HxGN LIVE EDITION

REPORTER 75

HEXAGON GEOSYSTEMS | Leica Geosystems

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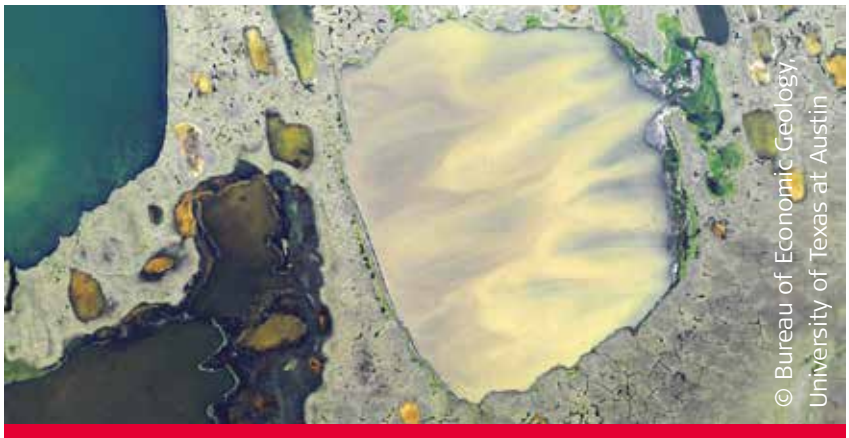

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Mapping the last frontier

A Message from the President

Whether a movie set decorator needs to measure the single distance between two props or a scientist needs to map the 3D terrains of a wild frontier, dimensional intelligence gives us the ability to understand our world. With the deeper knowledge of the challenging environments we operate in, we can then perform better work that's needed to shape smart change around the globe.

Dimensional intelligence is key to understanding the effects of natural disasters. An architecture team from the University of Notre Dame used Leica Geosystems laser scanning technology to find out if the famous Indian world wonder, Taj Mahal, was safe from the possible effects of a nearby earthquake, ensuring the antiquity was structurally sound. At the same time, the Leica Pegasus:Backpack was used after a destructive tornado in Italy to provide the local government with critical information, enabling recovery and rebuilding operations to get underway sooner and safer.

Without dimensional intelligence, producing quality results is not possible. The German cruise ship builder MEYER WERFT ensures 800-tonne blocks were precisely placed together with the Leica ScanStation P40 to construct some of the largest vessels on the high seas today. Scientists from the University of Texas at Austin's Bureau of Economic Geology used the Leica Chiroptera to take exact measurements of thousands of lakes to determine where ice roads could be safely and sustainably built in some of the most remote areas on the planet.

Dimensional intelligence helps us all to shape a more supportive world, and I'm proud our innovations are helping to get us there. Enjoy your read.

Juergen Dold
President, Hexagon Geosystems

Written by Katherine Lehmuller

©Hartsfield-Jackson Atlanta International Airport

SUSTAINING AN AIRPORT'S HEALTH

Hartsfield-Jackson Atlanta International Airport (ATL) in Atlanta, Georgia, USA, has been known as the world's busiest passenger airport for the past 15 years, with more than 2,700 flights coming and going and serving more than 250,000 passengers daily. Preparing for future trends in transportation, the airport has recently added new facilities and boasts a complex consisting of seven concourses and five runways, with the longest at close to 12,000 feet (approximately 3,600 metres). The entire infrastructure encompasses more than 4,700 acres (1,900 hectares).

Air transport is constantly expanding, and budgets continue to tighten. New strategies call for more efficiency, and this in turn calls for faster, more streamlined work processes and tools. The best solution for substantially improving an airport's efficiency is to properly manage and document the location and health of its infrastructure assets and utilities. Operation and maintenance costs of running an airport have major impacts on budget planning and help enable a positive revenue balance at the end of the year.

ATL has an enormous amount of complexities to manage, document and monitor; and managing these present a significant challenge to accomplish effectively. Like other airports of similiar size, ATL consists of many different utility systems such as storm water, sewer, aviation fuel, electricity, fuel pits, fat, oil and grease separation systems, and telecommunications. These, in turn, contain manholes, inlets and fuel hydrants. Any airfield pavement defects such as cracks, spalls or joint seal failures on runways and taxiways, also need to be detected and repairs planned well in advance.

Each of these systems require constant monitoring because of increasingly complex and demanding regulations. There are significant fines that compile if proper compliance is not demonstrated. GIS tools help airport staff to visualise all these utility systems on a single map and help complete operational tasks faster and more effectively. Asset management also documents the exact location of the airfield's lights, signs and markings, and it is imperative that airport asset management knows exactly which light, sign or marking require service. Modern GIS systems enable easy identification and simplify maintenance in a timely and cost-effective manner.

FINDING ANOTHER WAY FOR DATA COLLECTION

For the past seven years, ATL has relied on survey-grade, GPS data-collection technology to collect utility, pavement and other critical infrastructure data information with centimetre-level accuracy. This equipment, however, uses proprietary software and is difficult to manage collected data throughout airport operations, mainly because it didn't work efficiently with CAD, GIS planning or the workflows used by the airport's engineering and GIS staff. ATL has been looking for the right solution to map, collect and record their asset and utilities information in one centralised database and share this information between decision makers and field crews.

Three years ago, ATL made the decision to use Esri's Collector for ArcGIS to collect and update data in the field using smartphones and tablets. Airside and Landside Operation teams, who worked in the office on pavement management, required a common software interface to communicate with field crews efficiently and Collector for ArcGIS provided the missing link. Collector for ArcGIS sets up the collection project, manages and edits the data all in real time and exports it for use with other systems, such as CAD, with the ArcGIS Online environment.

Smartphones and tablets with Collector for ArcGIS installed were used by field crews and proved very popular. Crews easily understood how to use the already familiar smart device interface and within a short period of time, were quickly collecting, viewing and sharing data in real time across multiple platforms – online and offline. It was especially helpful for Airside and Landside Operation teams who could easily and simultaneously communicate with multiple field crews any edits made by each other.

Brian Haren, senior GIS program coordinator at Hartfield-Jackson, explains, "H-JAIA Landside and Airside Operations have a requirement to share information on airfield status and needed repairs in real time. In the past this meant identifying repair locations using imprecise methods such as verbal descriptions passed via email, text message or phone call. With Collector for ArcGIS, the crews can now share precise location, description and photo information in real time across the wide variety of platforms. This has resulted in more timely and efficient responses to critical airfield repair issues."

MOVING TO A NEW GIS FOR MORE EFFICIENCIES

When word spread of the recently released Leica Zeno 20 handheld GIS asset collector running on an Android operating system, the airport was immediately interested. This meant a survey-grade asset collection device could now achieve centimetre accuracy data collection that commercial grade smart devices previously used could not provide. Because it used an Android OS, the device could also run Esri's Collector for ArcGIS

After testing Esri's Collector for ArcGIS on the Zeno 20 using an external lightweight GNSS antenna on a pole, the Leica Zeno 20 provided the centimetre accuracy required by airport and field crews. It also could map and record their data in one centralised databank and share this information in real time. The entire airport now worked with optimised workflows, with back office crews efficiently managing data and easily incorporating it into their GIS and CAD systems.

This combination of the Collector for ArcGIS app, Zeno 20 and ArcGIS Online Subscription has now been branded as the ZenoCollector. With the ZenoCollector, field crews can view collected asset data with high-resolution background imagery on large displays. Key decisions can quickly be made in real time, based on the quality and accuracy of the data collected using ArcGIS Online, a cloud-based mapping platform. Project managers and other key personnel are also able to follow the progress of field data collection activities from their desktops or mobile devices as they occur.

Using the ZenoCollector enables ATL's field crews to accurately capture numerous assets efficiently and communicate in real time with all involved, documenting the health of this complex infrastructure with survey-grade accuracy. Over the course of time, decreased labour costs and proactive planning are possible, resulting in a vastly improved lifecycle of utilities and assets at the ATL.

"The Leica Zeno 20 running Collector for ArcGIS allows us to bring our high precision 2D data collection workflows completely into the ArcGIS environment. This means Esri's ArcGIS Online becomes the hub around which all field data collection activities revolve, eliminating the need for separate third-party solutions and expensive desktop applications," said Haren. "The ZenoCollector provides our Aviation GIS, Engineering and Facilities teams with an easy-to-use data collection experience that is consistent with our consumer-grade smartphone and tablet systems, yet provides the high accuracy and precision we demand for critical airport infrastructure location and identification."

GeoConnexion

A version of this story first appeared in ***GeoConnexion*** at http://www.geoconnexion.com.

Written by Kutalmis Saylam

MAPPING THE LAST FRONTIER

Alaska is the least densely populated yet largest state in the United States. Well-known for its diverse landscape and cold weather, travelling can be difficult during winter months. In the northern parts of the state, where tundra is vast and winter climate is harsh, use of ice roads are popular and necessary for transporting resources. Because the state has more than 3 million lakes that are larger than 20 acres in size, a clear understanding of the landscape is required to best determine where these roads could safely and sustainably be built. The Bureau of Economic Geology (the Bureau), a research unit at the University of Texas at Austin, set out to map a portion of this wild frontier and provide a better understanding of the local habitat, using the Leica Chiroptera airborne LiDAR system to survey the Alaskan Northern Slope.

A UNIQUE LANDSCAPE

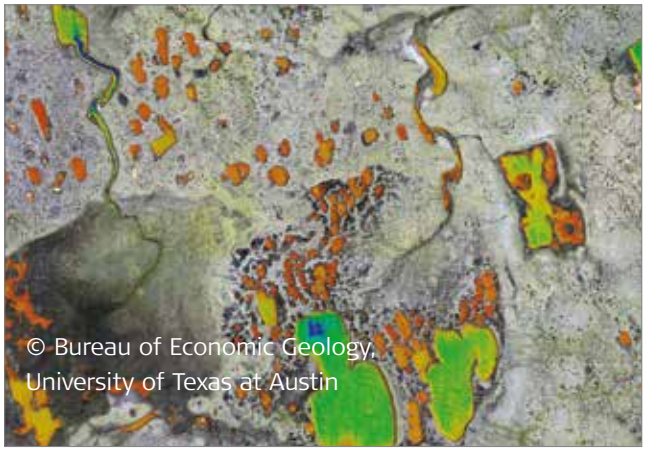
The Alaskan North Slope micro-topography supports various potential fish habitat water bodies and wetland areas within the arctic tundra environment. Shallow thaw lakes, less than 2 metres deep, in general, are a major component of the tundra landscape of the area, where they compose approximately 20 percent of the total area. They are completely ice-free only a few weeks in a calendar year, so we scheduled our field trip accordingly, beginning in mid-July and ending in early August.

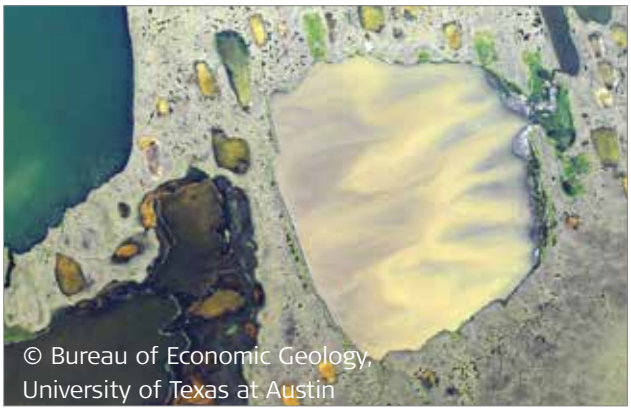
The lakes' depth, ice growth and decay determine whether they are suitable habitat for wildlife and aquatic fauna, as well as for industrial development. Ice accumulation is assumed to be 1.5 to 2 m thick in this area, and liquid water most likely lies below in the central basins of these lakes if the water is deeper than 2 m. Survey findings were particularly important because they would reveal lakes deeper than 2 m, suitable for building ice roads, but with potential fish habitat. Findings were also expected to assist other environmental and hydrological assessments in the area.

"With thousands of lakes – with varying turbidity levels – scattered throughout the survey area and challenging weather conditions that limited the airborne survey activities, this was certainly not an easy task," said John Andrews, a research scientist from the Bureau, who was responsible for ground truthing and overall logistical support. "With airborne LiDAR surveying, though, we were able to obtain very detailed and precise topographic and bathymetric data in areas where traditional survey methods would not be feasible."

FLYING WITH DOUBLE THE SCANNING POWER

A total of 95 lines were flown to cover the entire survey area, where line numbers increased in the westerly direction. The average flight line was approximately 50 km long. To ensure complete coverage, the flight line spacing was set at 160 to 180 m, where the ground laser swath footprint was calculated to be 280 to 290 m wide. To compensate for the changing ground elevation





(30 m in the north, 95 m in the south), atmospheric pressure was monitored during flights to maintain a constant flight altitude and swath above the ground.

The Chiroptera uses two LiDAR scanners to acquire topographic and bathymetric data. Data from the topographic LiDAR (red wavelength) was fired at 300 kHz and used to acquire high-resolution 3D positional data on vegetation height and earth topography. Data from the bathymetric LiDAR (green wavelength) was emitted at 35 kHz and used to determine water related statistics, such as depth, volume and area size. We also collected colour-infrared and natural-colour imagery at 400 m and 1,700 m, respectively, for visual reference and ortho-rectification purposes.

"The technological cornerstone of this project was the Chiroptera airborne LiDAR and imaging system," said John Hupp, a research scientist from the Bureau who was responsible for field data processing and system calibration. "Simultaneously collecting high resolution imagery with the LiDAR data allowed us to easily discriminate water bodies, vegetation characteristics, wetlands and uplands, saving us time and costs compared to any other conventional type of survey."

For both LiDAR scanners, the average vertical offset was measured at less than 1 cm, while the standard deviation was calculated at approximately 3 cm compared to the ground control points collected at Deadhorse airport runway pavement. Calibration procedures were applied to both scanners individually, where average roll and pitch biases were measured to be less than 2.6 cm.

"We also examined and corrected any evident LiDAR system calibration errors caused mostly by incorrect inertial navigation system (INS) rotation angles of roll, pitch and yaw. These errors can be detected through analysis of adjacent and opposing LiDAR strips," said Hupp. "In theory, if no rotational misalignments are present, LiDAR points registered from different strips

should match each other seamlessly on an unobstructed surface; although not expected to have perfection, we can achieve very close results in practice."

FASTER, MORE ACCURATE DATA ANALYSIS

Leica LiDAR Survey Suite LLSS v2.09 was used to convert raw data files into industry-standard LAS1.2 for output. Because LAS datasets are in binary format, they provide quick and easy access to information, either for analysis or visualisation purposes. Datasets from both scanners were tiled to 1 x 1 km to simplify the computational requirements for data viewing and analysis. As a result, we generated 829 tiles across the survey area, and each tile included a 20 m buffer zone in each direction to generate a seamless 1 m digital elevation model (DEM) for mapping purposes.

The deepest water body was calculated at 3.5 m. Of all 4,697 water bodies analysed, 3,837 (81.7 per cent) were classified as shallow or very shallow, with measured depths of less than 1 m. Only 4.6 per cent (216 total) of the water bodies had depths that exceeded 2.0 m. The average depth of all water bodies was calculated at 0.67 m. A total of 3,014 water bodies (64.1 per cent) contained less than 1,000 m3 of water volume whereas 1,683 lakes were calculated to have more than 1,000 m3 of water volume (35.9 per cent). The average volume of all water bodies analysed was calculated at 12,771 m3 (3,373,741 gal) of all water bodies analysed.

"The advanced technology of the Chiroptera provided accurate, detailed, and cost-effective results that permitted analysis of micro-topographic and bathymetric features in a remote location of the world," said Andrews. "Water bodies of all shapes and sizes — riverine environments, wetlands and uplands, hills and flat areas, and all other terrain features — were mapped and analysed rapidly and accurately."

A version of this story first appeared in ***Hydro International*** at http://www.hydro-international.com.

HxGN LIVE

Katalmis Saylam will present another research project he did in Arizona with the Chiroptera in Session 9215 Airborne LiDAR bathymetry survey of lower Colorado River basin 2 p.m. Wednesday, 15 June in Convention Centre 203B.

Written by Thorsten Störig and Ralph Zimmermann

SOS SHIPBUILDING ON SCANS

Imagine putting together a jigsaw puzzle of more than 30 million pieces. The instructions say to group these pieces into about 80 individual blocks, which will weigh up to 800 tonnes. Those blocks must be precisely placed together, offering passengers a safe and pleasant journey aboard a tremendous cruise liner.

Once planned, you have less than one year to construct, all the while meeting budget constraints and exceeding customer expectations in quality.

Welcome to the world of cruise ship building.

At MEYER WERFT, we face these challenges on a daily basis. Building ships since 1795 in Papenburg, Germany, our company has seen the evolution of watercraft transportation from wooden ships to our latest release in April 2015 of the Royal Caribbean Anthem of the Seas. Measuring 350 metres long and 168,666 tonnes, the latest in our long line of luxury cruise ships is making waves in the industry for its sleek design.

NO ROOM FOR ERRORS

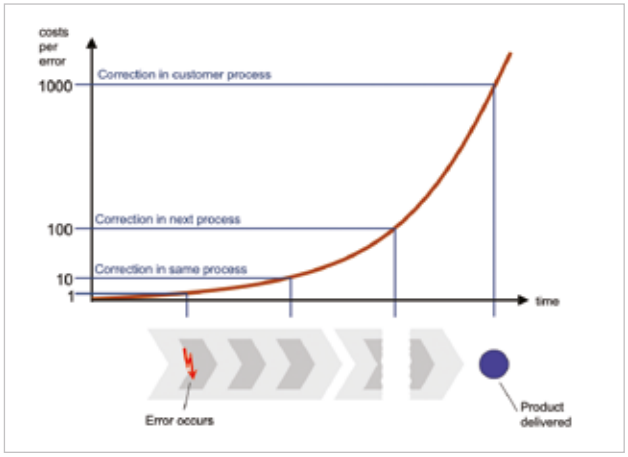
'First time right' is the target for all employees at the shipyard MEYER WERFT in Germany. Minor mistakes in one discipline can have a great effect on staff and material expenses and can even delay the entire building process resulting in additional costs. In particular, the short building period in the dock hall with its 500-meters-long dry dock highlights the daily challenges. By using its full capacity and building two vessels a year at intervals of six months, work processes serve two various types of ships in different stages. While the hull of one ship is completed with the final steel blocks, construction works in the engine room of the subsequent underwater part are already ongoing. Sophisticated quality and advanced planning procedures in design and production ensure that errors rarely occur and are detected promptly.

The roots for such a complex and diversified process lie in a risk-based approach by which the single vessel parts and work sequences are analysed and assessed for potential errors. Actions coming from those studies, though, do not only focus on the so-called 5Rs (right piece, right time, right place, right quantity and right quality). The right information is a key factor in modern and expeditious shipbuilding. Structuring drawing details and the chapters of numerous standard documents in a way that subject areas only receive the exclusive content they need reduces the hazard of missing the forest for the trees.

Information customised for the craftspeople distributes technical details as well as best practice procedures and the knowledge of how to avoid costly defects. With regard to location-independent process steps inside the huge vessel, news about every single improvement on error reduction by using new tools, sequences and available real-time data are inevitable for efficiency.

The second pillar in effective quality management is tests and inspections in short cycles. Quality assurance is supposed to be set up at certain stages where the risk of an error is high. A fast detection avoids having to dismantle, fix and restore completed hotel areas and mechanical spaces of a cruise ship. More than 60,000 single checks within the production process, plus additional checks in the commissioning and delivery phase, ensure problems in late stages will be eliminated.

These tests are carried out by dedicated and qualified staff coming from the disciplines of steel



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construction, welding, material testing, pipe systems, plant engineering, commissioning, interior furnishing and, in particular, dimensional control. The need for short-cycled quality assurance by well-trained inspectors is especially depicted in the above exponential cost graph. As construction cost incurs multiples of 10 or even more during each subsequent step of the process, mistakes not caught by early detection can result in millions of over-budget costs and jeopardise production schedules.

To sum up results at dedicated process steps, quality gates are installed to review test progress and test results. Due to the fact that the owner operating the ship later on and the classification society take part in some of the inspections, the follow-up of remarks and customer satisfaction contribute to a successful ship project completion.

The Quality Management Department comprises the system approach as well as the Measurement Group, which conducts geometric surveys and positioning. Our group is made up of nine different types of engineers, five technicians, six trainees and student apprentices. We conduct all measurement works throughout the entire construction process. Alignment of the plasma torch cutting machines is just one of the first tasks, and absolute accuracy is a must when laying keels and fabricating the blocks. On top of this comes a host of other special jobs, such as determining the overall length of a ship and assisting in research projects. With more and more parts of a ship being prefabricated and attached in blocks, we need to be able to trust our measurements without doubt. Whether you're measuring a complex sun shade composed of multiple concave shapes or a 260-metre-long waterslide with curves and loops, precise connection of the parts is critical.

If we fail to identify potential mistakes or to provide the correct measurements, the entire ship could be scrapped. It is no wonder, then, why we take our responsibilities so seriously.

VERSATILE TOOLBOX

To ensure we do not miss any critical details that could contribute to significant additional costs, we rely on a diverse set of measurement instruments. In particular, 3D laser scanning plays a significant role in helping us ensure construction quality on an efficient cruise ship factory line. Our pool of instruments, consisting of laser scanners, total stations, photogrammetric systems and cameras, are used every day under harsh conditions in both indoor and outdoor environments.

Since 2009, we have added Leica Geosystems laser scanners to our hardware equipment for documentation needs, depending on their high accuracy, speed and rugged design. Along with Leica TruView panoramic scan visualisation software, we've been able to overcome daily challenges with positioning and monitoring of special components and provide exact as-built verifications of complex constructions. Providing approximately 8,000 panoramic photos a year of critical ship elements to our internal clients, we can clearly show surface analysis, geometric controls and fit checks in our efforts to detect deviations at the occurrence

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stage before prefabrication installations. We've also met more advanced standardisation requirements with 3D laser scanning, such as structure analysis, reverse engineering and volume determinations throughout the ship building process. In addition to geometric surveying for construction monitoring, the data provides documentation for warranty needs.

Recently, by automating our 3D laser scanning, we have been able to even improve both our efficiency and our quality of measurements with around-the-clock capturing and monitoring of sections as they come together. Using multiple scans simultaneously day and night, we are gathering scan points to register, cut and fit into CAD models. With automated scan data analysis of the sections, every building part is inspected and our key performance indicators are strictly reviewed. We have realised significant cost and time savings since automating our process and our quality has improved even further.

ADVANCING 3D LASER SCANNING

With our latest purchase of the newest, ultra-high speed 3D laser scanner, the Leica ScanStation P40, we wanted to explore how this technology has advanced and if it could bring yet higher quality to our production. Under real-world conditions, we directly compared it side-by-side to our current HDS7000 scanner by scanning steel beams in the prefabrication stages.

To ensure a direct comparison between the scanners, the settings were equaled with a scan density of 6.3 millimeters point spacing at 10 metres distance from the scanner and set for 3.5 minute scans. We scanned and analysed the edge of the deck plating.

A main weakness in laser scanning in general is the noise at edges, known as mixed pixels. Mixed pixel noise was considerably lowered with the ScanStation P40 over the HDS7000.

There was also a better representation in geometry and contrast of the deckbeam, webplate beam and the deployed High Definition Survey targets with the new ScanStation P40.

At MEYER WERFT, where measurement quality and efficiency are critically important for cruise ship building, 3D laser scanning has proven to be increasingly beneficial in our daily activities. Our test results on the ScanStation P40 point to an even better future for this technology.

A version of this story first appeared in ***QMT Magazine*** at http://www.qmtmag.com


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Written by Cornelia Dietz

WISH UPON A LASER

What we see upon the silver screen can move us to tears, make us laugh until it hurts, and transport us from the everyday to faraway lands, ancient or future times and even to alternate realities. None of this, though, is possible without the expertise of the set decorator.

As head of the set decoration department, the set decorator is responsible for the selection, budgeting and positioning of all decorative items in the film, which underpins the storyline and defines the characters that live in the space. He ensures the vision of production design and direction is thoroughly expressed through the arrangement of the set.

SETTING THE SCENE WITH DISTANCE LASER MEASUREMENT

Before any film is shot, the set decorator must undertake intensive location visits to find suitable towns, streets, houses and objects. Measurements must be taken quickly and under difficult conditions.

Uli Tegetmeier is the set decorator for the 2016 German film *Das Tagebuch der Anne Frank (The Diary of Anne Frank)*, a documentary on the historical figure Anne Frank who hid from Nazi capture for more than two years during World War II before her and her family were discovered in a secret room. When Tegetmeier was in search of a reliable distance laser metre, he turned to the DISTO™, the laser distance metre made especially for outdoor measurements.

"For each set, we had to face a different set of challenges," said Tegetmeier. "In rain or shine, we had to continue with design. The Leica DISTO™ functioned even in the brightest midday sunshine. By means of the four-times magnification of the camera, I was able to measure distances for which I would otherwise have had to use a crane."

Many dimensions would have not have been able to be measured since it was not possible to set up a crane or lifting platform due to the heavy road traffic and limited space. With the Leica DISTO™, though, all measurements could be taken without problems.

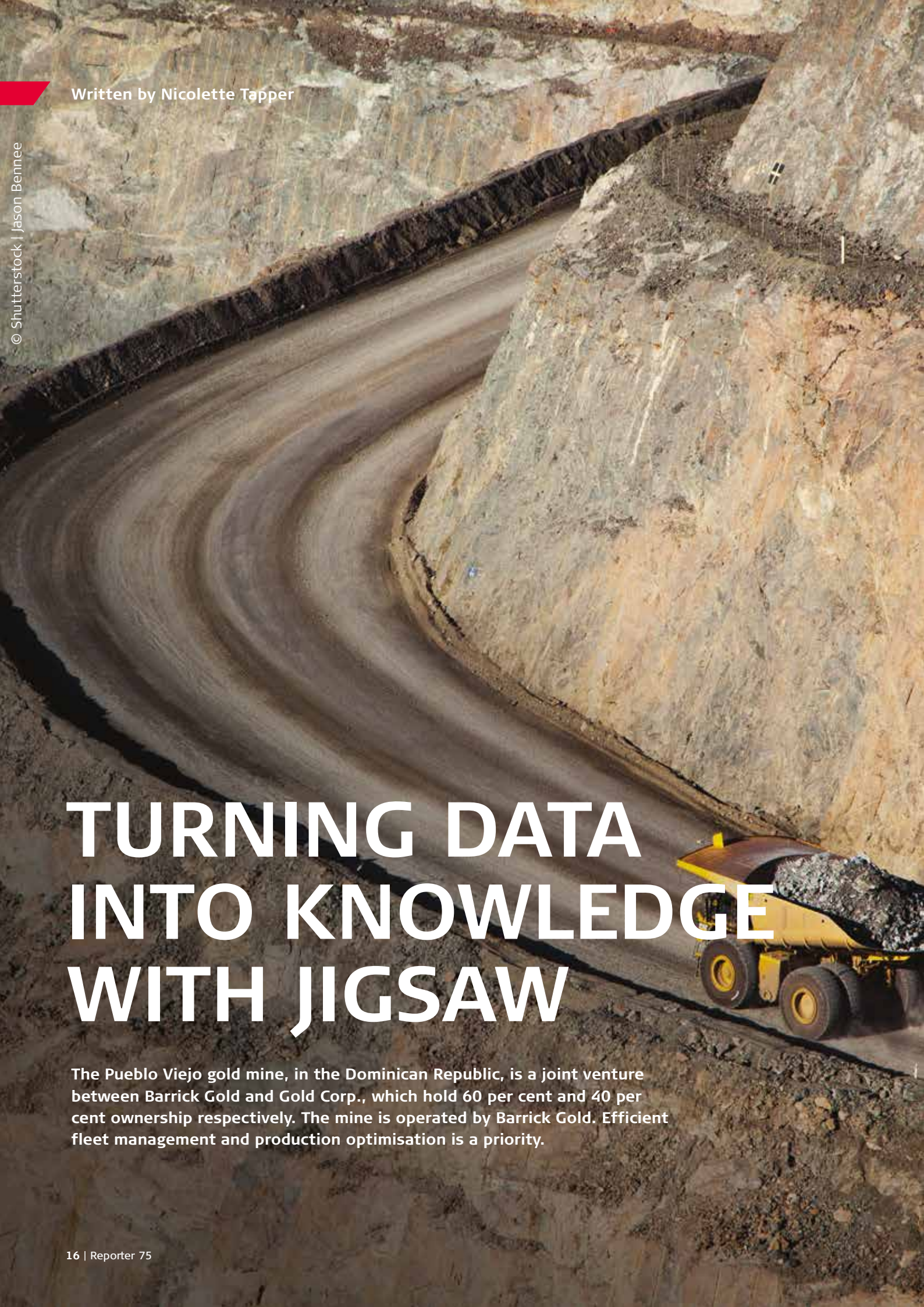
TRANSFERRING FROM SITE TO SCREEN

Filmed in Amsterdam, the film crew had to capture complete rows of houses. These included the entire façades on the Brouwersgracht, Leidtsegracht and other canal venues in Amsterdam. All the windows in the houses had to be blacked out as they would have been at that time during WWII. In addition, modern houses had to be masked by erecting mock façades.

The façades were able to be photographed extremely well and dimensioned using Leica DISTO™ sketch, the free app able to create ground plans or tables on iPhones and iPads. All data was continuously sent to Tegetmeier's tablet where all the information was recorded.

"With the DISTO™ sketch app, I could easily save all our measurements and work with them directly on my tablet on the set, saving time and costly returns to the office to process the data," said Tegetmeier. "We were able to quickly get the set designed and ready for filming."

Written by Nicolette Tapper



TURNING DATA INTO KNOWLEDGE WITH JIGSAW

The Pueblo Viejo gold mine, in the Dominican Republic, is a joint venture between Barrick Gold and Gold Corp., which hold 60 per cent and 40 per cent ownership respectively. The mine is operated by Barrick Gold. Efficient fleet management and production optimisation is a priority.

The focus of fleet management in any industry is to capture, measure and control. Hexagon Mining's fleet management system, Jigsaw Jmineops, is used commonly to optimise the real-time scheduling and dispatch of mobile mining equipment. Information provided by the fleet management system (FMS) gives greater control of operations and production. Jmineops optimises and centralises equipment tracking, dispatching and diagnostics, ensuring that activities and operators can be directed, material movement can be confirmed, and machine health can be monitored.

Pueblo Viejo purchased the entire suite of Jigsaw software, and is running Jmineops, Jview, and Jhealth. In the pit, it has implemented Jtruck, and J²guidance for high precision on shovels/loading units, production blast drills, dozers and track dozers.

"One of the biggest benefits of the Jmineops system is the amount of data it captures," said Shane Boak, former FMS Administrator at Barrick Gold. "Everything that's happening in the pit, in the mining environment, whether it be time-based information, where the material is being picked up, where it's getting dumped, who's operating the equipment, how fast it's going, or what's happening with the engine."

SOFTWARE + HARDWARE = MINING SOLUTION

In addition to Jmineops, Hexagon Mining's software modules and hardware components provide more precise measurement, enhanced operations logic, and wider ranges of equipment usage in run-of-mine (ROM) processes. The Universal Hardware Platform (UHP) also allows numerous Original Equipment Manufacturer (OEM) independent interfacing options and integration potential for further equipment diagnostics, maintenance, and lifecycle management all within the same system.

"We used these tools to pull all this information together so we could make more informed decisions," said Boak. "We keep trucks running longer and faster, optimising production and better managing risks."

Hexagon Mining's business intelligence (BI) suite for reporting and analytics, Jigsaw Jview, is then used to expand data collection and information management into knowledge. This improves processes, production efficiency and management decisions, all of which helps the mine stay on budget and achieve or exceed goals.

"It was all recorded. This is where the BI tools came in really handy to come back, analyse all of this information, and use it to make more informed decisions," said Boak. "We could then improve our use of the FMS and our processes based on past performance and benchmarking results with goals."

CUSTOMISED DATA FOR BETTER DECISION MAKING

Evaluating operations' performance and accounting for results depend on having data and information outside the FMS. Every mine must answer to many levels of data consumer and information user. From banking to manufacturing, every industry offers BI solutions, as well as productised solutions from basic reporting to data warehousing within multiple operations up to enterprise resource planning.

Jview takes frameworks and portions of these components, scales the data, and focuses the content. Information delivery is tailored to many levels of user and data consumer, from mine fleet dispatchers up to managers and analysts. The standard report suite combines dashboards for near real-time information, static reports for common daily and operational reports, dynamic reports for common longer term analysis, and Online Analytical Processing (OLAP) database cubes for ad-hoc reporting and in-depth analysis. Standard functionality is available out of the box. The platform is extensible and content is easily expanded and modified so you can own and interact with the data.

A mine administrator must provide specific reports to a manager upon request. The manager might not always know exactly what he wants to see and the administrator must explain what type of data is captured in the system, as well as the information it could provide. Using content like OLAP databases, ad-hoc reporting can be expanded and data explored. You can be shown how to slice and dice the data to investigate what you're searching for by leveraging the data model and tools with no specific coding or query skills necessary. Often the most difficult part of information discovery is the business rules and requirements to solve problems, as well as time lost to access and analyse data.

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"Jview made it easy to draft a report, show the manager, get feedback and then redesign the report to come up with the customised information requested," said Boak. "We used these systems in a lot of areas. One project was looking at visualising the information. A table of data is one thing and we needed different perspectives. Putting it into a visual context and then manipulating the scenario, we could see how the data relates and gives a lot of benefit, a lot faster."

DATA ANALYSIS FOR INCREASED SAFETY

Applying diagnostics information together with production events provides vital insight. This is where detailed historical information from the FMS on operators' working hours, cycle times and travelling speeds is extremely valuable. With high sample rate GPS data, actual speeds and equipment orientation can be determined before and after an incident. When played back, the equipment path and activity can be reviewed.

"Accidents on the mine site are the last thing anyone wants, but when they do happen, it is important to analyse what was happening in the lead up to the event," said Boak. "Jmineops combined with Jhealth and use of conditional virtual alarms, operational sensor context and snapshots, made it possible to determine use of brakes, gear selection and engine throttle position, giving you a black-box-type analysis around many situations."

Data from Jmineops' general equipment time use and availability can also be analysed to identify areas of improvement in planning. This allows for transparent decisions by management, shift supervisors and maintenance crews concerning equipment use, rotation and requirements throughout operations. Tracking these details to reduce idle time, fuel burn, engine hours, tire wear and other metrics increases efficiency and saves time and money.

Besides maintaining a consistent material feed to the mill through shovel and truck production, other critical operations benefit from FMS and BI. Drill and blast (D&B) can directly affect production as well as haul road maintenance, construction and material stockpile supervision.

"D&B is a critical path in most mining environments," said Boak. "Every day we had drills out there drilling holes, and the supervisor needed to know this process is on track, details on progress for the drilling of a pattern, accuracy in hole positioning and depth control, and even consumable wear. When the blast occurs, fragmentation distribution is critical and the

entire D&B process leads to the material removal and crushing. Tools like this make that information a lot easier for supervisors to see."

Using telematics and FMS integration, blasthole drills can position to survey drill patterns without marking and supervisors can monitor accuracy and progression from any location.

CONVENIENT DATA FOR IMMEDIATE ACTION

Pushing information to the field has always been a challenge. Jview is a simple, flexible platform that is extendable and allows customisation to content delivery across the operation. Supervisors get the information they need to make decisions on the spot, out in the field. Data can now be pushed out more efficiently to smart phones, tablets and 3G networks. Interface layout and design is important because visualisation differs between devices. Visual analysis improves discovery, interpretation and insight. Matching content with users' skills and purpose enhances interactivity and engagement.

"The goal was to make the information more manageable and accessible to people out in the field," said Boak. "Not everyone could always be in the dispatch centre, or even in their own office to look at information on computers. We issued shift supervisors tablets and they were able to pull up reports while they moved around the mine."

As operations and technology evolve and become more complex, control and monitoring will become even more vital. Demands on FMS and BI will continue. There is always a pull between operational intelligence with real time data versus business intelligence with collection of large historical data sets used to validate performance, discover event correlation, and compare metrics over greater time ranges. FMS will need to evolve to capture more data and store it for analysis. The vast amounts of data available in the FMS will allow us to make innovative changes to operations, exceeding industry standards.

Organisations will then combine the experiential wisdom of employees with engaging self-service information delivery tools, solving problems, discovering anomalies and taking action. Operations must continue to cultivate a data-driven culture that envisions new business rules, realises value in the information, and grows with these tools. Knowledge is gained by using data from these systems together with enhancing or implementing new processes and procedures. This method tests and validates current procedures, metrics, and processes by involving users with driving new features and enhancements in the FMS functionality. The outcome is the data is transformed into information, which leads to actionable insights and knowledge, resulting in better control. From dispatcher to analyst to management, Jigsaw elevates problem solving beyond just data use, allowing you to control the environment, discover information and gain knowledge.

Written by Jia Jia

LEVELLING THE (CEMENT) PLAYING FIELD

© Shandong Roadway Machinery Manufacturing Co., LTD

© Shandong Roadway Machinery Manufacturing Co., LTD

Not all Original Equipment Manufacturers (OEM) partnerships are created equal. When the Shandong Roadway Machinery Manufacturing Co., LTD, a firm specialising in production of machinery used in horizontal concrete placement, was looking for a competitive advantage for the company's high level applications, it turned to Leica Geosystems iCON and other construction solutions. Finding a trusted partner, Roadway was able to equip its best-selling concrete paver, the Screed RWJP14, with a laser guided solution that enhance the concrete flatness and improves the customers productivity and efficiency.

© Shandong Roadway Machinery Manufacturing Co., LTD

A NEW WAY TO SMOOTH

The first opportunity the firm had to use this new combined technology was for the concrete paving of an 8,000+ square metre parking deck in the Yantai Economic & Technological Development Area of the Shandong Province, China. Equipped with the Leica iCON iGD2 machine guidance system, the operator of the RWJP14 laser was able to more accurately and efficiently control height and slope of the screed for the concrete levelling. The screed was placed correctly at millimetre accuracy, enabling the concrete paving at the exact grade needed. This resulted in a drastic reduction of labour and material costs.

In conjunction with the Leica Rugby rotating laser, the exact flatness of the project was ensured within an acceptable tolerance for the project. Used for altitude datum, the tolerance came in at less than 3 mm.

Compared with the traditional method of using an aluminum alloy level where the contractor would have had to manually level the entire project, the use of the iCON iGD2 and Rugby enabled significant time and cost savings in labour. With this digital means of measurement, the construction material and quality control cost are also greatly reduced when recheck measurements are made unnecessary.

"The Leica iCON iGD2 has a bigger screen than others, allowing us to directly see the working status of the machine," said Zhou Zhe, Roadway technical director. "This gives our operators more confidence in their jobs. And, with the Leica Rugby, we are seeing the highest accuracy and efficiency we've ever had."

INAUGURAL PARTNERSHIP PAYS OFF

This combination of technologies, Roadway's concrete paver and iCON machine control solutions, is the first time Roadway has used Leica Geosystems technology. The firm has gone on now to place these new systems in the market, bringing high value to contractors.

"The quality and durability of Leica Geosystems has helped us provide higher customer satisfaction," said Zhe. "Since we developed this solution, we have also seen decreased costs on post-sale on-site services and, ultimately, further strengthened our market leading role as a concrete paving machine manufacturer."

With the iCON iGD2's PowerSnap, patented snap-on and snap-off solution, the control panel can quickly be changed from machine to machine. Roadway can now quickly and efficiently exchange the panel between its many specialised machines for applications in highway, railway and more. The firm is currently evaluating future opportunities with this unique iCON feature.

© Shandong Roadway Machinery Manufacturing Co., LTD

Written by Katherine Lehmuller

ENSURING SMOOTH FLOW

Germany's busy Kiel Canal has been used as an international shipping lane for more than 100 years. Linking the North Sea to the Baltic, the canal enables ships not only to save a distance of roughly 280 nautical miles but also to avoid the potentially dangerous storm ridden conditions of Denmark's northern Jutland Peninsula - the coastal gale winds and increasingly difficult tidal changes of the Skagervak between Denmark and Norway.

After a century of heavy traffic, German's Ministry of Transport, Building and Urban Development decided to modernise and carry out safety improvements on the locks of the Waterways and Shipping Authority (WSA Brunsbüttel). The Kiel Canal is one of the most travelled artificial waterways in the world and many countries rely heavily on the canal for the economy of their industries and businesses. Closing the Kiel Canal during this seven-year construction project would be unthinkable since the canal is the lifeline and gate that connects German ports to the Baltic Sea. Therefore, a fifth sluice chamber needed to be added to the existing infrastructure. With an expected completion in 2020, this fifth chamber will handle the shipping traffic while the older locks' renovation is being carried out.

ANALYSING THE RISE AND FALL OF THE TIDE

The Kiel Canal not only functions as a shipping lane but also neutralises the effects of the North Sea's tide fluctuations and the water level of the locks that continuously fluctuates, rising and sinking roughly 3 metres over the course of six hours as the tides change. The Brunsbüttel lock system also provides important coastal protection from the Baltic Sea's notorious water level differences that occur due to gale winds and storm flooding from the sea.

The WSA Brunsbüttel has numerous water sensors that continuously collect water level data to foresee any possible water-related difficulties for the locks' infrastructure and the canal's surrounding area, supplying vast amounts of historic analysis. A geodetic monitoring system is also onsite and continuously collects massive amounts of data. Further review of the data dictated the need for a programme that could read and combine sensor information into the data processing software.

Before beginning construction, the stability of this enormous project had to be assessed. The new infrastructure presented demanding technical and logistical challenges, which needed to be taken into consideration. The fifth sluice chamber, when completed will measure roughly 350 m in length, 45 m in width, with an underwater extending cill on the lock gate at 14 m below sea level. The chamber will be built into the sluice island between the large and small locks and requires the removal of roughly 1.6 million m³ of mostly clay soil. Three months of monitoring the existing lock system at Brunsbüttel was necessary in order to analyse the stability of the structure before starting with construction. Once the project began, the seven-year construction site will be monitored until its completion.

MONITORING MOVEMENTS DURING CONSTRUCTION

Kirchner Engineering Consultants GmbH was contracted to monitor the movements of the structure during construction. A key requirement for WSA was to incorporate data collected from existing water sensors scattered throughout the lock structure at Brunsbüttel and to easily integrate this information into the automatic, real-time geodetic monitoring analysis.

ALLSAT GmbH, a company specialising in geomonitoring using high-precision total stations and has been collecting geodetic data from the Brunsbüttel for some time, was contracted by Kirchner. The project requires the best possible deviation measurements and Leica GeoMoS Monitor software used by ALLSAT delivers the highest accuracy of +/- 2 mm.

After collecting and analysing new and previous data for three months, the building of the chamber could start. During construction, the chamber walls next to the building site will be continuously monitored three times per hour for any standard deviations (2 mm) and for any deformation activity of more than 15 mm from the position and height of each measured point being monitored.

The data collected for existing chambers gates and walls used four Leica Nova TM50 total stations set up on pillars throughout the lock infrastructure and also used Leica Geosystems monitoring prisms.

Installations were completed by ALLSAT, who used Leica GeoMoS software for data processing and visualisations. Communication boxes with GPRS data modems were also installed on top of the measuring pillars using mobile service providers to transfer data. Total stations were also secured by weather element protectors.

NECESSITY IS THE MOTHER OF ALL INVENTION

Due to the special demands required by WSA, Leica Geosystems added a new format editor to its GeoMoS software. This new editor can automatically process data from one or multiple sources, such as sensors, data loggers, files or databases. With this editor addition, Intelligent Open Interface was enabled, allowing the integration of any Comma Separated Value (CSV) file. After a one-time content configuration, the GeoMos CSV-module can automatically process any new raw data content from the water sensors on the tidal range water levels surrounding the locks. Each data field, separated by a semicolon within the CSV file, received certain configuration parameters, such as time format, identifier, observation, unit and location. With this information, any CSV file could be processed in pre-defined time intervals. In this case, the raw data of the water levels were combined with the coordinates of the geodetic monitoring system.

With the virtual sensor editor, the system could process the deformations corrected by the tide influence to become a complete monitoring analysis.

With this new file formatting editor, the monitoring software became highly flexible and able to read any software interface. Sensor data available via the Internet could be quickly integrated for real-time analyses. All changes to the canal's water levels can be taken into account when analysing the geodetic measurements for deformation tolerance levels. The software also processed this data into easily understood visualisations that can be customised to the level and needs of those responsible receiving the information.

Should any of the data measurements exceed the set maximal deformation limits, a second measurement is made immediately after the completion of that measuring cycle. If this second data measurement still exceeded the maximal allowed limits, the people responsible at Kirchner were immediately informed by an email message automatically sent so they could take the necessary actions.

GeoConnexion

A version of this story first appeared in ***GeoConnexion*** at http://www.geoconnexion.com.

Written by Christine Grahl

FILLING THE NEED FOR SURVEY SPEED

Timely investments in new solutions help surveyors address the demand for increased accuracy and efficiency within tight budgets.

Clients have always wanted rapid, accurate and complete surveys, but now that they know what's possible with the newest technologies, their expectations on all fronts have increased. Today, they ask for even greater accuracy, faster turnaround and lower costs. The bottom line is that whatever industry clients are in, from transportation to utilities to construction, they are facing more pressure to ratchet up project requirements.

In the architecture, engineering and construction markets, building information modelling (BIM) has fueled an upsurge in client needs. Surveying professionals are on the line to meet the tight tolerances that an efficient BIM process demands. Because comprehensive data produced quickly and accurately is necessary for successful BIM projects, it's not surprising that many building designers and contractors now require point clouds captured by laser scanning as part of the project deliverables. Clients in other industries are also tightening their specifications. After all, they too are working with limited budgets and shortened project cycles and cannot afford inaccuracies that lead to cost overuns.

Fortunately, while technology is driving higher client expectations, it also empowers surveying and engineering firms to meet and exceed those requirements. Staying on the leading edge can provide a large payoff in productivity and profitability.

EMPLOYING THE LATEST SOLUTIONS TO MEET CLIENT NEEDS

At SANDIS, a professional services corporation that specialises in civil engineering, traffic engineering, land surveying, 3D scanning and BIM preparation, the entire team understands the importance of accuracy. "There is little point in measuring unless the objective is to provide the exact coordinates of a point," says Laura Cabral, associate principal and survey manager. High-tech equipment is just one element necessary to satisfy customers' needs for efficiency and accuracy. To increase sales and profitability while achieving the best results for

clients, surveyors must choose the right technology, hire and train skilled professionals to collect data, and follow best practices for data collection. That is why the company employs detail-oriented, experienced field and office surveyors and invests carefully in only the most trusted technology.

SANDIS has used Leica Geosystems total stations exclusively for more than 25 years and, more recently, the Leica ScanStation C10 and P40 laser scanners. This year, to improve client service, SANDIS purchased 15 Leica CS20 controllers featuring Leica Captivate software. The CS20 field controllers enable accurate electronic distance measuring and display the 3D data captured on the screen. They include radio and antenna for long-range robotic total station control, a GNSS receiver, a laser metre and a camera. The Captivate 3D field software works with a variety of measurement instruments, including total stations and scanning total stations, to create realistic 3D renderings. This capability gives surveyors the flexibility to switch quickly, for example, from GNSS to a total station. The fully integrated system increases the speed and quality of data transfer to and from the office, enabling SANDIS to provide fast, high-quality service.

Technology assists the company in another way as well. Located in Campbell, California, SANDIS primarily serves clients in the San Francisco Bay Area, Silicon Valley and Sacramento. In these regions, development booms have stoked the demand for surveying crews. As new projects begin every week, it's often an uphill battle to find skilled and experienced technicians. The firm's state-of-the-art surveying solutions make it possible for SANDIS to collect more data with fewer field personnel. Crews can document more jobsites in a week and increase the accuracy of the jobs they complete.

These benefits have had a profound impact on business success. "With the Leica CS20 field controllers, we saw increased productivity and quality of both our field and office operations," says Ken Olcott, the firm's president. "Our crews work on hundreds of large, technical and complex projects. Whether we are laying out piles for a new NFL stadium or setting embeds for a Silicon Valley high-tech campus, we need to be precise and timely. We are only as good as our last survey. The Leica Geosystems' total stations, CS20s and Captivate software allow us to maintain a great track record."

RAISING THE BAR ON SURVEY EXCELLENCE

Investing in the latest technology helps the firm meet its clients' current needs. Since the market does not stand still, however, company associates are always looking ahead to what clients might need in the future. They already see more requests for thorough day-to-day updates on projects. When steel is erected, for example, or a large piece of structural concrete is installed, clients want meticulous details on how the structure differs from the original design. SANDIS has the technology and expertise available to provide this information, thereby empowering the project manager to provide the best information to subcontractors so they can make plans accurately in a virtual environment, minimising errors and waste.

While monitoring these trends, SANDIS also stays in touch with representatives from its technology provider to learn how the latest solutions dovetail with market needs. SANDIS has also expanded its industry coverage with the acquisition of Bryant Surveys Inc., a specialty steel erection survey firm, and CTS, Inc., a leader in laser scanning, point cloud post-processing and BIM preparation.

All of these strategies enable the firm to delight its clients with accuracy, efficiency and value. "Our clients deserve the highest level of value and quality," says Cabral. "Using the latest surveying solutions helps us be more efficient in the field and office and raise the bar on the level of excellence we provide in all of our projects."

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HxGN LIVE

Hear about SANDIS' experience surveying construction in Session 9055 Surveying the NBA's Greenest Arena 1:30 p.m. Tuesday, 14 June in Convention Centre 202A.

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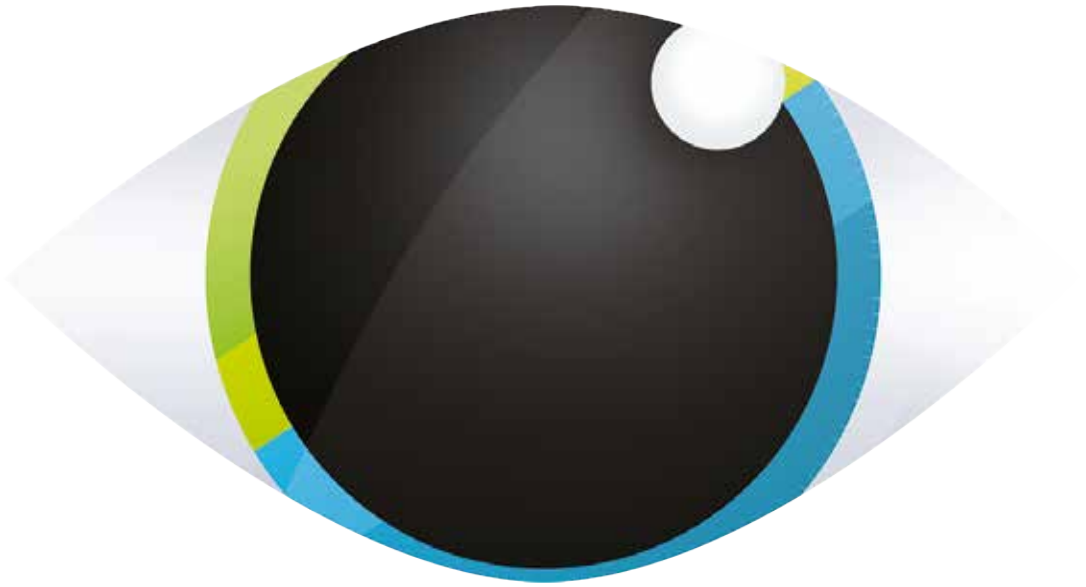

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HEXAGON
GEOSYSTEMS

Written by Amit Kumar

DIGITISING THE MIGHTY TAJ MAHAL

The Taj Mahal, Arabic for crown of palaces, is an ivory-white marble mausoleum on the south bank of the Yamuna River in the Indian city of Agra. Commissioned in 1632 by the Mughal emperor, Shah Jahan (reigned 1628–1658), to house the tomb of his favorite wife, Mumtaz Mahal, the tomb is the centrepiece of a 42-acre complex. Included in the complex are a mosque, guest house and formal gardens, all bounded by crenellated wall.

© Digital Historic Architectural Research and Material Analysis (DHARMA)

© Digital Historic Architectural Research and Material Analysis (DHARMA)

Construction of the mausoleum was essentially completed in 1643, but work continued on other phases of the project for another 10 years. The Taj Mahal complex is believed to have been completed in its entirety in 1653 at a cost estimated at the time to be around 32 million rupees, a value nowadays around 52.8 billion rupees. The construction project employed some 20,000 artisans under the guidance of a board of architects led by the court architect to the emperor, Ustad Ahmad Lahauri.

PRESERVING A NATIONAL TREASURE

In April 2015, a 7.8-magnitude earthquake razed Nepal to the ground and devastated the lives of millions. Apart from affecting 8 million people, the natural disaster severely shook and destroyed the architectural treasures of Kathmandu Valley.

This devastating destruction worried archeologists worldwide. Just 500 miles south of Kathmandu rests one of India's UNESCO World Heritage sites - the Taj Mahal.

Observing the extent of the ravage and the magnitude of this earthquake, Professor Krupali Krusche, an architecture professor at the University of Notre Dame in the United States, decided to measure the injury the earthquake may have caused to the treasure, if any. This project would also forever digitally preserve the Taj Mahal should the unthinkable occur in the future.

"3D blue prints allow us to understand how ancient structures were built and the techniques used to construct them," said Krusche. "So, in the event of a natural or man-made damage, they could be restored to their original state."

A SCANNING PARTNERSHIP

In October 2015, Krusche and a team of engineers and students travelled to India to document the Taj Mahal. Using the Leica ScanStation P20 and Cyclone software, they captured portions of the tomb up to 1 millimetre accuracy to obtain the spatial information necessary to analyse the state of the structural stability.

The team represented the Digital Historic Architectural Research and Material Analysis (DHARMA), an organisation committed to studying and preserving heritage sites around the world, such as the Taj Mahal. In partnership with the Archaelogical Society of India (ASI), the two organisations were able to discern, thankfully, no damage had occurred to the structure.

The ASI supervising archeologist on the project, Bhuvan Vikrama, was impressed with Leica Geosystems laser scanning technology.

"We collaborated with Dr. Krusche because she had the right mix of technology and expertise on the comprehensive digital mapping, which will be crucial for the future conservation and preservation of the Taj Mahal," he said.

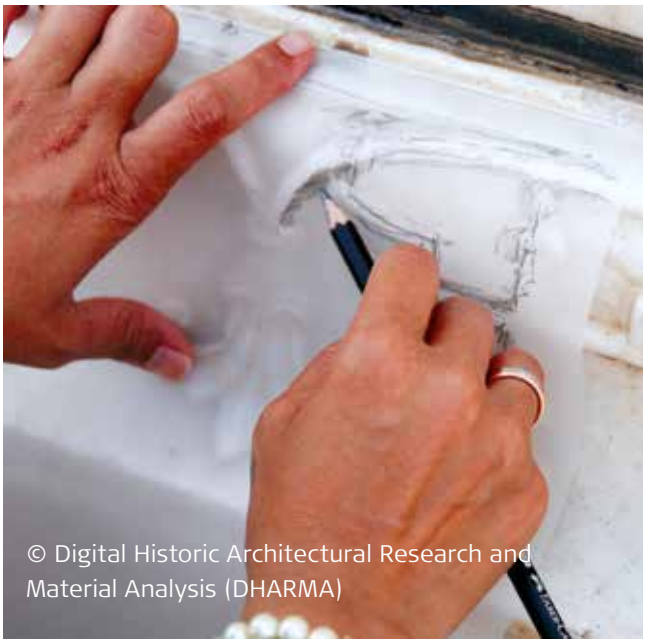
SIMPLIFIED SCANNING FOR LEARNING

Another aspect for this project was the ability for student researchers to learn in a real-world environment. Capable of fast, accurate and highly-dense data collection, the ScanStation P20 is simple to operate, making it a great teaching resource.

Student research assistants Kristen Gates and Anthony Derouin have been involved in creating the stitched 3D scan data along with Gigapan images, enabling study of damage mapping. These images are then transferred on large scale models, allowing the students to study the large structure more thoroughly.

"The P20 was easy to operate, and we were able to create a textured 3D model quickly," said Gates. "Without the need to actually touch any artefacts, we felt easier about modelling the data and training in the Cyclone software."

The final information is being put together in the form of a joint report for ASI.



Written by Benjamin Federmann

OVERCOMING FROM ABOVE

© Benchmark Survey & Design

With only 18 per cent of the country's population living in urban centres, Papa New Guinea is one of the world's most rural and unexplored countries. Dense with rainforest and other diverse ecological features, terrain is a constant obstacle for surveyors. Restricting access to key areas, measurement professionals must find innovative means to gather needed data.

When Benchmark Survey & Design, a survey firm in North Queensland, Australia, was contracted by the Porgera Mine Survey Team to map spill grounds around the secluded mine located at the head of the Porgera Valley in highlands at an altitude of 2,200 to 2,700 metres, the firm specialising in topographic site surveys knew it needed to find a new method of surveying. As the captured data would be used to environmentally monitor the dump sites of the spill generated by the mine, accuracy was of the utmost importance.

MAPPING DANGEROUS TERRAIN WITH AN UAV

In an area where landslides and earthquakes are common and with only five days available to map, Benchmark Survey & Design determined a survey by air would be the safest and quickest survey method. The firm turned to Spatial Technologies, an Australian firm with more than 20 years in GIS, to provide an UAV pilot. Flying the Aibotix Aibot X6 UAV and collecting data in various environments for the past two years, Spatial Technologies was up for the challenge.

With two sites to capture around the mine, Anjolek at 380 hectares and Anawe at 250 ha, the pilot, Anton van Wyk, had to carefully plan his route. Facing several challenges, such as much of the terrain only accessible by helicopter, use of the helicopter only available one out of the five days to map, and extreme weather with fog in the mornings and rain in the afternoon leaving only a few hours each day to survey, van Wyk's precise plan rested upon the durability and dependability of the Aibot X6.

"The Aibot X6 provided better results than what Porgera Mine Survey Team expected, even in such rough terrain," said Wayne Storey from Benchmark Survey & Design. "Though the mine survey team had someone prior fly this mission, the team didn't receive the expert mapping and processing of the data the Aibot X6 delivered with its more advanced sensors."

With 32 total flights at about 10 minutes each, Spatial Technologies collected 9,100 orthophotos at a 5 cm ground sampling distance. While Benchmark Survey & Design only need sub-metre accuracy for the project, Spatial Technologies was actually able to supply 10-20 cm accuracy with strategically placed controls in conjunction with the RTK on the Aibot X6. The entire project was processed in about 96 hours to provide visual documentation of volume changes in the spill grounds.

MORE THAN JUST VOLUMES

Combing the orthophotos from the Aibot X6 with older data and point clouds of the site created by laser scanning technology, engineers and environmentalists on the project were able to go beyond just volume calculations. Together with the many forms of data collected, they can now see visible proof of vegetation changes and conduct slope analyses.

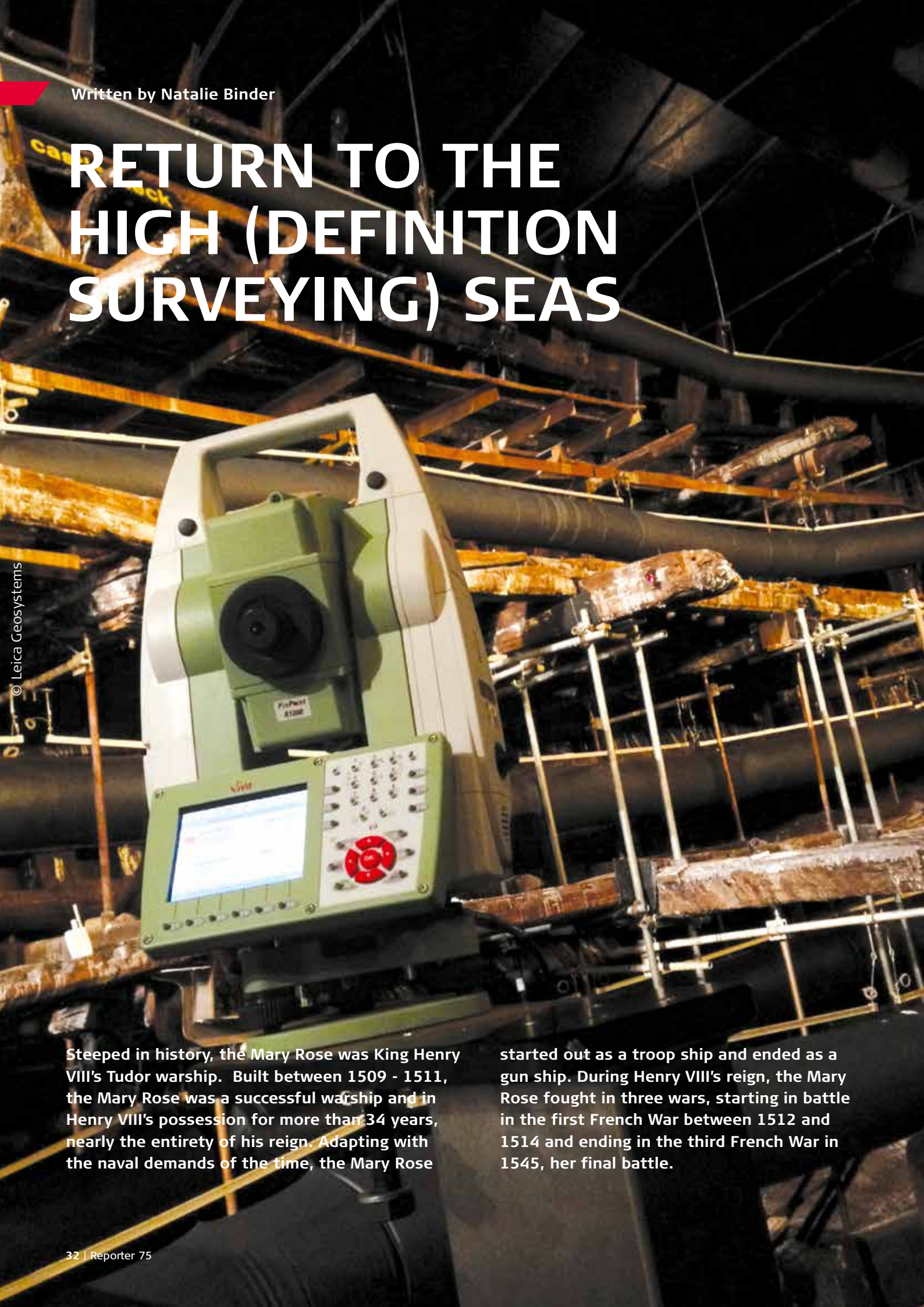
As the dangerous terrain evokes risky conditions for surveyors, measurements were previously being taken few and far between. With the safer and quicker UAV survey, the mine survey team can now monitor on a more regular basis to manage issues sooner and rectify problems before they become major concerns.

"Aerial surveys with the Aibot X6 can not only be done quicker than traditional methods, but with the advanced sensors it can carry, we can gain the same if not better accuracy, as well," said van Wyk. "Since surveyors don't have to enter risky areas to set up instruments, the UAV also makes our jobs safer."

When terrain creates obstacles on the ground, UAVs are able to overcome from above. Opening access to more and more areas, the Aibot X6 is creating new opportunities across the globe.

Written by Natalie Binder

RETURN TO THE HIGH (DEFINITION SURVEYING) SEAS



© Leica Geosystems

Steeped in history, the Mary Rose was King Henry VIII's Tudor warship. Built between 1509 - 1511, the Mary Rose was a successful warship and in Henry VIII's possession for more than 34 years, nearly the entirety of his reign. Adapting with the naval demands of the time, the Mary Rose started out as a troop ship and ended as a gun ship. During Henry VIII's reign, the Mary Rose fought in three wars, starting in battle in the first French War between 1512 and 1514 and ending in the third French War in 1545, her final battle.

The catastrophic sinking of the Mary Rose 19 July 1545 in front of the king has been a tale often retold. The cause of the tragedy is still uncertain; some accounts say French gunfire, a gust of wind or an unruly crew. Whatever the cause, the Mary Rose's history and her supreme marine excavation have truly captured the minds of the general public for generations.

MARY ROSE'S EXCAVATION

The discovery and excavation of the sunken Tudor warship some 437 years later was a milestone in maritime archaeology. Rediscovered in 1971 and salvaged in 1982, the Mary Rose was brought back to No. 3 Dry Dock in Portsmouth's Naval Base, metres away from where she was lovingly built all those years ago. The silt on the seabed helped to preserve some 19,000 artefacts, each excavated and brought to the surface. Here a secure and sheltered building was constructed over the ship so the process of conserving the ship could begin. The Mary Rose was open to visitors 11 October 1983.

Since her excavation in 1982, it was imperative to keep her wet, therefore the ship was sprayed with chilled water to stop the timbers from drying out and to inhibit fungal and bacterial growth. The ship needed to be strengthened before the hull could be dried to avoid collapsing. Therefore the Mary Rose was sprayed with a chemical called Polyethylene Glycol (PEG), which is like a wax. The concentration of the PEG was gradually built up to avoid damage to the wood. She was sprayed like this for almost 20 years to conserve her.

MARY ROSE MUSEUM AND LEICA GEOSYSTEMS' INVOLVEMENT

By 2005, plans were being developed to create a new flagship museum in which to house the Mary Rose hull and her unique collection of artefacts, and to tell the story of her crew. These plans were realised when the new Mary Rose Museum opened in May 2013. Prior to opening the new museum, the wax spray was turned off and the drying process began, keeping the Mary Rose in a controlled environment, called the "hotbox", with a 54 per cent relative humidity and 19 degrees Celsius. Once dried, the PEG will stop the cells from collapsing and will hopefully help to preserve the ship for hundreds of years to come.

In 2013, Leica Geosystems was asked to assist with the conservation project and help to monitor the ongoing drying process of the Mary Rose in the confines of its "hotbox" within the new museum. The system provides vital data to enable the Trust's conservation team to understand the effects of the controlled drying

process on the 500 year old timbers and will be involved in the project for four years, after which time, the majority of the timbers will be dry. As the timbers dry, they can move and understanding the magnitude of this movement and in which direction is significant to this unique scientific research. Once dried, all the black ventilation tubes aiding the drying process will be removed from around the timbers, opening up unhindered views. The ship is also supported with scaffolding and braces to provide extra support and protection and to slow down the movement of the ship, preventing both damage to this unique historical artefact and also safety-of-life for those working on the 500-year-old timbers.

To accurately measure the hull's movement, a Leica Nova MS50 MultiStation was initially installed with optimal line-of-sight coverage onto the hull along with 36 reflector targets attached to the timbers in key locations. The MultiStation automatically calculates its position and orientation prior to each measurement cycle to militate against any movement itself. Five widely distributed control reference targets mounted in stable locations away from the timbers form the basis of the resections. Measurement cycles run three times a day.

Leica Geosystems, with more than 25 years of automated monitoring expertise, has supplied the hardware, software and consultancy for this prestigious project.

Involved from the early stages of the drying phase, Leica Geosystems Account Manager Mark Francis commented; "Leica Geosystems is proud to be involved in offering the latest state-of-the-art measurement solutions to assist in the research of such a prestigious and unique project, and we look forward to further collaborations."

In May 2015, Leica Geosystems' Steven Ramsey and Francis also assisted with a High Definition Survey (HDS) using the newly released, state-of-the-art ScanStation P40. This technique produces a point cloud of billions of points to accurately model every millimetre of the structure, far beyond the 36 discrete monitoring points. The intention is to re-laser scan in 2016, post construction of the opened viewing galleries for an updated model.

As with any continuous monitoring project, in addition to the sensors, power and communication are key components of the system architecture for the reliability and success of the complete solution. At the Mary Rose Museum, main power and an ethernet cable connected to the site LAN ensured the continuous operation, control and data transfer with a computer in the museum connected to the network server. Leica Geosystems' renowned GeoMoS monitoring software controls the measurement cycles three times a day. Additionally, the data is extracted to a spreadsheet format from the open SQL database and automatically emailed to key stakeholders on a regular basis for continued analysis.

"The incorporation of the MultiStation into our conservation plan provides us with invaluable information, which will greatly enhance our understanding of the drying hull. This will allow us to develop a strategy that will ensure the future of this unique piece of cultural heritage," said Dr. Eleanor Schofield, conservation manager.

The data from the MultiStation is delivered by email to doctoral students from the University of Portsmouth's Civil Engineering and Surveying Department. They are then able to analyse the movement data, identifying trends and correlating to other lines of research including the dryness of the timbers.

FUTURE OF THE MARY ROSE

Since the introduction of the MS50 MultiStation to the museum, there has been a lot more interest in how such an instrument works and Leica Geosystems as a company, with visitors young and old alike wanting to understand more. Leica Geosystems works closely in partnership with the Mary Rose Trust to not only monitor the ship's movement but to help support in this important conservation and maritime archaeological project.

The Mary Rose is currently in a period of temporary closure in order for the next chapter in her long and remarkable history to commence. Phase Two of the Mary Rose started at the end of November 2015 and will greatly improve the visitor experience by providing uninterrupted views of the ship from the walkways, as well as all the main galleries at all three levels. For the first time since she was raised in 1982, visitors will also be able to share the same space as the Mary Rose, entering the upper deck through an air lock, allowing visitors to experience the full magnitude of the Mary Rose. During this phase movement, monitoring of the 500-year-old timbers will be critical, and so the MultiStation will remain in its position in the next phase, continuing to provide vital data for the Mary Rose team. The museum will fully re-open in late summer 2016.

Written by Irene Simonetta

MOBILE MAPPING A DISASTER AREA

On July 8, 2015, an Enhanced Fujita Scale (EFS) 4 tornado struck the Brenta River area of northern Italy, around the towns of Pianiga, Dolo and Mira. A famous feature of the area, the Venetian Villas were severely impacted, scattering them along the river region. Built in the 16th century and designed by the renowned architect Andrea Palladio from Padua, these classical forms draw thousands of tourists from all over the world every year. The area was recognised as a UNESCO World Heritage Site in 1994.

The natural disaster tragically caused one death and injured 72 people, heavily damaging 250 homes and displacing hundreds. In all, damages accounted to tens of millions of Euros.

UNDERSTANDING THROUGH MOBILE MAPPING

The headquarters of T&T Service is located in the region where the tornado struck. With a long experience in topography and High Definition Surveying (HDS), the surveying firm helped local authorities in the first hours of the aftermath and beyond to understand the extent of the damage.

"To see that amount of destruction that close to home was very trying for us, but we wanted to help our community in any way we could," said Gianpiero Toniato, owner of T&T Service. "As soon as the tornado passed, we set out with our equipment to help the emergency responders and police to document the damage."

That equipment included the Leica Pegasus:Backpack. As the area was being evacuated for safety reasons, T&T Services needed to quickly get in, document and get out in the midst of the evacuation. Mobile mapping, therefore, was the best solution to acquire data as swiftly as possible while ensuring all necessary information was captured.

Leica Geosystems was immediately available to carry out a pro bono survey to support the local authorities. Since the area wasn't accessible by traditional mobile mapping systems, the Pegasus:Backpack was selected for its advanced mobility to access difficult areas easily.

Taking immediate action with minimal interference to the operations of the rescue workers, Aldo Facchin, Leica Geosystems Mobile Mapping R&D manager, was able to access the area to scan the extent of damage caused by the storm's fury.

"We found excessive damage to home and other structures," said Facchin. "With the Backpack, we were able to easily pass through areas obstructed by fallen debris."

Once completed, all data was turned over to T&T Service. Toniato and his team used the detailed point clouds to investigate and measure the damaged areas, providing a valuable perspective on how a natural disaster affects such a historic space.

ACCESSING THE INACCESSIBLE

Allowing the surveyors to cross into areas where standard vehicles couldn't and the ability to


© T&T Service

quickly collect and analyse data, the Italian public administration of the affected area has been absolutely impressed.

"We depend on various street view tools to understand damage during natural disasters and other accidents like this, but we really appreciate the possibility to use acquired data along days, months, even years to assess how we're recovering," said Dolo Mayor Alberto Polo. "The Backpack makes that possibility a reality. With this Big Data aspect, our technical operators can evaluate damages with an higher accuracy than ever before."

With the Pegasus:Backpack, the public authorities of the municipalities impacted have been able to rely on acquired data and information to measure the progress of cleanup.

FUTURE DEVELOPMENTS FOR RECOVERY

Mobile mapping solutions created a real and immediate picture of the damaged areas. Local authorities were enabled to access areas that were before inaccessible due to damage and effectively coordinate recovery work.

The experience gained by the government in this catastrophe has proven the need to have documented pre- and post-disaster databases to allow for an immediate verification of damaged areas with totally automatic comparisons activities.

"With the technology of the Pegasus:Backpack, authorities can better plan for and react to emergency situations," said Stuart Woods, Leica Geosystems Geospatial Solutions Division vice-president. "By being able to visualise damaged areas in their current and immediate state, from the ground at street and building level, a reality-based effective response to disasters is now possible."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LIFT OFF WITH MULTISTATIONS, ROBOTIC TOTAL STATIONS

Written by Christine Grahl

Bolstering the newest NASA space launch system's testing capabilities, the agency in charge of U.S. science and technology of airplanes or space is now using Leica Nova MS50 MultiStations. The fast, precise robotic total stations with integrated laser scanning capabilities will provide accurate deflection monitoring during comprehensive structural tests.

As NASA continues to make progress on its new rocket, the Space Launch System (SLS), testing the hardware is becoming a crucial focal point at the agency's Marshall Space Flight Center in Huntsville, Alabama, USA. Each structural test article must be carefully evaluated to verify its integrity and ensure it can withstand the loads it may experience during flight.

WITHSTANDING ALL THE ELEMENTS

The tests will be conducted outdoors in one of two structural test stands. A 66-metre-tall steel structure known as Test Stand 4693 will be used to test the liquid hydrogen tank, while an 26-metre-tall steel structure known as Test Stand 4697 will be used to test the liquid oxygen tank. These test stands will push, pull and bend the tanks of the SLS's massive core stage to subject both the tanks and hardware to the same loads and stresses they will endure during launch.

During the tests, multiple points on the tanks must be monitored accurately for deflections over a 48-hour period. To accomplish this task, NASA will use the MultiStations, which are precise robotic total stations with integrated laser scanning capabilities. These will be added to NASA's existing arsenal of Nova MS50 MultiStations and Leica Viva TS15 robotic total stations all of which will be used for deflection monitoring during the comprehensive structural tests.

According to David Rutledge, the NAFTA Director of Structural Monitoring for Leica Geosystems' Engineered Solutions business, NASA continues to invest in the Leica Nova MS50 both for its versatility and its accuracy compared to other total stations.

"Critical applications like the structural test program for the Space Launch System demand solutions that can provide high accuracy and outstanding performance," he said. "Comprehensive surveillance of the test article deformation throughout the testing period with both the Leica Nova MS50 and Viva TS15 instruments will provide highly accurate data that will help NASA engineers understand article performance and guide them in future rocket development. We're excited to be able to play a role in the continued progress at Marshall Space Flight Center."

Written by Justin Barton

THE REALITY CAPTURE OF ELLIS ISLAND

For 62 years, New York Bay's small Ellis Island was the United States' first and primary immigration inspection centre, processing more than 12 million immigrants from 1892 to 1954. Today, the island with its Main Immigration Building and many ancillary structures is a U.S. National Monument and receives 3.5 million plus visitors annually as part of the U.S. National Park Service (NPS).

HURRICANE TAKES A HIT ON HISTORY

In 2012, Hurricane Sandy bombarded the East Coast of the United States and swept over Ellis Island with fierce winds and tidal surges upward of nearly 4.3 metres. Damage was sustained throughout the National Monument, including the already dilapidated Georgian Revival hospital buildings from 1900-1909, the Main Immigration Building and the 1950s park housing. Basements of nearly every structure were flooded.

The historic park housing is now slated for demolition due to the extent of the damage. Basic infrastructure like electric, sewer and phone systems was destroyed while brick pedestrian pathways were ripped up from the ground.

It was a year before the park could reopen to the public.

REALITY CAPTURE FOR REHABILITATION AND INTERPRETATION

The NPS has an on-going preservation project focused on rehabilitating and interpreting the hurricane-damaged hospital buildings and support structures that were once crucial to the daily operation of Ellis Island, yet had been closed for decades to the public during stabilisation efforts of these endangered structures. This multi-year effort, largely funded by Ellis Island (part of the Statue of Liberty National Monument) through its visitor and concession fees, is being carried out by the NPS' Heritage Documentation Program (HDP), which is tasked by the NPS with creating guidelines and standards for the documentation of the United States' architectural, engineering and landscape heritage.

Historically these documents consisted of copy-right-free permanent records, like architectural drawings, photographs and written histories. Today, these traditional archival materials are supplemented with laser scan point clouds, photogrammetric models and virtual tours derived from reality capture technologies. This digital data, according to Dana Lockett, architecture project manager for the HDP, is "extremely useful to the project sponsors and a public that thrives on virtual access."

The NPS has been using Leica Geosystems' laser scanning solutions for reality capture since 2006 as part of the HDP. The terrestrial laser scanning technology is incorporated extensively into the HDP's workflows, and Ellis Island has seen the technology's evolution, having been scanned with a Leica


© NPS

ScanStation II, ScanStation C10, and now the flagship ScanStation P40 over the course of this multi-year effort.

Additionally, by using the external camera kit for the C10 and P40 as part of its reality capture workflow at Ellis Island, the HDP has provided its first online virtual tour to the public. Composed of panoramic photography, embedded with hyperlinked point cloud animations, 3D meshes, and other interpretive multimedia, the tour creates an educational and immersive virtual experience of an otherwise restricted area of the National Monument.

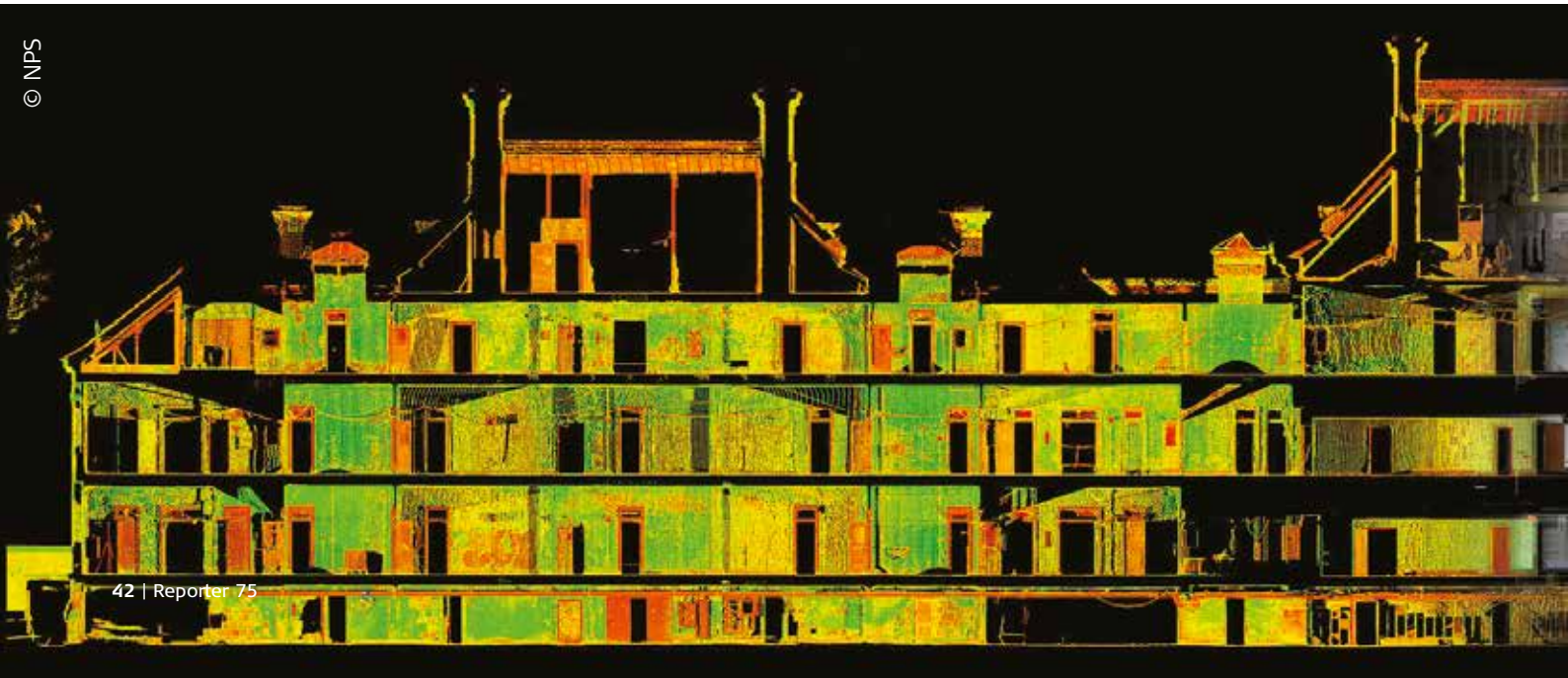
"The evolution of this laser scanning technology has paralled the complexity of the structures surveyed at Ellis Island," said Paul Davidson, Historic American Buildings Survey architect for the HDP. "As that complexity has increased, the Leica Geosystems scanners have risen to meet that challenge in speed, accuracy and efficiency."

FROM FIELD TO OFFICE TO ARCHIVE

The challenges of digitally capturing the three sizeable, interconnected hospital buildings of Ellis Island from the exterior included the structures' irregular footprints; large aged trees in close proximity; inadequate exterior sight lines to rooftops due to a nearby sea wall; and ongoing construction to repair damaged infrastructure from Hurricane Sandy.

The interior spaces' also had challenges, including the hospitals' four floors and complex attics totaling 11,148 metres of complicated, disconnected maze-like corridors and spaces. Adding to the challenge, decades of deterioration needed to be worked around, including collapsed walls, unpassable stairs, and no working lighting despite boarded windows, which lead to an extensive setup of interior lighting rigs being used throughout scanning.

In years past, the 11,148 metres of interior floor space and complex exterior footprint was a daunting scope. The ScanStations' extended target acquisition ranges were pushed to the limits to keep a tight, accurate control network around the large structures while interior efforts focused on major corridors, large spaces and stairwells to build out the key interior spaces and link the floors in the digital point cloud model.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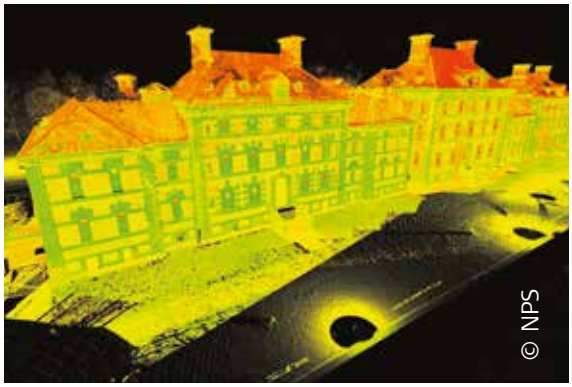
"In the hundreds of surveys I have performed for the NPS, I would deem this the most challenging due to this disjointed nature of interiors and the few access points and sight lines to the exterior," said Davidson.

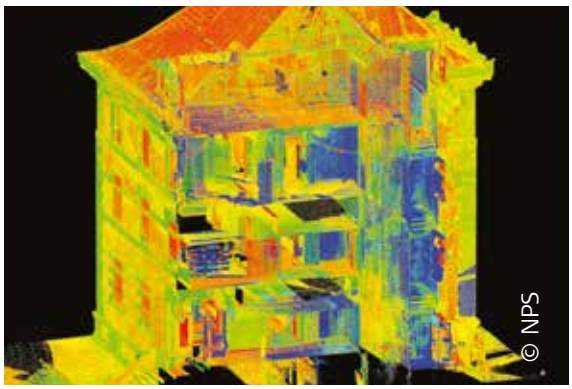
With the newest ScanStation P40 in the HDP's arsenal, blazing fast scanning speeds are providing an opportunity to capture a far greater amount of the 250 interior rooms. Leica Cyclone, the 3D modelling software, continues to be the backbone of data processing for photo-texturing and the registration of years' worth of HDS data, controlled in a survey network.

From Cyclone, in addition to the virtual tours and other interpretive media, the data is migrated to AutoCAD via Leica CloudWorx software in order to create one of the pillars of the HDP - 2D measured architectural drawings of great accuracy and detail. Such drawings were historically created entirely by hand-measurements. Although hand methods are still used by the HDP to create complete parametric 2D drawings by filling in data gaps ("shadows") in the scans (for example, where the details of window frames were blocked by boarding), the laser scans create the baseline of accuracy key to archival records that will guide future rehabilitation or mitigation against possible damage.

Davidson concludes, "It would have been next to impossible to accurately map the interior spaces, let alone the complicated roof lines with traditional survey methods. While creating the final archival drawings and records to be delivered by the HDP, knowing the precise relationship of building components to one another eliminated guesswork and saved valuable time in the field and office, allowing us to focus our energy on the significant and unique detailing of the Hospital Buildings. To me, laser scanning rocks!"

Editor's Note: See the HDP's online virtual tour of Ellis Island at https://www.nps.gov/hdp/exhibits/ellis/Ellis_Index.htm.





HxGN LIVE

Don't miss Dana Lockett present this project and more in Session 9127 Commemorating the 100th Anniversary of the US National Parks Service - HDS at Ellis Island 10:30 a.m. Thursday, 16 June in Covention Centre 204B.

HEXAGON GEOSYSTEMS FEATURE CUSTOMERS

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Imprint

Reporter: Leica Geosystems customer magazine

Published by: Leica Geosystems AG, CH-9435 Heerbrugg

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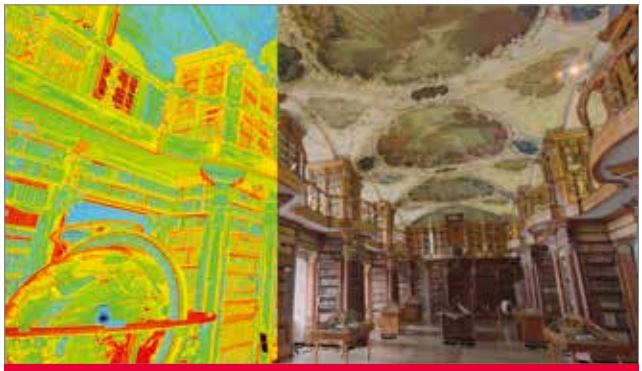
Cover: © NPS

NEWS

LEICA GEOSYSTEMS WINS 2 RED DOT DESIGN AWARDS

The Leica Pegasus:Backpack and the Lino LP41 won the prestigious Red Dot Design Award. With entries from 57 nations and more than 5,200 products being judged, these two Leica Geosystems products stood out above the rest. A 41-expert independent panel judged entries based on innovation, quality, functionality and ecological compatibility.



NEW PARTNERSHIP WITH DOTPRODUCT, SPHERONVR

Leica Cyclone now combines with DotProduct's handheld 3D scanners and SpheronVR's imaging technology to deliver end-to-end integrated workflows. The handheld scanners cap-ture hard-to-reach objects for 3D views. Point clouds can be colourised in Cyclone with the SpheronLite camera.

NEW REFERENCE SERVERS, MONITORING RECEIVER

The latest generation of reference servers and monitoring receiver, optimised with multi-frequency 555 channel capabilities, connect with current and all anticipated GNSS signals. The new Leica GR30 and GR50 reference servers and GM30 monitoring receiver are primed for the constantly changing requirements of GNSS technology.

NEW SMART ANTENNA PROVIDES SUPERIOR PERFORMANCE

Static, long term projects requiring a high number of sensors now have a new affordable smart antenna. The Leica GMX910 enables dynamic monitoring with up to 10 Hz data streaming and advanced multi-frequency, multi-constellation tracking. Start with the basic GPS single frequency receiver and add multiple upgradable options.

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