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Dear Customers and Partners of Leica Geosystems

Leica Geosystems has been part of the Hexagon Group since November 2005. You have surely followed the reports on this acquisition. Let me briefly introduce the new owners of Leica Geosystems to you.

Hexagon is a global Technology Group headquartered in Sweden. We employ a total of 7,500 persons in over 30 countries and operate sales organizations in more than 100 countries. The Group has three divisions: Hexagon Polymers, Hexagon Engineering, and Hexagon Measurement Technologies. Our strategic goal is to be the Number One or Two in the market in all these fields in which high-precision instruments make a vital difference to our customers. We aim to do this on the basis of continuous innovation, cost leadership, and outstanding management.

In the future, Leica Geosystems will form the Hexagon Measurement Technologies division in conjunction with Hexagon Metrology. Together, we are the global leaders in the supply of measurement technologies in the micro- and macro-scale area – a precision range extending from .3 millimeters to 10 meters.

Nothing will change as far as the strategic orientation of Leica Geosystems is concerned. We will continue to offer high-grade data collection sensors based on cutting-edge technology. We also aim to further improve our data processing sensor hardware and software in the future. And we will also further expand our customer services and our network of strategic partnerships and alliances. The goal of this strategy is to ensure that you will continue to be offered the best complete solutions under the “Leica” brand that you can find anywhere in the world.

I take this as an occasion to thank all employees, who over the past decade have transformed Leica Geosystems into one of the most fascinating companies in the field of measuring technologies. They have all succeeded in inspiring customers across the world with enthusiasm for Leica Geosystems products when it came to capturing, analyzing, and presenting spatial information. And you, our valued Customer and Friend, can continue to rely on the Leica brand when accuracy and precision count and you need dependable measurement data – when it has to be right.

Ola Rollén

President Leica Geosystems
President & CEO Hexagon AB
by Hollie Brassington

Dawson Mine in Queensland Australia is a shining example of how a real-time machine production monitoring and integrated fleet management solution can be implemented successfully across a 48 kilometer mine site, assisting decision making and productivity.

Following Dawson Mine’s decision to move from a paper-based data collection system to a new generation of integrated mining systems, Leica Geosystems has recently spent three months rolling out the systems across the mine site.

During the project, various machine automation modules to monitor and control the whole fleet at Dawson Mine were installed. These included three Dragline Monitors, as well as four Drill Navigation Systems, Dozer Guidance Systems, Fleet Monitoring Systems and Leica Geosystems’ new Leica Pit Ops software that integrates all of the machine data into one software package. This allows dispatchers to quickly and easily see the mine operations and make informed decisions maximizing productivity.
mine itself is covered by a radio network to give saturated coverage for GPS corrections and real time data exchange over the mine site.

In the early project planning stage a key decision was taken by Dawson to implement a Dispatch Supervisor role with responsibility for coordinating overall mine logistics, using the new Leica Pit Ops software. Leica Geosystems’ integrated mine management system provides Dawson Mine’s machine operators and site managers with key real-time information for production monitoring.

**Smooth Implementation**

Mr Bruce Robey, Dawson Commercial Manager, said the implementation of the new integrated systems by Leica Geosystems staff has run very smoothly. “The team from Leica Geosystems have been extremely product knowledgeable and have gone out of their way to assist Dawson in making this project a success to date. Leica Geosystems staff made sure each user of the system understood what they needed to do,” he said.

“Automating a mine site can be met with a lot of resistance as has been seen on other mine sites in the past. However, good communication by Dawson management with all staff on site in the lead up to and during the implementation process, combined with Leica Geosystems’ professionalism and attention to detail, has resulted in high operator acceptance and all involved supporting the many positive benefits of the new systems.”

**Working together for productivity gains**

Leica Geosystems’ Vice President Machine Automation Mining, Mr Geoff Baldwin, said Leica Geosystems’ integrated fleet management solution is rapidly becoming known as a one-stop shop for mines to implement real-time operator, dispatcher, and management feedback to drive productivity gains with ease.

“Leica Geosystems is proud to be involved in the Dawson project. We have never seen a better implementation of a fleet monitoring system across a mine site ever. The key has been proper planning and total management commitment,” he said. “Mr John Taylor, Director of Tailored Business Solutions, who consults to Dawson Mine on this project, has played an instrumental role in providing the management and vision required to make it a success from strategic planning through to site communication and installations.”
Mr Taylor said that managing the change process initially at the management level and then identifying key stakeholders and owners of the various system components was key to the project. “When implementing a technology solution, which opens up the opportunity to do business differently, it is essential that there is equal balance given to aligning business process and organisation accountabilities around the new technologies. This integrated approach, supported by Leica, has been a major contributor to the success achieved to date,” Mr Taylor said.

Mr Baldwin said that overall, the entire project has been well orchestrated by John Taylor, Dawson mine and Leica Geosystems’ staff. “It highlights the success that can be achieved on any mine site when we work together for the greater good – productivity gains,” he said.

**Time management critical**

Mr Stuart Brown, Dawson’s Operations Co-ordinator, who has been heavily involved in the implementation of Leica Geosystems’ fleet management systems across the mine, said running a mine is all about doing it safely and efficiently and that means time and resource management is critical.

“Leica’s systems have enabled our staff to better understand what our fleet of machines are doing time wise allowing us to more effectively manage the controllable delays. When you lose productive time on a machine or group of machines, it’s critical to understand why this occurred.”

Mr Brown said the level of information and accuracy that Leica Geosystems’ solutions provide recently helped with an internal project: Anglo Coal Australia was operating to find out the best way to control ‘hot seat’ changes at the start and end of shifts. “Knowing what the actual time loss is and whether it is due to lunch breaks, fuelling, a lack of trucks, or too many trucks made all the difference to finding a successful outcome. Leica Geosystems’ fleet monitoring systems helped provide the feedback needed,” he said.

Mr Brown said access to real-time feedback also allows Dawson to compare its productivity to that of other Anglo Coal mines via the intranet. In this way, productivity can be measured at another level.

“The Dawson Mine project represents an important validation of Leica Geosystems’ direction in machine automation systems as well as a growing presence in the mining industry.”

**Geoff Baldwin, Vice President Machine Automation Mining, Leica Geosystems.**
Superior fleet management
Dawson Dispatcher, Mr Neil Pollard, agreed that real-time operator feedback was making a big difference to productivity management. “From the control room, I can see on screen where our vehicles are on site, delays, breakdowns, hot seat changeovers, and generally how efficiently our site is working. With such credible data we are able to swap trucks around the site to where they are needed or can be better utilised before our on-site supervisors can see the problems in the field. Leica Geosystems’ fleet management system has really opened up our eyes to actual machine utilisation,” he said.

Mr Pollard said being able to see the real-time mine site operations at a glance on screen means numerous people can walk into the control room during the day and share in the accurate information they are receiving. “Leica Geosystems’ software is very easy to use and since the new system was turned on it’s been working well. This combined with the support from Brisbane’s software team and Leica Geosystems’ Field Support Engineer, Bryan Noga on site at Dawson, has been instrumental to the success of the implementation of the Leica systems.”

A bright future
Dawson is one of Australia’s largest coal mines producing seven million tons of coal per year and is currently expanding to meet demand. It is located in Central Queensland and is a joint venture between Anglo Coal Australia and Mitsui Coal Holdings. Dawson’s engineers and production managers expect significant gains in productivity and machine utilisation by trusting Leica Geosystems’ comprehensive mining solution. The large amount of planning and work to date is just the beginning of the project for Dawson. There is still much more to come including more Leica Geosystems software rollouts.

Mr Geoff Baldwin said Dawson is a large change project, enabled by Leica Geosystems’ technology, and is therefore the start of an ongoing relationship between Leica Geosystems and Dawson mine.
Moving the earth...

by Gernot Bilz

I must have looked fairly impressed standing there – in this enormous hole that had been dug into the earth. In front of me a 350-meter-high pit wall, behind me gigantic bucket-wheel excavators, and underneath my feet billions of tons of brown coal. My guide smiled to indicate he understood me and said this view still awed him, too.

The place I was standing is the bottommost level of the Hambach open pit mine operated by RWE Power AG near Cologne. With an annual output of some 40 million metric tons of brown coal, this is one of Germany’s highest-output open-cut mines. 20 percent of

Peter Göllner from RWE Power (center) and Leica Geosystems Support Engineer Heiner Gillessen (left) in front of one of the big bucket-wheel excavators in the open pit mine of Hambach.
the entire annual german production is mined in Ham-
bach. The excavated brown coal is conveyed by the
company’s own railroad directly to the power plants
near the pit mine to be used for power generation.

You need to dig down about 200 meters on this 30
square-kilometer area to reach the coal. Eight huge
bucket-wheel excavators remove about 240,000 cubic
meters of earth a day. The material is conveyed on
apparently endless belts to fill a big hole where they
had mined coal formerly. The only hill within sight is
close to the excavation area, where the story started
in 1978. The dump called Sophienhöhe has turned
green in the meanwhile.

The man giving me all this detailed information is Peter
Göllner, employee from the staff department of the
Hambach open pit mine. He also shows me the prisms
set out on the steep pit embankments surrounding
me. They are used to measure with GeoMoS monitor-
ing software supplied by Leica Geosystems. The moni-
toring and computation of embankment displacements
is crucial to ensure the stability of the open pit mine
embankments. Peter Göllner says that monitoring the
steep embankment is the only way to be able to work
close to it.

In the following interview Peter Göllner explains how
GeoMoS works in the open pit mine of Hambach and
why RWE Power has relied on Leica Geosystems right
from the beginning.

Leica GeoMoS at
RWE Power

Geodetic Monitoring System

Purpose: Detection of relief deformations, continuous
monitoring of pit walls
Installation: 2002
Software: GeoMoS Professional, Server, Analyzer, Remote
Instruments: Leica TCA1201M, Leica TM1100 plus
DI3000, Prisms
Other fields of application: Monitoring of dams,
trenches, rockslides, bridges

Why do you use Leica GeoMoS at the Hambach
open pit mine?

Göllner: GeoMoS is used to automatically monitor the
embankments of the open pit and where it is moving,
in other words: the system computes and monitors
the stability of the embankments. We have set out
prisms which are tracked, measured und monitored
by robotic stations from Leica Geosystems. GeoMoS
allows us to display the measured data graphically and
achieve a qualified assessment very quickly.

How did the cooperation with Leica Geosystems
come about?

Göllner: GeoMoS itself evolved from a cooperation
with Leica Geosystems. It replaced our own software
we had in use since 1982. We have simply learned from
the problems we faced in the past: our employees
have moved on up the career ladder and smaller external
software companies were not as reliable. We needed a
reliable partner who would meet our pretentious re-
quirements in a qualified manner. We expected that
the new system should be comparable with our sys-
tem in functionality plus additional functions. Our aim
has always been having a universal software solution
that could be applied by many people at RWE Power.
Therefore we wanted an open system that is also
suitable for displacement measurements and can be
used with all geodetic instruments and has an open
data-interface. It is exactly what we cherish about
Leica GeoMoS software.

In a nutshell: What are the benefits of
Leica GeoMoS?

Göllner: Depending on specific requirements it can be
used together with many different instruments and is
very easy to use. You get familiar with Leica GeoMoS
very quickly because of its simple workflow. The main
benefit is that we can immediately recall measurement
results. Leica Geosystems provides me with everything
I need: measurement, control und the presentation of
the results – that means the entire workflow required
for monitoring tasks.

The total station is incorporated in a mobile measure-
ment station in the open pit from where it measures
automatically. The system works as an autonomous
unit with its own power supply and a data processing
computer. If the link with the central database server
is interrupted the station continues to measure and
process as a stand alone unit transmitting the data at
a later time.
What exactly does Leica GeoMoS measure on the pit embankments?

**Göllner:** We have set out about 200 prisms with a distance of about two kilometers to the measurement container. We require instruments of high quality and accuracy with special functionalities – the Leica TC1201M total station with its long range is the ideal choice for this application. We measure individual points with an accuracy of less than one centimeter. The system measures continuously and one set of measurements lasts about 30 to 45 minutes. Depending on the visibility and weather conditions we obtain more than one value. By averaging and filtering data in Leica GeoMoS we achieve an accuracy better than five millimeters.

What happens when values deviate from your limits?

**Göllner:** We compare the current distance with the average measurements taken within the last four hours and the past 24 hours. If predefined limits are exceeded, Leica GeoMoS will automatically set off an alarm, prompting us to take a closer look at the situation. The measured distance values on a path-time diagram show us whether the movements are little distortions of the relief caused by excavator operations, or whether the embankment starts to displace.

What hardware and software do you use in these adverse environments?

**Göllner:** We use newest-generation computers. GeoMoS runs under Windows XP. For distance measurements we use a Leica TCA1201M and in a few cases older total stations. However, these are being gradually phased out and replaced by the newest generation of Leica total stations. Remember that the total stations are operating 365 days a year non-stop. But they withstand this tough environment. The data is transmitted by radio from the measurement containers to the central monitoring station. This could also be done via cables or a network.

Do you also profit economically from Leica GeoMoS besides the safety factor?

**Göllner:** As well as – we have the ability to exactly monitor the embankment. We can easily and quickly determine if the preliminary computation of the stability as planned meets the mandatory values of the authorities. The use of Leica GeoMoS results in mining brown coal in a more economical way and more safely. In the seventies coal was mined with traditional techniques that means the embankments had to be inclined less steeper. At the time we applied measurement techniques like intersections and traverses. Now we are in a position to increase the steepness of the lower embankments. This enables us to extract more coal while ensuring the highest safety.

What role does the Leica Geosystems’ Customer Service play?

**Göllner:** We have a long history of working together with Leica Geosystems. This cooperation started before the development of GeoMoS. We can say that the customer service offered by Leica Geosystems’ experts Michael Rutschmann and Heiner Gillessen leaves nothing to be desired. It has always been important to us, for we did not want just any system provider as our partner. What we needed was a renowned company capable of offering us the required support besides hardware and software. We depend on an outstanding customer service. We cannot shut down a measurement container just because an instrument did not return on time from maintenance.
Volcano watching

by Jennifer Forsythe

The Istituto Nazionale Geofisica e Vulcanologia (INGV) is the Italian institute for monitoring volcanic activity. The Italian region is one of the most volcanically active on earth and the INGV is at the forefront of Volcanic Research. Over the past 10 years, volcanologists have realized the benefits of using GPS for gathering continuous, real-time and highly accurate information about the movements before an eruption. In February 2003, the INGV installed Leica Geosystems’ GPS equipment on the highly active volcano of Stromboli.

These instruments enabled Dr. Mario Mattia and his team to track displacements on the volcano in real-time, just before a series of eruptions. Not only was the data useful for ensuring the safety of the island’s inhabitants – for the first time, scientists have data that show the movement of the mountain in the vital minutes leading up to a paroxystic explosion.

The main goal of the INGV’s research is learning more about physical processes that can be considered the root of all volcanic activity. The use of GPS and live wireless links to the volcano opens new possibilities for the scientists. “Our work can be considered as the new deal of volcanology because we are abandoning the concept of the recognition pattern of visual observation and of instrumental data. We have approached the quantitative concept of the knowledge of the physic of the causative process” explains Dr. Mario Mattia, the chief geologist from the INGV.

Living on a “bomb”
Stromboli is a composite volcano, forming the northernmost island of the Aeolian Archipelago and is located between Sicily and the southern part of the Italian mainland. Composite volcanoes are particularly dangerous because of their tendency to erupt in an extremely explosive manner. Although it has been almost permanently active during its history (several chroniclers from the Greek epoch mentioned its con-
constant activity), this tiny island on the Tyrrhenian Sea is also a home to people who live in the two villages of Stromboli and Ginostra.

Despite its unquestionable beauty, Stromboli is a hazardous island on which to live. Not only do its volcanic eruptions pose a risk to the two local villages, they create devastating tsunami waves that can cause severe damage to the Islands and the Italian mainland’s coast. For instance, the eruptions in 1919 and in 1930 killed 10 people and injured dozens. In the last century, ballistic ejecta emitted during explosions destroyed many buildings and fires caused severe damage to crops. However, the people of the region are not alone. They are constantly watched by a group of scientists from the Catania section of the INGV who monitor volcanic activity on Stromboli – Dr. Mario Mattia and his team.

On 28 December 2002, after a 17-year period of moderate activity, the Stromboli volcano suddenly erupted. The pressure of lava created an eruptive fissure from which lava outpoured. Within 30 minutes the lava had reached the sea – almost 1 kilometer away. In the days to follow, two landslides generated a 10 m high tsunami that caused severe destruction on the island and some damage to the Aeolian archipelago and the northern coast of Sicily. Fortunately, these events occurred in winter. It is frightening to imagine the devastation that might have occurred if the tsunami had been unleashed at the height of the tourist season.

Adapting real-time GPS to the volcanic environment

The December events prompted the INGV decision to set up a GPS network aimed at real-time monitoring of the volcano’s movements. The scientists used Leica SR530 receivers, equipped with the Leica AT 502 and Leica AT 504 antennas. There are a multitude of challenges associated with the continuous operation of a real-time GPS system in any harsh environment. Of prime importance is the safety of personnel. Apart from the obvious danger of volcanic activity, the ideal location for the GPS reference station was far too hot for scientists to remain long enough to carry out a conventional installation. Once installed, the GPS is vulnerable to volcanic activity itself.

Although Leica Geosystems’ instruments are built to the highest environmental specifications, the INGV built a re-inforced concrete structure to protect the system against volcanic activity such as debris flung from the volcano and the extreme heat. A very important aspect of the structure was that it was self-installing. To facilitate this, the INGV used the services of a military helicopter to ensure rapid and safe installation. Another
challenge was power supply. The instruments are powered with energy from solar panels, which reduces the power consumption. “Installing a new station is always a difficult task. However we have a lot of experience in this field. In particular, during the 2002 crisis on Stromboli we designed a new type of ‘self-installing’ station, dedicated to areas impossible or dangerous to reach. In order to minimize the risk we used military helicopters for logistical support to drop concrete cages with GPS” says Dr. Mario Mattia.

The highly accurate position data is sent from GPS receivers through a radio-bridge to San Vincenzo Observatory in the village of Stromboli where information is collected and archived. This system provides scientists with fast real-time data that enables an early warning to be given to the population of large regions of Southern Italy potentially affected by large-scale tsunami.

One reference station was finally destroyed by lava flow on February 15th 2003. The other two instruments continued to provide valuable data until they were also destroyed on the 5th April 2003. When the reference station was destroyed, there was concern that the volcano would trigger another major landslide – a major threat to the island’s inhabitants. However, the data recorded by the GPS allowed scientists to determine that the movements were not consistent with those which would trigger a landslide. As a result of the data, the cost and distress of a major evacuation was avoided. The experience gained is of great scientific importance. Scientists studying physical processes of volcanic eruptions now have access to high precision, real-time data showing the movement that occurs right up to the moment a violent eruption.

Automatic measurements of slope stability with total stations

At the same time, Leica Geosystems’ total stations were used to monitor prisms strategically located on the volcano’s slopes. The instrument chosen was a Leica Geosystems TCA 2003 total station equipped with Leica GeoMos software. The new system was called THEODOROS, which is an acronym for THEODolite and Robot Observatory of Stromboli. The system measures 17 strategically located reflectors 48 times per day. The properties of prisms allow scientists to take measurements in even more extreme environments. As with conventional monitoring, it is very important to have a range of technology to suit different tasks.

Future directions

Current surveying technology allows scientists to perform real-time, detailed monitoring of ground deformation. The achievable accuracies in 3D positioning are suitable for both scientific and early warning purposes. The strategy that was implemented on Stromboli allows Civil Protection Authorities to appropriately manage the volcanic crisis, warn and evacuate population endangered directly by the volcano and by the imminent tsunami wave. The INGV is installing another GPS system to continue the valuable research and monitoring service.

The INGV and Dr. Mario Matta

The INGV was born in 2000 as a merger of several Italian institutes whose activities were related to geophysics and volcanology. In particular, the Catania section of INGV is the result of a fusion between two different institutes: the IV (International Institute for Vulcanology) and the Sistema Poseidon. Alfred Rittman, one of the most important volcanologists of the past century, founded the IV in 1969. In 1999 the monitoring activities of IV were separated in another institution, called Sistema Poseidon, but this institution lasted only 2 years before the birth of the INGV. Dr. Mario Mattia is a geologist and has worked on volcanoes since 1995, when he was involved in the installation of the first GPS permanent station in Vulcano Island (Aeolian Islands, Italy). He has developed software and technological solutions for GPS permanent stations on volcanoes from the beginning of his professional career. He is responsible for all of the GPS stations on Sicilian volcanoes and is a member of the INGV committee that is implementing the national Italian GPS network. He has published more than 20 articles in national and international reviews of geophysics and volcanology.
IBEREF links up Spain

by William Martella and Javier Peñafiel

On the first of July 2003, IBEREF, the independent permanent reference stations network in Spain began its operation. It is designed and operated by the Spanish Engineering and Systems team of Leica Geosystems and many Surveying and Mapping firms and public organizations.

IBEREF was created with the aim to offer a non-existent service to Spaniard users: a common GPS stations network. Since IBEREF was launched and for the first time in Spain, any user is able to receive real-time corrections and downloading data of every station from a single web page: www.IBEREF-GPS.com.

The first steps

It was in 1997 when the first System 300 reference station was set up in Guipúzcoa. That would be the first of 18 reference stations distributed all over Spain, being part of the IBEREF project. In that time, users working on surveying tasks had to set up their own GPS reference station to obtain differential corrections. Obtaining a connection to the Internet was not very easy and accessing these data in the web was something unusual.

With the aim to offer an additional service to their customers, Aticsa, Leica Geosystems dealer in Extremadura, installed a reference station in Badajoz and later, Lógica Equipamientos Integrales, dealer in Galicia, installed another one in La Coruña. But this time, the service had an added value: Logica set up the first GPS reference station in Spain transmitting differential corrections using radio modem and GSM technology simultaneously. Following this operating model, in 2003 there were 6 GPS permanent reference stations covering the Spanish territory.

In that moment, the Engineering and Systems team of Leica Geosystems established the basis to create a new service for the Spanish Surveying community and its costumers: IBEREF, a common platform. The next step was contacting with recognized companies and Universities in Spain to promote this project: the idea was enthusiastically supported by most of them. On the first of July 2003, IBEREF web page, containing every reference station, started its operation and became a common objective for every project collaborator.

Leica Geosystems Technology

The next step was incorporating to the project the highest possible number of reference stations and giving a better coverage to certain areas of special interest to create local networks. In this way, it would be possible to generate real-time and homogeneous corrections all over the area. Nevertheless, there was a problem to be solved: how to connect remotely these stations, considering that there would be hundreds of kilometers between them and the control center. The
The project has three phases:
1) Searching for collaborators and setting up permanent reference stations in those areas where it is necessary to offer a local or global service
2) Transmitting differential corrections from every reference station via internet
3) Establishing local RTK networks to transmit corrections using the RTCM 3.0 standard

Until now, the first two phases are taking place simultaneously, and every new station that joins to the project is managed through an IP protocol and sends the corrections in the same way.

Due to the number of stations and its location, Madrid is the only area where the establishment of local RTK networks has already begun. In fact, since September 2005 it is possible to obtain these network corrections in Madrid and its surroundings. As a consequence, every user working in this zone with a GPS is able to obtain highly accurate differential network corrections on the rover, irrespectively of his position inside the network. The first local network in Madrid is called IBEREF-net.

control center was established in Leica Geosystems offices at Madrid, using Leica GPS Spider software to control all of the receivers via the Internet. Considering that formerly, every remote control communication was realized via modem, Leica Geosystems technical staff in Spain successfully solved the communication challenges. By the first time, the Internet was used for these tasks.

One of the objectives of this project is offering the most advanced service, that’s why Leica Geosystems was the first organization in Spain transmitting differential corrections via Internet, considering that it will be the most popular means for surveying data transmission. Using System 1200 instruments and cellular telephones (with a cable or wireless-using Bluetooth technology), Spaniard users will be able to access the Internet.

Successful collaboration bears fruit (from left): Javier Peñafiel (Leica Geosystems Spain), Francisco Sanchez (Junta de Andalucia), and Manuel Berrocoso (Universidad de Cadiz)

«IBEREF-GPS has greatly simplified road construction.»
Professor Andrés Seco, Universidad Pública de Navarra
Support from Sponsors and Collaborators
Since the beginning, one of the main objectives was to find and contact with firms and organizations, preferably Universities, due to their technical background and resources that could support the project. These organizations would lead locally the project and they could become the future local network managers. The first proposal to participate with IBEREF was made to the Universidad Politécnica de Madrid. As it was accepted enthusiastically, this University has become the project leader in Madrid, managing the data from other members of the GPS network in the Spanish capital. Similar agreements were made later with Universidad de Jaén, Universidad Pública de Navarra, Universidad Politécnica de Barcelona, Universidad Politécnica de Huesca and Universidad de Extremadura. Thanks to this project, all of them found new research lines about the GPS differential applications. Also, this project gave the possibility to make practical use of these researches, establishing a public service for all Surveying and Mapping users.

Using one single rover and avoiding setting up a field reference station, this project helps the collaborating firm to increase its productivity level, reducing considerably the operating costs. José Manuel García, Alcor Topógrafos Managing Director and IBEREF collaborator declares: “As almost 90% of our projects take place in Madrid, where there is a local network, we can reach centimeter accuracy in this area, the investment in a Leica Geosystems reference station and participating in this project is paid for itself.”

Andrés Seco, Surveying professor at the Universidad Pública de Navarra and Designing engineer says: “Working with IBEREF support is essential for every GPS user who requires high accuracy. This project makes our job easier saving time and costs and increasing the security... when you leave the GPS reference equipment in a place while you are working, there is always the risk that you won’t find it when you come back.” And he adds: “The funniest thing is when I go to the field with my GPS and the non-users of this platform ask me where I placed my fixed reference. My answer is at 50 km away... obviously they don’t believe me and they think I’m kidding, but they ignore it’s true and that IBEREF is my fixed reference. I even tell them to look for the fixed GPS if they don’t believe me.”

Professor Seco is convinced that saving time is another advantage. “In a 15 km highway, surveyors have to set up the fixed reference in different points along the highway. With the permanent availability of the IBEREF network, that effort is not necessary anymore.”

The Project and its Future
It is interesting analyzing IBEREF web page statistics: Since its launch, it has been accessed almost 14,000 times. Every week, between 160 and 200 user contacts are registered, and this number is assumed to increase the next months: 1431 pages will be visited, with an average of 780 accesses. These results show the success of this project.

Moreover, real-time corrections of all stations are available for the user via Internet. It is only necessary having a GPRS connection to receive them.
“Guided by VMT” – This quality hallmark now distinguishes 400 tunnel construction projects the world over. VMT GmbH Gesellschaft für Vermessungstechnik, a company headquartered in the Southern German town of Bruchsal, has been developing highly successful navigation systems for tunnel drilling machines since 1994. Total stations from Leica Geosystems supply the exact measurement values for this purpose – under the most exacting of conditions, as general manager Manfred Messing explains.

What exactly does VMT do?
Messing: We produce navigation systems for tunnel drilling machines. These control systems indicate the position of the tunnel drilling machine relative to the target axis. On the basis of this position information, the machine operator can see whether he is drifting away from the target axis so he can correct his course. At present, 81 jumbo machines and 20 small systems are in service around the world using total stations from Leica Geosystems.

What do you mean by small systems?
Messing: Micro Tunneling for us starts at 800 millimeters’ nominal width, in which the entire set of instruments has to be incorporated. Fortunately, this is done by servomotors today, that is: automatically. The tunnelling method applied is a reiterative process. Tubes are lowered into the shaft, and a main press drives them forward together with the drilling machine. In this way, tunnels with a length of up to two kilometers are driven into the underground. This is anything but easy!

How do you control tube driving in this process?
Messing: This is extremely complex, since the entire surveying network is in constant motion. In other words, these hard-to-control tube driving movements are continuously sensed in six degrees of freedom, measured, and converted to obtain the accurate position. We are very proud of having refined and automated this sophisticated process.

Does this process also work with large tunnels?
Messing: Unlike the tube driving process, larger machines use the segmental lining process. Here, the drill head with a diameter of about 12 meters is driven forward some 2.5 meters per cycle. Depending on the rock, this takes between twenty minutes and two hours. Then individual segments – the tubbings – are brought right to the rear of the machine inside the tunnel, where they are assembled to the shape of a ring. Once this has been accomplished, the machine detaches itself from the ring and continues to drill. In the meanwhile, the next ring segments are brought in.

What role does your navigation system play here?
Messing: The control cab of the drilling machine is equipped with a display screen. It shows the machine operator the position of the machine relative to the target axis, whether the deviation in height is one or three centimeters, and in which direction the machine is going. To be able to display this position, signals are transmitted from the total station permanently installed in the rear of the tunnel, from the target unit mounted in the front of the machine, from inclinometers showing the inclination or rolling of the machine, from the machine itself and its orientation relative to reference targets. All this data is converted by the computing unit and displayed in an easy-to-understand way to the operator.
What makes your navigation system so unique?

**Messing:** No doubt its accuracy of one to two centimeters, and this under the extreme vibrations and poor visibility prevailing inside the tunnel. And its availability: During tunneling, our control system shows the machine operator the current position almost in real time. Today, with daily capacities exceeding 50 meters and diameters of 12 meters and more, a machine operator must really know at all times the position to ensure he will not move this behemoth of a tunnel drilling machine to the wrong direction.

What exactly is the function of the Leica Geosystems total stations as part of your system?

**Messing:** Take the Gotthard base tunnel in Switzerland as an example: There, we have fixed total stations mounted on the wall in areas where stresses are not so high. They continuously survey stations in heavily stressed areas – where drilling is being done and where the total stations travel along with the tunneling system. During drilling breaks – that is, in brief two-minute intervals – the fixed station is able to detect and survey the total station on the tunneling system. This surveying of the forward total stations by the fixed rear total station is repeated about 23,000 times, and there you have the Gotthard tunnel finished!

Which total stations from Leica Geosystems are used in such adverse environments?

**Messing:** The instruments mounted on the excavation machines are exposed to extreme stresses. They are expected to withstand vapors, air, shotcrete, cement, oil, all kinds of chemicals, and heavy shocks. Our experiences with the current Leica TPS1200 total station as a carrier unit have been excellent so far in terms of ruggedness. Across the world, a several hundred Leica total stations are in service. Last year alone, we supplied 40 systems. And with such strain to stand up to, Leica Geosystems total stations prove their quality.

“*The outstanding global service and support offered by Leica Geosystems is crucial for us in the field of tunnel construction.*”

Manfred Messing, VMT
Leica Geosystems Machine Automation improves pavement construction all around the world. The Australian Civil Contractor Baulderstone Hornibrook Pty Ltd, is contracted by the NSW Roads and Traffic Authority (RTA) to upgrade of the Pacific Highway at Nabiac on Australia’s east coast.

The road construction project involves the realignment and construction of a 10 kilometer section of the Pacific highway to a two lane dual carriageway, with bridge construction and associated local roadworks. The pavement layers for this contract include stabilized select material underlying Plain Concrete (PCP), Continuously Reinforced Concrete (CRCP) and Steel Fibre Reinforced Concrete (SFCP).

Baulderstone Hornibrook Pty Ltd have installed Leica Geosystems’ LMGS-S 3D Machine Control systems on their Gomaco 9500 trimmer, Wirtgen SP1600 and Wirtgen SP500 concrete slipform pavers. Construction Manager Steven Glover said “The utilization of the Leica Geosystems’ control systems has dramatically improved our management and performance of pavement placement whilst maintaining the RTA’s strict tolerance requirements.”

Placement of the underlying stabilized select layer is normally a very machine and labour intensive process, involving site surveyors to set out trimming stakes, compaction equipment, motor graders and a trimming stringline crew of 2 to 3 men. Due to the stabilization of this material layer time restrictions must normally be factored into the select placement as the motor graders must have the material trimmed before curing is completed when final cutting by the grader is very difficult. “Having the Leica LMGS-S 3D system on the Gomaco trimmer has removed the need for surveyors to stake-out and stringline trim crew”, Steven said. The management and cost of the select placement is dramatically improved. Now the paving engineer receives

“No strings attached”

by Graham Wirth
the road design data on a flash card and manages the setup and progressive movement of the total station position location alone, a truly one man operation. The system’s total station is also used for spot-checks of the trimmed surface as the operation progresses and minor height adjustments can be carried out on-the-fly.

Following the select layer two concrete layers are placed. Firstly, a 150 millimeter layer of 5Mpa lean mix concrete is used, which for this project has a volume of approximately 34000 cubic meters. Over this layer is placed the Plain concrete Base (PCB), which is 38000 cubic meters at 250 millimeters thick, and the continuously reinforced concrete base (CRCP) at 220 millimeters thick. The benefits of precision 3D machine control are simple to realize – the management of these layer thicknesses are extremely important and saving even a few millimeters over the length of the project can potentially save Baulderstone Hornibrook large sums of money in concrete. The Leica LMGS-S guidance system is a true “Plug and Pave” installation onto both the Gomaco and Wirtgen machinery.

Its functionality is as follows: The ruggedized Leica MPC4 machine PC is mounted to the Wirtgen SP paver and connected to the pavers SPS controller. The 3D design data of the project is uploaded into the MPC4. The total stations are setup, orientated and coordinated within the project grid. After the instruments and design data is set and loaded, the machine is brought into the picture. The total stations are then locked on to the two prisms mounted on either side of the paver using Leica Geosystems ATR technology.

The total stations, via radio link, send real-time coordinates of the prism positions back to the MPC4 machine PC. The paver’s coordinate position information is then constantly updated with the design model throughout this process. As the machine moves, the total stations continuously track its position at a rate of up to eight times per second. In milliseconds, the Leica MPC4 takes the real-time coordinate data and compares it to the design and then controls both steering and elevation of all tracks of the paver.
Leica LMGS-S system has several unique advantages. Its D45 model data is a simple ASCII format that can be extracted from most CAD systems, and can accommodate radii or superelevations automatically according to the design model data.

The Leica LMGS-S system on Baulderstone Hornibrooks Wirtgen SP series slipform pavers has improved the management, performance and safety of their concrete pavement placement process. “The savings are obvious”, said Steven Glover. “Our surveyors would traditionally spend many hours placing pegs and stakes in preparation for concrete paving, with the risk of these being damaged prior to the days paving due to the large traffic flow of trucks feeding concrete to the paver. It is not always evident if they have been knocked. With stringless paving this risk is eliminated and the design surface levels are directly regulated by the machine, under command of the Leica 3D system. We would previously have employed two men to install and maintain stringlines for paving and these positions are no longer necessary”, Steven said. And so the savings continue to mount.

The Nabiac project is being built with the existing two lane Pacific Highway snaking through the construction site. This makes the logistics of the traditional stringline control method for the trimmer and concrete pavers very restrictive and a constant safety hazard. Steven Glover believes the ability to supply the paving train with concrete and materials without the logistics headache associated with stringlines has improved their supply cycles and highway traffic safety whilst paving.

In closing, Baulderstone Hornibrook believes the resultant pavement product is fantastic, with Leica LMGS-S delivering a superior ride quality to this important infrastructure project. Site management of the pavement process has improved and the Leica LMGS-S Guidance systems installed on the trimmer and concrete pavers has given them an industry advantage.
Small size, big marvel

by Petra Ammann

“The new-generation Leica DISTO™ is so small, it even fits into my breast pocket. Customers love it!” Klaus Brammertz, head of the Measuring Tools Division of Leica Geosystems, is enthusiastic about the success of his new laser distance measurement instruments. And indeed: The models Leica DISTO™ A3 and A5 clearly set new standards in terms of handiness and ease of use.

Almost as small as a cell phone and just as easy to use – these are the main features of the basic model Leica DISTO™ A3. Direct keys for addition and subtraction and for computing surface areas and volumes make measurements child’s play. New functions include minimum and maximum measurements. They are indispensable especially in performing horizontal measurements without a tripod or for marking out distances. Using the “smallest of all” turns measurement tasks into pure pleasure.

The new Power Range Technology™ even allows measurements to be performed up to 80 meters’ distance without using any traverse target. With a target, up to 100 meters and with the Leica DISTO™ A5 even 200 meters are possible. The Leica DISTO™ A3 measures distances to an accuracy of ± 3 millimeters at the push of a button and within a matter of seconds. Its built-in bubble tube and its compact design enable the instrument to be applied also as a spirit level. This allows easy alignment of objects such as power sockets. Moreover, it is no longer necessary to immediately note every measurement result. The memory displays the 20 most recent results and related information such as surface areas or references.

The measure of all things: Leica DISTO™ A5

Most usable functions, precise results up to 200 meters distance, and a cool design, the Leica DISTO™ A5 has been a hit since its rollout. What professionals appreciate particularly are its practical features: The most frequent computing functions such as volume or wall and ceiling areas can quickly and easily be called up through direct keys.

The unique multifunctional end piece can be swung out, and the built-in sensor automatically detects the correct reference. This makes stable measurements from edges or corners easier than ever before. The integrated telescope searcher has an optical magnification of 2, making the Leica DISTO™ A5 a reliable partner for extended measurement distances up to 200 meters with a traverse target. In combination with its indirect height and width measurement feature, it is the ideal choice for performing outdoor measurements.
Leica Geosystems: take over of FieldDesigner, Canada

Leica Geosystems took over the Canadian software company FieldDesigner Inc., Montreal. FieldDesigner provides CAD-based software solutions for field data acquisition in a broad array of market segments ranging from surveying to engineering and construction to architecture.

“The acquisition and visualization of GIS and survey data directly in the field will become more and more important as will providing an integrated logical and physical data flow from the field into the office. Delivering intelligence into the field will help improve productivity throughout the value chain,” said Clement Woon, president of the Geosystems division. “Leica Geosystems already offers its MobileMatriX software as a field solution for GIS users and surveyors based on the ArcGIS platform. The CAD-based FieldDesigner product range will complement and enhance our mobile solutions offering.”

Leica Geosystems is setting up a GPS network in An-Hui Province, China for atmospheric research

Leica Geosystems successfully achieved a tender award from An-Hui Meteorological Bureau on 8th November 2005 to setup a data centre and several GPS meteorological stations covering the whole province area.

The purpose of this project is to establish a real-time continuously operating GPS/PWV data analysis system for monitoring ionosphere, improving research on water vapor variation in atmosphere and also its inter-relationship with the climatic changes in China. Thus, the system will able to improve the reliability of weather forecasting and enhance the capability of disaster prevention in the province.

The system will contain 10 units of newly purchased Leica GRX1200 Pro GPS receivers, antennas, existing data communication infrastructure, various automatic meteorological sensors and Leica GPS Spider software package for automatic data measurement, collection, management and also analysis. The network operator is also able to monitor the operation performance and modify operational setting of those GPS reference stations remotely.
Leica Builder: Built to Build
The Leica Builder is specially designed to meet the needs of building experts. Robust, it withstands weather and dirt, it is easy to transport and most of all, extremely easy-to-use – features that save a lot of time in the field. No matter if a quick stake-out is required or plumbing, measurements, angle or slope determinations or the combination of laser distance and angle measurements, saving and calling up measured data or construction information: the three models of the Leica Builder have the right construction site solution in store for you.

Detailed tunnel documentation and analysis with the new Leica TMS Tunnelscan
TMS Tunnelscan is the new system module for tunnel scanning within the Leica TMS product family. TMS Tunnelscan combines its software with the high-performance of the Leica HDS4500 imaging scanner. This forms the most powerful system solution available in the surveying market for tunnel as-built documentation and analysis. The system provides highly reliable information – from tunnel excavation, through completion of excavation support, to lining acceptance check and tunnel commissioning. Thus the tunnel contractor, the client as well as the designer and not least the surveyor profits from the Leica TMS Tunnelscan.