHS' AS VIRTUAL TOURS

Site-Walk 360 enables clients to do a virtual tour of the project on their device. The 3D construction walkthroughs allow owners, general contractors and facility managers to review project progress remotely as well as use the virtual tours to provide complete documentation. This process is ideal for QA/QC inspection and monitoring, validation of as-built conditions, capturing hard-to-visualise spaces and also project marketing.

EYES IN THE SKIES

Increasingly building projects are being planned and monitored from the sky. UAVs are now frequently utilised for site planning and progress tracking, aerial site surveys, tracking equipment and measuring volumes, QA/QC inspection, and site mapping. Adding aerial data into a single collaborative online platform means it can be accessed alongside terrestrial data so the entire project can be viewed, measured and managed instantly, without having to step on site.

BETTER CONSTRUCTION FOR A SMARTER FUTURE

To build better construction projects around the world collaboration is increasingly required across remote global departments and dispersed team members, which means access barriers to information must be removed. By capturing and sharing measurable data with stakeholders wherever they are, all parties can virtually visit the site and stay connected to the build.

Some of these latest technologies enable all project stakeholders and teams to avoid delays and respond to real-time changes with minimal delay, which creates efficiency, cost-effectiveness, improved safety, and sustainability for the entire industry. By developing and deploying reality capture and sharing digital realities, the industry can bring greater focus on building better for smarter cities of the future.

BUILDING A NEXT-GENERATION HOSPITAL

☰ Editorial



Penny Boviatsou is Marketing Manager, Building Solutions, at Hexagon's Geosystems division

Construction of more than 10,000 square metres of facade elements with the highest architectural and technical requirements for the new building of the University Children's Hospital in Zurich.

The children's hospital started its operation on January 12, 1874, located in Zurich-Hottingen with only 30 beds. Today the Children's Hospital Zurich is the largest university hospital for children in Switzerland and one of the leading centres for child and adolescent medicine in Europe. It has more than 2,300 employees committed to the well-being of 100,000 patients every year from the first day of their lives to the age of 18.

The hospital is struggling to keep up with demand. Because the current conditions do not meet the requirements of research and treatment, the Eleonore Foundation is constructing a new modern building in Lengg, Zurich, and the goal is to be ready in 2023. With a floor area of 77,300 square metres, the acute-care hospital will cover the full spectrum of specialist fields in child medicine and pediatric surgery.

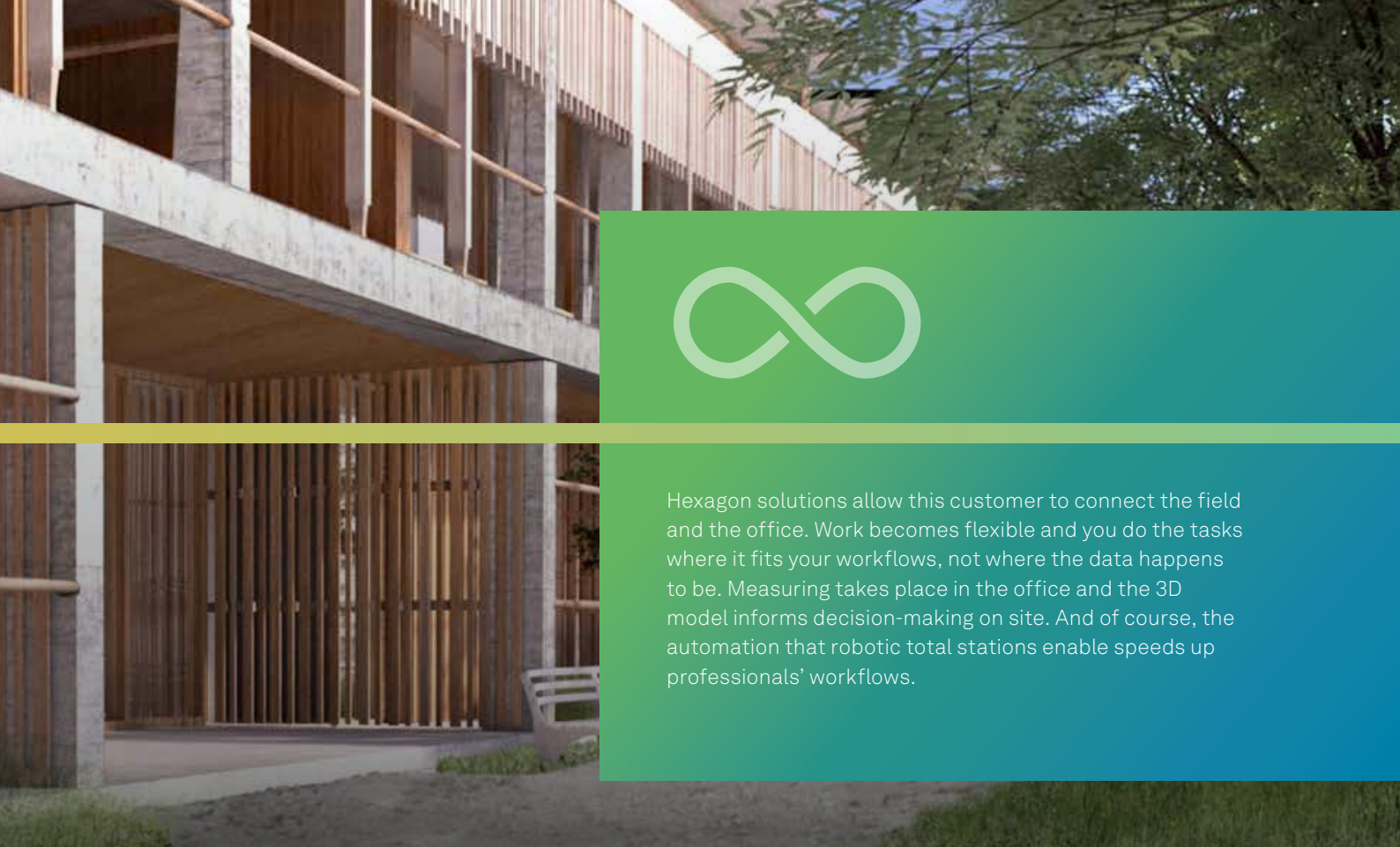
Künzli Holz AG plays a leading role in the construction of the new hospital. The company is constructing more than 10,000 square metres of internal and external facade elements with the highest architectural and technical requirements regarding surfaces, geometries, fire protection and more for the new University Children's Hospital.

A HOSPITAL IN DRASTIC NEED FOR INNOVATION

The emergence of new building materials and new construction technologies has changed the face of the building industry. The new hospital is a hybrid concrete structure with prefabricated timber frame elements. The hybrid construction maximises the structural and architectural advantages of combining components made of different materials providing a high-quality building.

Künzli Holz has been a Leica Geosystems customer for many years. As soon as the company was selected for the project, they enriched their tools kit with the Leica iCON solution consisting of the Leica iCON iCR70 total station and Leica iCON field software. Künzli Holz has its own architecture, engineering and project management departments to prepare the curved facade timber frame elements and the internal wall system.

"It takes talent, long experience and tested techniques to deliver high-quality output. As a company, we understand the need to invest in the latest technology to ensure we deliver the very best results to the project we are entrusted with. We use the iCON iCR70 to measure all the concrete structure of the new hospital; it has been an irreplaceable



Hexagon solutions allow this customer to connect the field and the office. Work becomes flexible and you do the tasks where it fits your workflows, not where the data happens to be. Measuring takes place in the office and the 3D model informs decision-making on site. And of course, the automation that robotic total stations enable speeds up professionals' workflows.

component of our workflow," said Thomas Siegrist, project manager at Künzli Holz.

ONE-PERSON LAYOUT WORKFLOW

Siegrist uses the iCR70 total station to measure the height of the floors, the top and bottom of the walls and the columns. The team needs these measurements to prefabricate the timber elements.

"We measure the concrete structure and import it to our CADwork where we check all the concrete points; this means that we don't check them on-site but on the computer in our 3D model," explained Siegrist. "We load the updated model to the iCON field software and then go back to the site, and we do the layout with the layout lines and layout points, and then we have the 3D model directly in the field."

"We need to ensure our processes and procedures are the best and most efficient for our customer and cost-effective for our company. The iCON iCR70 robotic total station allows me to operate it alone remotely from a distance. I don't need assistance to complete the task; I save time on the setting-out process, increasing on-site productivity. That's a big profit for our company," says Siegrist. "I can then import and display a DXF digital drawing on the tablet's screen and work directly from the drawings."

AIMING FOR ACCURACY

Siegrist points out that their main priority for this project is to bring the 3D model as accurately as possible on site.

"We are trying to achieve accurate placing of all these prefabricated elements. The level of accuracy we get from the iCR70 is incomparable," highlights Siegrist. "With the robotic total station, we can jump from level to level, and this gives us a more accurate positioning of the layout lines."

The new hospital has a suspended ceiling fixed to the framework and suspended from the main structure. There are pieces of aluminium the team has to screw into the concrete.

"I use the iCON to bring a layout point from the 3D model to the ceiling; then, I can mark it and screw it instead of measuring all these points by hand. This is one of the best features that the robotic total station offers to us," Siegrist continues.

Siegrist received half-day training to operate the total station. "I found the iCR70 very easy to use," he added. "The Leica Geosystems representative gave the team and me a half-day course, which was more than enough for us to learn how to use it."

DIGITAL TWINS FOR MANUFACTURING FACILITIES TO OPTIMISE OPERATIONS

☰ Editorial



Penny Boviatsou is Marketing Manager, Building Solutions, at Hexagon's Geosystems division

Completing a renovation or expansion of an existing facility can be difficult. When companies expand their product lines, they regularly rearrange assembly lines and repurpose spaces to optimise manufacturing operations. Having a digital twin of these facilities speeds up the planning process for changing manufacturing shop floors, increases safety standards for production and employees, and improves workforce productivity.



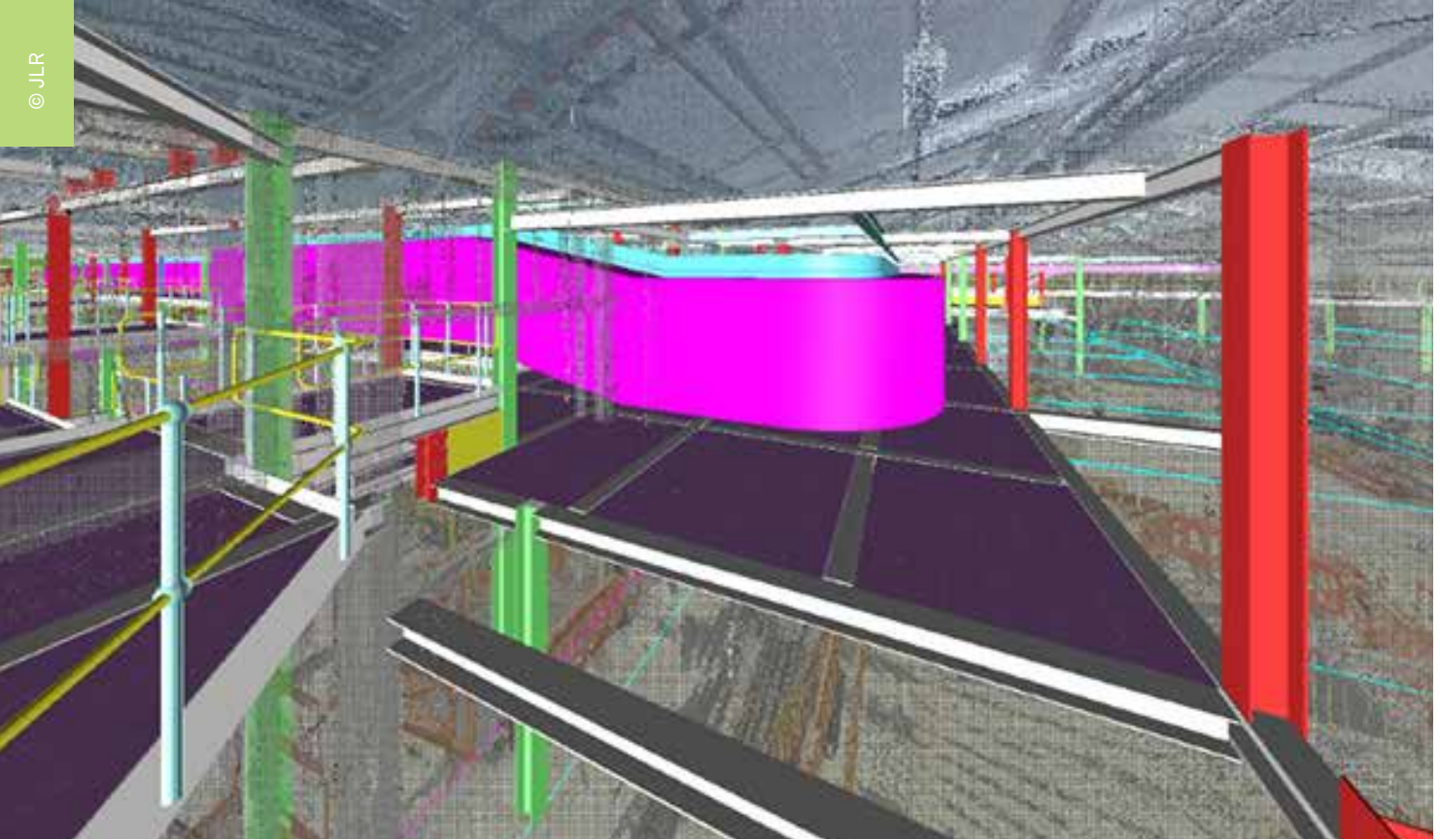
Several firms in Europe and the U.S. use large post-war buildings constructed in the 1950s and '60s as manufacturing facilities. Many of these properties have an outdated infrastructure and need to be upgraded to comply with the latest building codes and manufacturing regulations. Limited space conditions in those older manufacturing facilities make it challenging to upgrade and refurbish the building to guarantee safe production and working conditions and minimise operational downtime.

Similar historic manufacturing facilities without up-to-date records belong to Jaguar Land Rover Automotive PLC (JLR), a British multinational automotive company with headquarters in Whitley, Coventry, United Kingdom. The principal activity of JLR is the design, development, manufacture, and sale of vehicles bearing the iconic Jaguar and Land Rover car brands.

JLR frequently has to redevelop the properties when new product lines come on board. The manufacturing and engineering team is responsible for developing new manufacturing equipment for their production lines. This can also impact their existing assembly lines and building infrastructure and requires redesigns, renovations and changes to the manufacturing facilities. JLR required an up-to-date digital twin of the existing building and production lines to plan and redesign all the changes efficiently.

DIGITAL TWINS FOR FACILITY MANAGEMENT AND RENOVATIONS

Having an accurate digital twin of the existing conditions enables the engineering and facility management team to plan their renovations virtually and evaluate changes before executing them. By adopting the right technologies, facility management teams uncover hidden inefficiencies, recover costs, deliver new value



to buildings and ensure properties are fully optimised.

Historically JLR had clashes when renovations were taking place; they were looking for a solution to help them understand the existing buildings in the UK and Slovakia to perform basic clash detection. This process would help the team identify, inspect and report interference in the construction project model.

With a drive to do more work in-house, rely less on external providers, and facilitate business processes, JLR invested in the Leica RTC360 laser scanner, a reality capture solution that enables users to capture and document their environments in 3D, and Leica Cyclone point cloud processing software.

“We often used survey companies to conduct our internal surveys, but we would find that the survey data wasn’t shared between vendors; by scanning the properties and processing the data ourselves, we can share the information across a wider project team so we could all benefit from it,” said Alistair Innes, information manager at JLR.

CONNECTING THE PHYSICAL AND DIGITAL WORLD TO GAIN CONTROL OVER YOUR FACILITY

The RTC360 allowed them to capture the physical world and create a digital 3D point cloud of their facilities. This 3D digital twin helped the team to analyse and modify

different elements of the existing facility directly in the model.

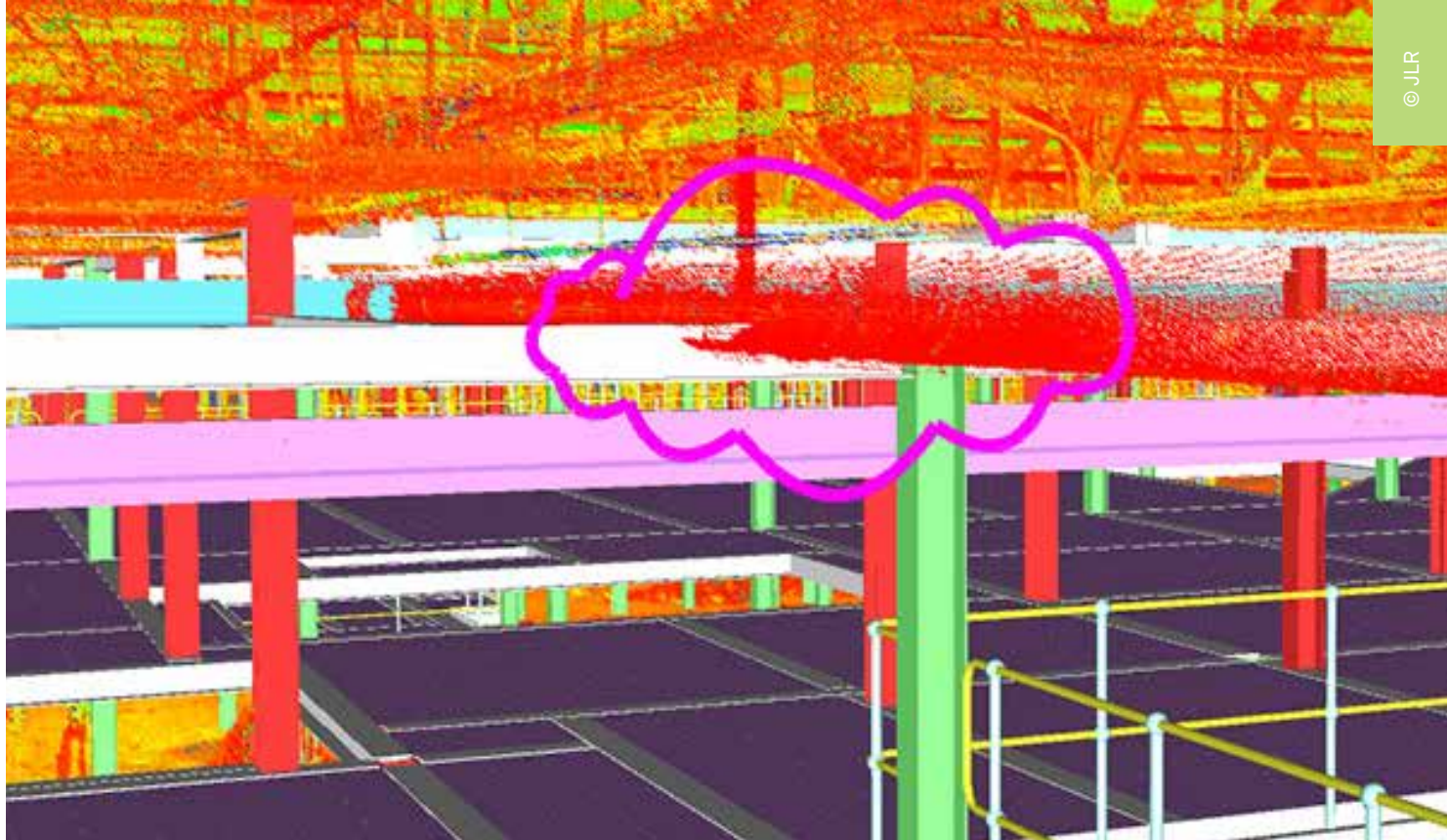
JLR used the RTC360 point cloud for different applications:

- To create digital models (digital twin) of physical locations.**

Matt Thompson, virtual manufacturing engineering manager at JLR, and his team scanned a 9,000 square metre assembly hall to create a digital twin for virtual-to-physical alignment. The digital twin is the extracted value, the connection between the physical world and the virtual world, which leads to digital transformation through intelligent software working on the data from a reality capture – in other words – “the physical product, the virtual product and the connection between the two”.

JLR used the digital twin to perform clash detection and for rapidly confirming what is physically in the facility when looking at designing elements in the digital space. The digital twin was used during the pre-design phase for site analysis, review of existing structures, construction cost analysis and engineering budget evaluation.

“The use of the Leica RTC360 has allowed us to link our physical and digital worlds like never before. The team now has the capability to rapidly bring physical geometry into our design phase, ensuring that we minimise any clashes



at the installation phase long before we have begun construction of components,” said Matt Thompson, virtual manufacturing engineering manager at JLR.

- **Verification.**

Mistakes and rework can consume the construction budget. With a proactive approach, Alistair Innes, information manager at JLR, would compare the as-built high-quality point cloud scan data from the RTC360 against the model to establish whether it meets their requirements. The process would ensure that the equipment is installed in the correct location and according to the 3D CAD model. Leica CloudWorx allowed JLR to work efficiently with the point cloud directly in Navisworks.

- **To create CAD models for physical alignments.**

When JLR had to install a climate chamber tester system, it took them two hours of scanning, an hour of registration, and four hours of post-processing to create the CAD models from the point cloud. The point cloud represents the real environments and enables an accurate 3D CAD modelling process.

“With the RTC360, we can quickly scan spaces in-house, create CAD models within a few hours and provide stakeholders the required deliverable to design, modify and install the equipment in the facility,” said Thompson.

“Instead of relying on external providers, we can identify the need and activate a team to provide the survey data within a day.”

INVESTING IN DECISION-MAKING TOOLS

Leica Geosystems organised a two-day training for JLR in Milton Keynes, UK, to discover the full potential of the RTC360 and provided after-sales support during the data acquisition and processing.



Connecting the physical and digital world helped JLR create a digital twin for virtual-to-physical alignment. The digital twin also served as one source of truth helping to connect the different construction phases, ensuring the as-built met the design — avoiding costly rework — and facilitating the communication with project stakeholders.

THE GREATEST CONSTRUCTION PROJECT IN HISTORY

☰ Editorial



Thomas Harring is President at Hexagon's Geosystems division

Hexagon is re-imagining construction from the ground up with Smart Digital Realities and empowering the industry to be exponentially better.



EXPONENTIALLY BETTER THANKS TO THE DIGITAL AWAKENING

It is no secret that digital adoption in construction lags behind other industries. But what you might not know is that contractors and construction companies are going bankrupt at alarming rates despite extremely favourable market conditions and an enormous backlog of work. The industry is under pressure to do more with less, overcome the labour and supply chain disruptions and, of course, deliver on time, within budget and in scope.

In addition to these industry pressures, there are ever-growing pressures on the environment. Nature has its limits. We are pushing them. We now need infrastructure and buildings to be more resilient to climate change and more sustainable to reduce carbon footprints, all while still being economical. And the potential impact is massive. The construction ecosystem represents more than 10% of worldwide GDP. The amount of carbon dioxide emitted and resources consumed are astronomical.

THE QUESTION WE ALL NEED TO ASK OURSELVES RIGHT NOW IS: HOW ARE WE GOING TO BUILD FOR THE FUTURE?

We must re-imagine our industry — transform the way we live and work without causing irreversible damage to the planet.

The companies who are re-imagining our industry are no longer thinking of themselves as construction companies but rather as hybrid companies with technology, engineering and construction as their core competencies. They

are attracting a new wave of talent and capital investments to accelerate the change.

This digital awakening is leveraging technology to turbo-charge collaboration, seamlessly connecting office and field applications and finding new ways to work across the entire construction lifecycle.

PRECONSTRUCTION — ENHANCING AUTONOMY FROM THE CONCEPT ONWARD

Too many construction projects are bidding, designing and planning based on incorrect assumptions. In most cases, it is due to a lack of information on the existing conditions such as the terrain for civil engineering projects or plans of existing buildings for remodel or expansion projects.

An intelligent design and plan based on accurate assumptions represented in a Smart Digital Reality that connects people, departments and assets throughout each phase sets the project up for success. Hexagon's range of sensors and applications capture existing conditions for individual building projects, civil engineering projects and smart cities, and enable data to flow seamlessly from the field into the office. These solutions use artificial intelligence (AI) to automatically create 3D models from 2D designs — from digital terrain models to digital twins of existing buildings. Software can also simulate real world conditions that affect infrastructure such as air flows, temperature, sun angles and water tables. The Smart Digital Reality provides a time capsule of the baseline assumptions over the life of the asset.



CONSTRUCTION — ADAPTING TO CHANGES WITH AGILITY

Once projects are digitally enabled, the designs and plans need to be read by people and machines on the job site. Our machine control operating platform seamlessly integrates models from the office to the job site providing exact instructions to operators and machines. But our goal is not just to automate a piece of equipment to do a discrete task. It is about automating and optimising an entire process and workflow.

The next generation of construction management solutions, includes powerful 5D real-time progress monitoring and cost deviation tracking. This holistic performance management creates transparency and balances the magic triangle of costs, time and scope while driving short- and long-term productivity across multiple departments and stakeholders.

Reality capture solutions also create constant feedback loops between the office and the job site. The ongoing reconciliation of plans and actuals bring visibility into the project status and allows stakeholders to drill into details, enabling root cause analysis and faster course corrections. Making issues in the field transparent for office-based staff avoids costly rework, waste, delays and potential downstream issues while enabling an agile response to changing conditions.

Safety is one of the industry's biggest challenges. But today, personal alert solutions combined with machine control ensures people and equipment can be productive and safe at the same time. Such solutions bring awareness to individuals and equipment down to centimetre-level accuracy and allow site workers to operate multiple machines with the same user experience.

During construction, change is inevitable and constant. Flexibility to adapt is incremental, but the agility to build the best scenario is exponential. As we plan and design remotely and control operations autonomously, we use optimisation engines and workflows to maximise productivity and assess all operational scenarios down to shift level plans. The next phase is to have complete control and to automate all equipment on the job site, doing the "right thing" without human intervention.

OPERATIONS — PREDICTING OPERATIONS WITH AI

For quite some time, constructing and operating buildings and infrastructure has been in a deadlock to overcome the barriers to higher productivity, but this has changed rapidly. Today, technology offers significant opportunities to improve the total cost of ownership and pave the way for a sustainable future.



Facility management or asset performance management becomes smart to improve the total cost of ownership. Using digital solutions, we can provide operational agility to increase building and infrastructure performance and thus extend an asset's lifecycle and maintain or increase its value, which is also the best way to reduce an infrastructure's environmental impact.

This is not possible without a dynamic digital twin. For existing buildings and infrastructure, a digital twin needs to be created well after the physical version was created. Reality capture technologies provide the solution, enabling assets to be managed remotely with the relevant content, documentation and context.

Unlike prevention, predictive maintenance is based on the current operating health conditions of assets instead of statistics and previously defined schedules. Intelligent buildings and infrastructure are vital elements of a future where cities and nations become safe, smart and sustainable with owners and operators harnessing and improving the asset life cycles. Let Smart Digital Realities with AI-enabled insights support you to predict the future of your buildings and infrastructure assets.

A NEW PARADIGM

We need infrastructure and buildings to create a more inclusive world, to strengthen urban resilience and to remain economical. The next frontier is connecting the planet to the buildings and infrastructure ecosystem, a future with

interconnection between technology, nature and people, with technology enabling more natural and human value.

Maximising the power of digital realities needs to occur in every stage of construction and throughout the life of the assets. The current approach of seeking incremental improvements is not going to be enough, we need to think in exponentials: 10 times, 20 times, 30 times better. We need a new paradigm because the stakes have never been higher.

Our technology is now reshaping the world's largest ecosystem. We are re-imagining construction to build more connected, collaborative, efficient and sustainable cities, and nations with Smart Digital Realities. The evidence is overwhelming — powering innovation provides enormous opportunities.

Scan to watch the HxGN LIVE Global 2022 keynote by Thomas Haring, President at Hexagon's Geosystems division, and Josh Weiss, then COO of Hexagon's Geosystems division.



CAN DIGITAL CONSTRUCTION SAVE THE PLANET?

☰ Editorial



Holger Pietzsch is Vice President, Heavy Construction, at Hexagon's Geosystems division

Data science is often focused on social, financial or manufacturing processes — but what about construction?

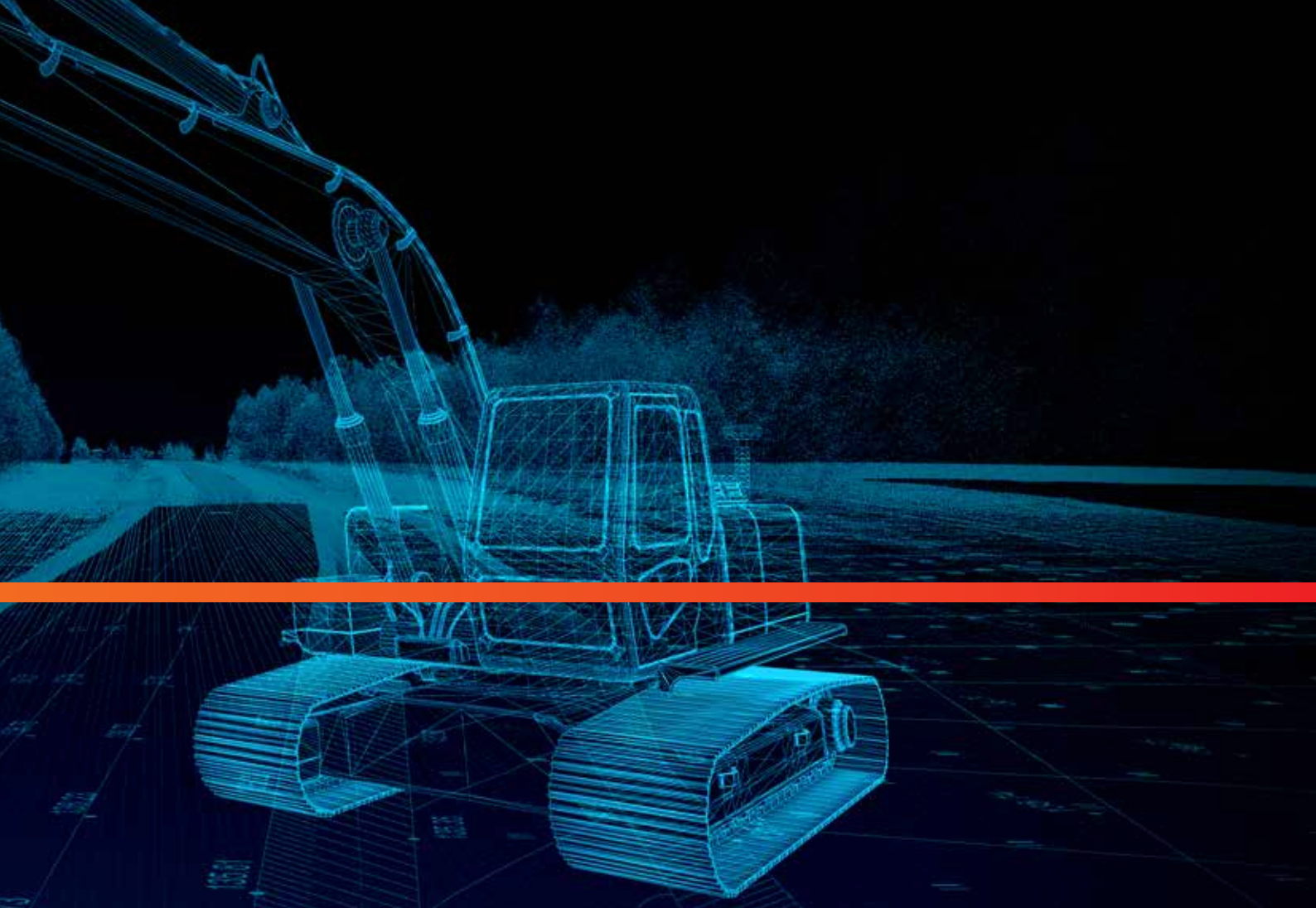
As social media and e-commerce giants capture the headlines, a less publicised but possibly more impactful digital evolution has been shaping the construction industry. After two decades of change, the sector is now entering its next phase, and the impact might reach beyond roads and bridges. Digital construction technologies could well shape and preserve the mother of all ecosystems: Earth itself.

PHASE 1: CONNECTING PEOPLE TO THE CONSTRUCTION ECOSYSTEM (2000–2010)

By 2000, civil and structural engineers were already using computer-aided design (CAD) models. The launch of AutoCAD 2000i in July 2000, however, represented a turning point. Leveraging internet-enabled features, the global community began collaborating at a growing scale and speed. You could now develop digital representations of actual or future infrastructures in the cloud and share them. However, updates to the models still required human intervention.

PHASE 2: CONNECTING OBJECTS TO THE CONSTRUCTION ECOSYSTEM (2010–2020)

In 2010, the Chinese government made the Internet of Things (IoT) a strategic priority in their five-year plan, and by 2011, Gartner, a leading technological research and consulting firm, added IoT to the infamous hype cycle. Objects such as excavators, trucks and conveyor belts were being fitted with affordable sensors that automatically updated their digital representations with temperature, pressure and humidity — thus adding more-frequent and more-diverse data points. Sophisticated algorithms emerged that “listened” to these connected objects, analysing billions of data points to predict failure or enable automation. Today, many pieces of construction equipment have become fully connected “talking machines” that deliver remote diagnosis. And yet, the dirt they move continues to be silent. The same applies to oceans, mountains and forests — none of which you can connect to sensors. So, the next frontier is making nature itself machine-readable.



PHASE 3: CONNECTING THE PLANET TO THE CONSTRUCTION ECOSYSTEM (2020+)

Technologies that use methods as old as maritime triangulation have found their way into lasers, LiDARs and radars. These devices can literally “see” their environment, giving geospatial awareness not only of their own position but of everything in their sight. They can efficiently digitise and monitor not just streets and tunnels but entire landscapes. Their condition can be mapped against the past or intended future. Initially, this will allow excavators to dig straighter, faster holes.

In the long term, these connected digitised ecosystems will allow us to analyse large-scale, slow changes in our physical environment. Algorithms will identify underlying patterns of system interaction.

NO FREE LUNCH

One can now imagine interconnected ecosystems that optimise the complex interplay of people, products and precious resources. Such a system could, for example,

help guide decisions on whether to refurbish a bridge, build a new one or substitute it for a tunnel. It could create a decision landscape with different optima that vary depending on social, financial or environmental preferences. It could quantify a project’s financial costs so it becomes more sustainable or calculate the infrastructure savings related to a healthier rainforest. But even the most sophisticated framework will require tremendous judgment. Political stakeholders will still claim to have the best ideas, but trade-offs will become more transparent and subject to scrutiny. And this transparency might just be enough for a better future, because given the long-term, multigenerational effects of infrastructure development, even small trade-offs can have a big impact.

First appeared on Harvard Data Science Review



PRECISE MILLING WITH LEICA ICON PAVE 3D MACHINE CONTROL SOLUTION

☰ Editorial



Reka Vasszi is Communications Manager, Heavy Construction, at Hexagon's Geosystems division

Automation and machine control technologies help contractors mill the surface of an 11.5-kilometre-long motorway section in Switzerland.

Motorway construction in Switzerland started in the 1950s with the country's increasing prosperity after World War II. Due to the mountainous terrain, motorways are essential to ensure a smooth and fast commute, as well as to connect people, cities, businesses and neighbouring countries. National road maintenance is therefore of great importance.

The Swiss national roads network is currently in good condition. However, the infrastructure is ageing. Some of the motorways are almost 70 years old.

The Swiss government is currently carrying out a forward-looking maintenance project of the A1 motorway between Effretikon and Winterthur-Ohringen, a section that is around 50 years old.

"This maintenance project started in the summer of 2019 and will last about three-and-a-half years, and the complete renovation of this 11,5 kilometres long section is planned to be finished by the end of 2022", says Robin Goldinger, site manager at KIBAG Bauleistungen AG. "Our task is to refurbish this section and ensure the maintenance and safe operation until expansion to a 6-lane motorway in 2035."

"DIGITALISATION HELPS US BECOME FASTER, BETTER AND IMPROVE QUALITY"

The usage of automation and machine control technologies is growing rapidly thanks to their benefits for the operator, contractor and end customer. Digital technologies guide and support construction companies from the first step of planning and estimation to the maintenance of the final assets.

"Digital tools on the construction site, from machine control to refuelling systems, to accurate positioning instruments, make our workflow a lot more efficient and faster," says Goldinger.

"Modern technology also helps us every day that we become faster, better and of higher quality, and that is exactly what makes digitalisation exciting. Every day is different, and we are constantly challenged with new tasks, changing

weather, too much or fewer resources, materials, stopped machines, etc. With such digital aids, you are also at the point where you can do things much easier."

Accuracy and speed are essential for road construction. Thus, when KIBAG Bauleistungen AG was contracted for the renovation and refurbishment of the Effretikon-Winterthur section of the A1 motorway, they chose subcontractors that can carry out the work with high accuracy, following a digital reference model and supplying digital data.

For those reasons, Reproad AG, a construction company with expertise in industrial floor construction, milling, grinding and shot peening, was contracted for the milling job.

"ONE MACHINE — ONE OPERATION — DONE!"

A strong foundation is critical for any structure. For motorways, which hundreds of vehicles use every hour, you want to ensure the milling contractor you hire uses the best equipment to provide a smooth surface and the correct layer thickness.

3D systems and machine control are established technologies that operators at Reproad use to control road and rock milling machines. Machine control solutions help eliminate the spraying of the milling depth on the asphalt, controlling the levelling panels, manually entering the depth information into the cold planer and monitoring the surface before and after the mill. 3D technology enables Reproad to provide an even surface for repaving and achieve the accuracy and profile required by KIBAG to ensure the right amount of hot mix asphalt needed for later paving.

"On my first day at KIBAG, I had to mill directly in 3D. It was incredible to see how it all works and how precisely you can mill. I was flabbergasted," says Andreas Reinisch, surveyor at KIBAG.

"We use construction tools from Leica Geosystems a lot. We rely on the software, total stations, levels, and machine control solutions



for excavators, dozers and graders. Digital solutions from Leica Geosystems and the machine control solution help our construction team work efficiently and accomplish tasks in the shortest possible time and with the highest precision,” explains Reinisch.

The height-adjustable chassis of the Wirtgen cold milling machine defines the milling depth so precisely that individual paving layers can be removed and loaded. This precision — combined with the possibility to mill automatically following a digital reference model with machine control — makes the height-adjustable trolleys suitable for milling foundation faster with high quality.

“Today, our task is to mill the entire surface 500 meters long in 3D and with the highest precision,” says Fabian Stöckli, milling operator at Reproad. “The advantage of using 3D machine control is that you have a finished plan. You no longer need a fine level anymore. One machine — one operation — done!”

Using 3D technology, Reproad delivers high-quality results with only one operator carrying out the job.

“There are no more mistakes with Leica MC1; it is really fun, and the accuracy and the end result are great!”

The Leica iCON pave-for-milling application consists of the Leica MC1 software platform, the MCP80 panel, prisms, LRBT radio, total stations and various sensor configurations. Besides the hardware and software solution, Leica Geosystems offers cloud connectivity through Leica ConX and continuous customer support.

With the help of a prism mounted on the cold milling machine, the position and height of the machine are automatically measured with a total station and compared with the digital reference model loaded to the Leica iCON pave milling 3D machine control solution. “3D milling solutions have total stations that continuously track the milling machine, and based on the machine’s current position, it is controlled with millimetre accuracy in relation to the project data,” explains Reto Bardill, support engineer at Leica Geosystems. In the event of deviations from the plan, the machine control system automatically makes corrections. That way, Reproad operator, Fabian Stöckli, achieves a high level of accuracy over the entire processed area.

“With the old system that we had, the margin of error was relatively high. So far, with the new 3D milling solution, everything is going smoothly and perfectly. We cannot complain,” says Stöckli. “Of course, the speed always depends on the layer thickness we need to mill. In the case of removing only the top layer, we’re talking about a maximum of 15,000 square metres of milled area per day. However, if we need to go down into the base layer, it decreases speed, but we can still achieve 8,000 square metres to a maximum of 10,000 square metres of milled surface a day.”

“The latest Leica iCON pave solution allows a lot of new functions. For example, if the total station is interrupted by a truck that is arriving or departing, the next total station automatically takes over the positioning,” explains Stöckli.



The intuitive user interface of the MC1 software platform gives easy access to the menu items and provides Stöckli with an overview of the project, including elevation differences, slope and design model and speed. Thanks to the green and red colour signages, the operator notices if there is any deviation from the plan.

“Milling with the Leica machine control system is always a pleasure, especially with the new MC1,” says Stöckli. “There are no more mistakes. It is really fun. The accuracy and the end result are great!”

DIGITALISATION IS THE FUTURE

Leica Geosystems, part of Hexagon, has been offering asphalt and concrete paving solutions since 1999 and released the first 3D solution for milling machines in 2006. Our machine control technology is developed in close collaboration with equipment manufacturers to ensure that the systems work smoothly on every piece of equipment, in this case, on a Wirtgen cold planer. By automating the depth and slope of the cold planer with the 3D solution, Leica Geosystems saves surveyors and operators from performing labour-intensive tasks such as placing stakes, manually adjusting for variable mill depths or marking locations.

Keeping up with technological advances and integrating digital solutions processes into their everyday workflows, KIBAG Bauleistungen AG has been one of the leading construction companies in Switzerland since 1926.

“In the future, I hope to be able to carry out many more beautiful projects,” says Goldinger. “We will invest in new technology and use simply everything

that helps us make progress faster, ever higher, ever broader and, of course, hand over projects to our customers with the highest level in terms of quality and execution,” concludes the site manager.

At Hexagon’s Heavy Construction Solutions we drive ourselves and the industry to never settle and always move forward, digitising processes from planning to estimation, to site preparation, to construction and maintenance, helping our customers to be on time, on spec, on budget and on safety.



Leveraging data to automate machine operations helps connect people, products and precious resources as well as the field and the office. This is critical for making construction projects more efficient, safer and more sustainable. Machine control solutions, for instance, enable teams to be on site less, enhance safety awareness and reduce emissions. By embracing connected technologies, the heavy construction industry moves toward an autonomous future.

AUTOMATION AND THE SMART, CONNECTED MINE

☰ Editorial



Rob Daw is Chief Innovation Officer at Hexgon's Mining division

Above and below the surface, every mine is unique, but common goals unite all mining operations: reduced costs, increased productivity and improved safety. Digitalisation of mining operations is increasingly helping companies to achieve these goals. Forming part of this trend is automation. And at the heart of automation is a more connected ecosystem of technologies.



According to Berg Insight, connected mining solutions will reach 1.2 million units by 2023. The figure represents connected devices deployed on machines and vehicles used in mining operations, solutions ranging from OEM telematics systems on mining equipment to advanced connected solutions supplied by mining technology specialists, solutions deployed to support the safety and productivity of mining personnel, plus sensor technology implemented for environmental monitoring of the mine itself.

From my meetings with customers, it is not hard to see that the industry is looking for a more connected ecosystem of technologies; and that ecosystem is increasingly connected autonomously. We're seeing edge devices capturing data and bringing it back to the office, where it is transformed into information for more-proactive decisions.

There's no question that the digitalisation of mining operations can profoundly affect production, efficiency and safety. Some might

call this a smart mine. But what exactly makes a mine smart? Is it a philosophy? Or a well-defined solution set?

MINING AUTOMATION BEYOND HAULAGE AND DRILLING

The Internet of Things (IoT), cloud computing, artificial intelligence (AI), predictive analytics and ultimately automation play a role in this shift toward more connected ecosystems. And by automation, I don't just mean automated haulage or automated drilling. Automation goes all the way back to data acquired at the very beginning of the value chain and reconciled at the end: from geological modelling to the execution of tasks and operations. Many companies are starting to execute such data-management strategies, allowing them to access and gain more insight into their data.

In addition to obtaining more insight from data, companies also focus on ensuring that data is secure. Cybersecurity is an increasingly hot topic, especially as mines adopt semi-



autonomous and autonomous solutions. Change management becomes important here as companies grapple with the challenge of embracing technology in operations and within organisations.

“How do we bring our employees on this journey,” is a question I’m increasingly asked. The answer lies in understanding social responsibility, so mines not only leverage technology but ensure they bring their staff along.

THE KEYS TO A SMARTER MINE

The industry is witnessing a trend toward autonomous vehicles. Ensuring our equipment runs 24/7, 365 days a year — or as close as possible to that — enables us to get the most out of what can be expensive assets. This has implications for productivity and safety. Reducing human interaction in a mine site is a high priority for many companies striving to make their operations safer and more productive.

When we focus on automation, it is not just about vehicles being able to travel from A to B. In a smarter mine, those vehicles need to connect within the entire ecosystem of technologies. So within one feedback loop, from end to end, we can know how our scheduling affects our truck haulage, reconciliation and material flow.

We can then integrate other parts of the mining value chain within this process. For instance, a geotechnical monitoring system or radar system detects when we are about to experience a wall failure in a particular area of the pit. Within an autonomously connected ecosystem, that system must automatically connect to alert the trucks to evacuate the area.

THE EVOLUTION OF UNDERGROUND MINING SOLUTIONS

Technology companies have good reason to renew their focus on underground solutions. Minerals close to the surface are increasingly



rare, and underground mines tend to have a smaller environmental footprint. We're finding newer ways to extract minerals at the surface and underground. As we push underground, we will need to develop those technologies to suit different methodologies.

Block caving, for instance, has different technology needs and process needs compared to more-traditional methodologies. The biggest challenge we've always had is connectivity and the means to actually run technology underground. How do we transfer data back to the surface to make the right decisions? You can't just step over the pit's edge and see what is happening.



From automation to teleremotes and more-connected devices, recent innovation is helping mines locate their assets and understand what those assets are doing and when they're doing it — ultimately helping companies get more from those assets.



CONNECT AND PROTECT: TECHNOLOGY FOR A SAFER, SMARTER MINE

☰ Editorial



Neville Judd is Communication Director at Hexagon's Mining division

In the pursuit of zero harm, the International Labour Organization is ever vigilant in reminding industries of their obligations to protect employees. The United Nations agency focuses world attention on the need for a safety and health culture in all workplaces. To that end, Hexagon is applying its leadership in digital reality solutions to safeguarding workers across the many industries it serves.



The mining industry is all too aware of the consequences posed by hazards at work. In 2020, the last year for which statistics are available, the International Council on Mining and Metals (ICMM) reported 44 occupational fatalities.

Miners face numerous daily dangers above and below ground: poor visibility, blind spots, fatigue, distraction and slope instability, for instance. Heavy machinery, monotonous work and long hours heighten the risks.

Distraction and fatigue are assumed to be behind the majority of accidents in open-pit mines.

According to the National Institute for Occupational Safety and Health, employee fatigue contributes to at least 20% of all workplace incidents and costs employers at least \$135 billion per year.

Point solutions supplied by multiple vendors are no match for such a wide array of risks. A comprehensive safety response demands an integrated technology portfolio, proven change management and a collective commitment to a zero-harm culture.

COMPREHENSIVE, INTEGRATED MINE SAFETY PORTFOLIO

Hexagon's MineProtect portfolio integrates systems for collision avoidance, operator alertness, personal protection and vehicle intervention. HxGN MineProtect Collision Avoidance System, or CAS, is used in more than 50,000 vehicles worldwide. It protects drivers and equipment with 360-degree operator awareness via a nonintrusive cabin display unit for vehicles, assets and operators in open-pit mines. It integrates with slope monitoring software developed by IDS GeoRadar, part of Hexagon.

Mines can now receive real-time equipment visualisation with timely alerts about hazardous areas for people and machinery. Workers and equipment are protected from injury-threatening events by being forewarned of no-go-zones.

For customers, such as Cerrejón in Colombia and Codelco in Chile, the benefits of an integrated safety portfolio are clear.



SERIOUS ABOUT SAFETY AT CODELCO

Codelco needed a collision avoidance solution for its Radomiro Tomic mine in northern Chile. In a video shared by the company, CAS was shown to have helped reduce potential collisions by 90% and decrease speeding events by 54%.

“We are a large organisation, [with] more than 100 mining trucks, 40-plus ancillary vehicles and 14 loading units,” said Pedro Díaz, Radomiro Tomic mine superintendent. “Thus, technical implementation is complex, and we are a large universe of people.”

“Here is where technology becomes a useful tool. When we are able to reach all parts of our operation, everybody understands the system and sees how valuable it is.”

Evans Díaz, Radomiro Tomic mine engineering and process control superintendent, added: “It’s a vertically integrated technology and every information CAS outputs is visible through one platform.”

“For the management of our mine, we have created our own reporting system to provide

quality data to all productive processes and to women and men supervisors; to make decisions and pinpoint where alarms are mostly triggered.”

HOW CERREJÓN TACKLES RISKS AND PREVENTS MINE ACCIDENTS

Extending more than 270 square miles (699 square kilometres), Cerrejón is the largest open-pit coal mine in Latin America and the 10th biggest in the world. Complete with its own railway system and shipping terminal, the mine employs thousands of people operating hundreds of vehicles. A zero-harm culture is enshrined in all aspects of the business.

CAS not only helped the mine minimise the risk of accidents, it also addressed other safety challenges.

“We put in place a system of random monitoring and preventive monitoring of compliance with stop signs in the mine and in the company,” explained Álvaro Uribe of Cerrejón’s production safety committee.

“And this allowed us, from 2014 up to date, to gradually decrease up to 90% non-compliance



of stop signs. This is a great benefit to the safety performance of the company. We are being preventative, and we are identifying and correcting wrong habits in our operation.”

In February 2022, the Colombian Safety Council (Consejo Nacional de Seguridad de Colombia) selected Cerrejón as a finalist for its occupational health and safety program.

SAFETY IS THE SMARTEST INVESTMENT A MINE CAN MAKE

Collision avoidance systems are important but only part of the answer. Hexagon customers understand that to take zero harm seriously, they also need an enterprise solution to transform safety data into actionable intelligence.

CAS was already the market leader among collision avoidance systems. The recently launched CAS 10 advances the technology by consolidating even more functionality into fewer parts: one smart antenna and one display.

Codelco and Cerrejón understand that investing in safety need not be at the expense of productivity. In fact, it’s the most valuable investment a mine can make.

CAS 10 embodies this sound investment, integrating several sensors in one powerful platform that will protect miners and their equipment. It is a landmark enabler for next-generation autonomy, offering mines a uniquely intelligent approach. Most importantly, everyone gets home safely.



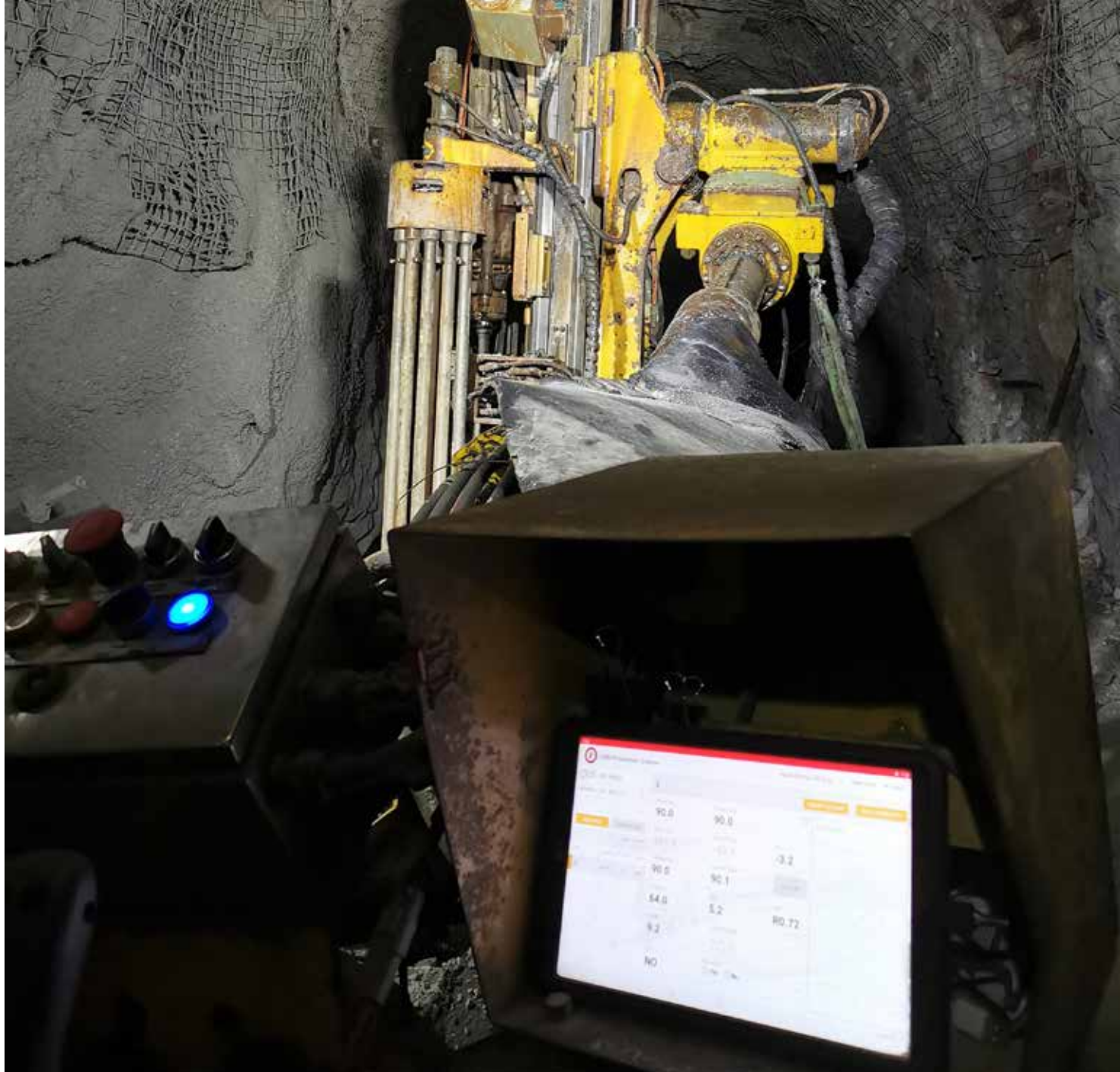
DRILLING ACCURACY PROVES GOLDEN FOR AUSSIE MINE

☰ Editorial



Mick Beilby is Director at Minnovare

In January, 2022, Hexagon acquired Minnovare, a leading provider of drilling technology that improves the speed, cost and accuracy of underground drilling. Like Hexagon, Minnovare built its business by enabling connectivity: connecting people, processes and workflows with integrated technology. The following is a customer case study illustrating the benefits of Minnovare's Production Optimiser.



In early 2018, the Cracow Gold Mine, located 500 kilometres northwest of Brisbane, Australia, faced challenges of dilution and stope performance due to inaccurate drilling. The drilling operations team decided to implement Minnovare's Production Optimiser technology to address the challenge. The initial implementation led to increased drilling accuracy and thus to an immediate reduction in blast-hole deviation and a 62% reduction in average dilution.

Following the Production Optimiser's successful implementation, Cracow engineers began experimenting with a new Zipper drill pattern since the mine was facing very narrow stopes which would've been uneconomical to mine using the current DICE-5 pattern method.

The aim was to replace the traditional DICE-5 pattern on the narrowest vein stopes. Due to the nature of the design, the Zipper pattern relies on a high degree of drilling accuracy — reducing the total number of holes drilled per stope and the average stope width to just 1.5 metres.

Two trial Zipper stopes were drilled and subsequently blasted. One of these stopes recorded 495 tonnes less dilution compared to what would have been mined using a traditional DICE-5 pattern. This represented an approximate 25% reduction in waste tonnes for the Zipper stope — which is a considerable sustainability benefit, not to mention a significant cost saving.



Phil Jones, at the time senior drill and blast engineer at Cracow, stated: “We estimate that 10% of our stope tonnes going forward can now be mined using the Zipper pattern instead of Dice-5.

At 390,000 stope tonnes per year, a similar 25% reduction equates to approximately 10,000 tonnes less waste/low grade ore that would otherwise have been hauled and processed, which at current cost works out to approximately AUD\$1 million (USD\$0.7 million) a year.”

Minnovare recently caught up with Thao Nguyen, senior mining engineer at Cracow, now under new owners, Aeris Resources.

“Our stope sizes have dropped significantly over the years. Originally the majority of stope designs were much larger, 2.5 metres to 3.5 metres. Now, on average the majority of our stopes are 1.5 metres to 2.5 metres wide. If a stope is 2.5 metres wide, we would still use the Dice 5 pattern. However, if we expect our stopes to be less than 1.5m wide, we use our Zipper pattern, with a hole spacing of 0.9 metres. To which, we add 0.3 metres planned over-break either side of the stope, making the designed width 1.5 metres wide.

That’s pretty narrow — typically equating just 2,000 stope tonnes. The margin for error is very fine, hence requiring a high degree of drilling accuracy.



Before the introduction of the Production Optimiser technology on our long-hole rigs, very narrow stopes such as these would have been difficult to recover economically.”

Following analysis of Cracow’s reconciliation data for FY20 and FY21 stopes with <2,000 tonnes equated to 119 stopes or around 53% of total production. Based on this, Cracow have been able to recover AUD\$59 million worth of gold ounces that were at risk due to the narrow vein nature of the stopes. The all-in cost of mining these stopes was approximately AUD\$27 million, generating an additional AUD\$32 million profit.

“That’s a big positive – ensuring we extract the maximum value possible over the remaining life of mine,” says Nguyen.

“Optimiser has allowed us the flexibility to continue drilling optimally with both narrow vein and wider stopes, whilst also maintaining the accuracy from setup that we established back in 2018. Being agile to move between Dice-5 and Zipper pattern as needed has allowed us to maximise gold recovery and reduce dilution.”

AUTOMATED VOLUME MONITORING WITH LEICA BLK247

☰ Editorial



Carl-Thomas Schneider is Vice President, Business Development, at Hexagon's Geosystems division

Gain real-time volumetric insights about bulk goods like grain, wood chips, chemicals and other precious resources.



IMPRECISE VOLUME MONITORING IS PROBLEMATIC

Volume monitoring is essential for today's automated processes, which depend on accurate, up-to-date data. Precise asset management is also necessary for controlling downstream processes: Managers of power plants or chemical factories can only optimise operations if they know the exact amount of goods that have gone into these processes. Knowing how much is on stock allows the purchasing manager to procure supply at the right moment regarding pricing and availability.

Today plant managers often merely estimate volumes of goods. They base such estimates on their experience or roughly calculate the amount based on laser distance measurements of the stockpile's height. Often, they do precise volume detection with a human-operated high-precision laser scanner only once per quarter or even

once per year. This method is very accurate and allows operators to reset the volume estimates and correct the data in the systems. However, it is time-consuming and expensive and doesn't deliver a continuous data update.

Automated processing requires regular monitoring with high accuracy and frequency. Other solutions, for example, single-point laser or radar/echo systems, don't deliver the necessary accuracy, especially when the stockpile has an irregular shape.

3D SCANNING FOR REAL-TIME VOLUME INFORMATION

The solution is installing a 3D scanner that provides real-time information about the existing volume. Combining advanced sensor technology from Leica Geosystems, part of Hexagon, with powerful software processing creates a rapid and autonomous volume monitoring solution.



For volumetric measuring, the BLK247 is mounted above the stockpile. The sensor can scan up to 60 metres in diameter and 30 metres in height. The BLK247's rotating LiDAR continuously scans the surface of the goods and creates a dense point cloud of the surface. This point cloud is then passed to the Cyclone 3DR software for automatic processing and evaluation of the volume in relation to the empty storage facility

The user can select the measurement frequency, whether it is every few minutes, days, weeks or months. The BLK247 also delivers high-resolution images of the stockpile so that staffers can inspect the material and notice abnormalities of the surface.

VISUAL AND THERMAL CAMERAS

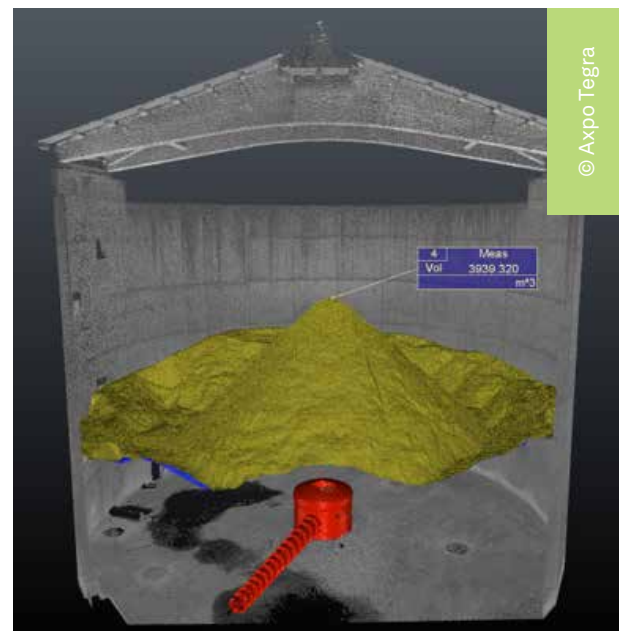
With two high-definition video streams, users can utilise the BLK247 to provide visual monitoring of the site in real time. Additionally, the BLK247's thermal cameras deliver information about the surface temperature. The system will inform staffers if the temperature exceeds a user-defined threshold or if it detects temperature abnormalities.

The BLK247 is an IoT device, and a simple network cable will link it to the control system and network of the factory. As an edge computing device, it does not need any extra processing capabilities for many of its features and functionalities.



3D SURVEILLANCE SOLUTION

Not only can the BLK247 provide volumetric and visual monitoring of the site, it is also a surveillance device with an advanced set of security features. For example, 3D zones can be defined around the stock area where persons shouldn't trespass. When an intruder is detected in this area, an alarm and video information can be sent to the control room to allow a rapid response.



PUBLIC SAFETY IN 3D

☰ Editorial



Malgorzata Krol is Global Director Marketing Communication, Public Safety, at Hexagon's Geosystems division

(Em)powering collaboration, increasing safety and simplifying workflows

Geospatial technology and Forensic Digital Twins transform how crime scene investigators, police officers, crash investigators, fire investigators and security professionals collaborate and manage pre-planning, forensic mapping, evidence gathering, and incident and scene investigation.

ENHANCING PUBLIC SAFETY THROUGH 3D REALITY CAPTURE

The common challenge for the Public Safety professionals at any incident scene is to capture, document and visualise the real world quickly, safely and accurately. Environmental factors or the movement of people and objects can affect on-site evidence collection and scene documentation: Streets must be reopened; a dangerous location must be cleared; or restricted access to certain areas must be restored. This is only possible through the smooth collaboration of many people from different units, teams and agencies on scene but also afterwards, in the office, police or firefighting station, or even in court.

For example: When a crash or collision case ends up in court, it is usually because there was a tragic death or serious injury, which may also mean that significant amounts of money are at stake. Accident investigation experts must present the captured evidence and their hypothesis of what has happened so that a group of nonexpert stakeholders, including

insurance representatives, lawyers and the jury, can understand the events and collaborate in the critical decision-making process.

Leica Geosystems Public Safety-dedicated Reality Capture and Mobile Mapping solutions help to understand what caused the incident and assist the investigation. They capture and preserve the accident scene as quickly and accurately as possible while allowing officers, investigators and emergency response teams to stay out of harm's way. Leica's scene documentation equipment enables investigators to work safely, efficiently and confidently.

THE FORENSIC DIGITAL TWIN

Close collaboration and teamwork are also required on and after a fire or explosion scene. Objects, roofs, beams, or other things can collapse during fires. After explosions, there are usually a lot of scattered parts. Often these objects block access to crucial evidence that the fire/arson scene investigator needs to examine. And they are carbonised, meaning they break when one touches or treads on them. Also, the fire and emergency teams can face human casualties during a rescue operation. All the Public Safety professionals involved here must cooperate fast and safely during an operation while complying with the appropriate codes of practice and conduct. Fire investigators, whose work starts as soon as possible after the fire, collaborate with fire and rescue services and other partners



to investigate, for example, by preserving the scene, "freezing" it in 3D and securing the unstable evidence as accurately as possible during the first walk-through. The Forensic Digital Twin is then created with Leica Geosystems Reality Capture technology and can be re-visited as often as needed by different stakeholders during the investigation process.

During a rescue operation or scene clean-up phase, the safety of the response teams and their collaborators is crucial. The stability of a building after a fire or a gas explosion can quickly change and usually poses a significant threat to the rescue units working on-site. Leica's Total Station solutions can be used to monitor the structural stability of burnt and close-to-collapsed buildings 24/7. If the structure starts to move, the device immediately gives the system operator visual feedback and sounds an alarm. These signals allow the unit commander and EMS supervisor to order an immediate evacuation and thus maintain the safety of the firefighters, the emergency response units and the living victims.

These are just a few examples of how Leica Geosystems' Public Safety solutions empower and support the collaboration between different stakeholders and ease complex workflows and processes. We and our technology contribute directly and indirectly to improving prevention and protection activities in the communities and improving

law enforcement, firefighters, and the EMS teams' safety. We learn and cooperate with our customers and users every day and share the knowledge with our colleagues and Leica's development teams on the continuous development and invention of technologies. Our technology and data find broad use and acceptance in the justice system processes worldwide, where appropriate.

TECHNOLOGY THAT CONNECTS AND AIDS COLLABORATION

In the end, our high-tech solutions are not only about more features. For us, our technology is about enabling our customers to connect, collaborate and deliver best-in-class, reliable results safely and securely. At Leica Geosystems, we care about the continuous enhancement of our solutions for law enforcement, private investigations and all other Public Safety professionals interested in 3D technology because better workflows translate into real safety and quality of life improvements for our users and the public. Furthermore, knowing the truth about a crime, homicide, or severe collision and being able to present it convincingly in court helps drivers, victims, and their families to come to terms with what has happened and move forward with their lives. And, if serious incidents happen over and over at the same location, then the authorities can simulate and implement preventive measures with the help of our technology.

Work smart with the new Leica AP20 AutoPole

The Leica AP20 AutoPole is a unique smart solution for our automated total stations that boosts on-site productivity.

The easy-to-use AP20 gives you the flexibility to work faster on any site – adjust the pole height without needing to record your changes and measure hard to reach points with a tilted pole. The Leica AP20 also ensures search and lock to your target only, crucial on a busy site. Accelerate your work on-site, save time in the office and make fewer mistakes with the Leica AP20.

#MadeForTheBestSurveyors

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- when it has to be **right**

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