

SURVEYORS

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TO CREATE A NETWORK OF POSSIBILITIES



Van Harten surveyors rely on a speedy, accurate and highly advanced survey toolbox that includes robotic total stations and a regional reference station network.

Beginning in 1967, Van Harten Surveying (VHS) built a reputation in the City of Guelph, Ontario, Canada and surrounding communities for its ability to complete a wide range of engineering and surveying activities with speed and accuracy. The company's list of clients eventually grew to include builders, developers, lawyers, universities, utilities and government agencies.

Yet, after 30 years of successful local operation, VHS opted to toss out its conventional survey practices in favor of more advanced, automated, albeit more expensive, survey technology.

The company saw an opportunity to reshape its survey practices, perform activities with greater efficiency and expand its business opportunities to a much greater market by investing in GPS and robotic technology, as well as all the peripheral systems that had begun to emerge with these advancements.

The investment has had a remarkable impact on company growth. Over the last decade, VHS has doubled its annual revenues and grown into a regional survey firm that serves the continually growing communities of Southern Ontario that extends to the residential, commercial and industrial centers of Toronto and the Golden Horseshoe—all with about same size survey staff. Along with this shift to technology, VHS has also contributed to a unique GPS reference station network that has helped advance GPS use for surveyors throughout the entire region.

>> By Vicki Speed

The Last of Steel Tapes

Through the late 1990s, VHS, like many survey firms in the area, still used conventional survey equipment such as steel tapes, first generation total stations and conventional theodolites to handle topographic, boundary, property surveys, site plans and stakeouts. Yet, company owners and its progressive staff of surveyors kept a close eye on advancements, testing new equipment as the opportunities arose.

Ron Mak is the managing partner at VHS's Orangeville office. He specializes in GPS and conventional control surveys and adjustments as well as GIS applications, and is in charge of equipment management. Says Mak, "At the time, we ran between five and seven two-man crews and could just handle the available work within about a 100-kilometer radius of our main office in Guelph. RTK GPS had just begun to emerge as a viable and affordable investment, offering good accuracy and speed. We had already begun to rent and test some of the new GPS-driven devices that were moving into the market."

As the surveyors became more comfortable with GPS, they began to see greater opportunities for business well beyond the local community. Unfortunately, the excitement over new GPS technology, as well as total stations and robots, created some chaos.

"In particular, we underestimated the learning curve associated with different total stations," recalls Mak.

Over the years, VHS bought survey equipment based largely on price and advice of a dealer, with minimal crew input. Soon, the company found itself with four different kinds of equipment, and all kinds of management problems. Each piece of equipment was good at certain things, but not everything; and each staff person could only operate specific pieces of equipment that they had become familiar with on certain jobs.

"At times, it was as if VHS contained four small, independent groups each with their own specialty. Communication between the groups was difficult and the situation drove me crazy!" Mak says. "If a surveyor was sick, then data from a particular job had to be processed and converted before another surveyor could continue the project. It was impossible to manage and limited our overall company growth potential. We knew it was time we invested in our own equipment and standardized our toolbox."



With the reference station network providing local control, a Van Harten surveyor has the ability to conduct surveys, stakeouts or other survey tasks quickly and easily using a fully-integrated GPS and total station system.

System Selection

As the equipment manager, Mak opted to go through a comprehensive technology selection process. He called major survey equipment suppliers in the area and asked them to let the company test out their best GPS units for a month. The result was VHS bought two Leica 530 GPS units with PDL radios.

Mak explains, "A key reason for going with this particular vendor was the ready availability of support. Great equipment is pretty useless if there is a glitch that you can't figure out."

A year later, VHS went through the same technology evaluation exercise with robotic total stations, ulti-

mately selecting the Leica Geosystems TCRA1101 Plus with reflectorless distance measuring technology. The crews were particularly excited about the passive tracking technology built into the robotic total stations which eliminated the need for power at the prism, thus making life at the pole much easier. They also like the total station's Power Search feature for its ability to consistently and quickly find a prism after a loss of lock.

Not long after, the firm upgraded to a TPS1200 robotic total station system, a fully integrated GPS and TPS solution. All TPS1200 series total stations—robotic or manual—have SmartStation capability.

VHS' RX1250T series controllers can also seamlessly switch between robotic total functionality to GNSS rover functionality with one keystroke.

Mak says, "Our two-person crews became one person 'crews' with the ability to conduct surveys, stakeouts or other survey tasks quickly and easily, in part due to the ability to switch between RTK and total station measurements as required. I initially thought the ability to alternate between GPS and robotic modes with a keystroke was cool, though not really all that big a benefit in terms of day-to-day activities. I've since learned better."

VHS has two crews that use the SmartPole on a regular basis. They've completely abandoned traditional methods of setting control points and traversing through a site.

Station coordinates are usually established by resection between multiple GPS observations. Often times, neither the station nor GPS points have physical points in the ground (e.g., nails or bars). Points under tree cover are measured with TPS, buildings and many other features are measured reflectorlessly, and everything else is done with GPS. Even when working on more traditional sites with control points, the situation would often occur when points were disturbed or obstructions made a line of sight between station and backsite impossible.

Mak says, "With the SmartPole, a backsite could be established anywhere. When high accuracy control points are required on the site, it is easy to take redundant observations with GPS and TPS which are later checked and adjusted with a least squares adjustment."

Building a Network

VHS's opportunity to further extend its reach throughout the area came in 2005 when Leica Geosystems began implementing the Southern Ontario SmartNet reference station network.

First implemented in 2005, the Leica SmartNet Southern Ontario network now consists of 10 GNSS reference stations spaced 30-70 kilometers apart in and around the greater Toronto area, with a total of 50 GNSS reference stations in southern Ontario. VHS was one of Leica's first partners in SmartNet. Initially, VHS installed a SmartNet reference in its Orangeville office. Shortly thereafter, VHS procured a location in Listowel, which ultimately acted as the catalyst for full reference station coverage in and around the greater Kitchener/Waterloo area. Not



At least one Van Harten survey crew has completely abandoned traditional methods of setting control points and traversing a site, relying instead on a pole-based GPS and TPS system.

long after, Mak procured yet another reference station location for SmartNet in Guelph, completing the network coverage from Toronto to Kitchener/Waterloo.

The SmartNet network is available 24 hours a day, 7 days a week with broadcast correction service available to most network-ready RTK receivers. The network is enabled by Leica Geosystems, which provides corrections at the centimeter level in RTK mode or sub-meter DGPS and with raw data for post-processing. Data from each of the reference stations is received over the Internet at a highly secure location in Toronto where it is processed using Leica SpiderNet network calculation software, and made available to users when they log in or as 1-second RINEX data from a FTP download site. Currently

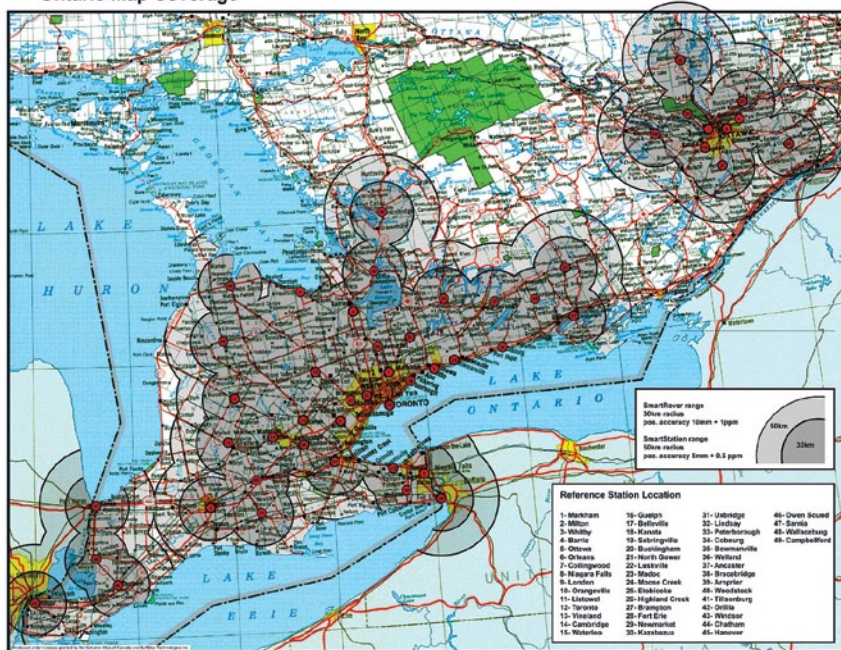
there are from 60 to 100 users on the network at any given time.

"The reference station network is all about convenience and consistency," says Mak. "Our surveyors no longer have to set up a local reference station. They get to a spot and start gathering points, using the SmartNet network as the base reference. We're also increasing the accuracy of our surveys over large and multiple sites."

VHS is often called in by developers to survey large 300-plus acre properties designated for multiple subdivisions. Using conventional survey techniques, the surveyors would have to put in reference stations to initiate and create a local coordinate system for each subdivision. Normal small measurement errors were propagated into large discrepancies when linking these large sites together.

Leica SmartNet
Commercial GNSS RTK Network

Ontario Map Coverage



SpiderNet - Network RTK services

GNSS RTK correction information from and range of reference stations

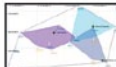
- Best reliability
- Fastest rover initializations
- Consistent high accuracy
- Higher productivity

Master Auxiliary Network corrections



RTCM V3.0 Standard for full Network RTK correction

Automatic cell selection



SmartStation



SmartPole



SmartRover



- when it has to be right



local coordinate system. With SmartNet, we're all working to the same universal coordinate system which has, in turn, opened new doors of opportunity."

Beyond Boundaries

With its technology edge, VHS is now working with municipalities and local government agencies to update and manage parcel maps. Many of the region's parcel maps are out of date or built on legacy systems that were not accurate to begin with.

For example, the City of Guelph often combines parcel data with orthoimagery to better manage public and private property boundaries. Unfortunately, the parcel data gathered over many years using a variety of local coordinate systems is not as accurate as the imagery. The positions are often shifted by as much as 10 meters in some spots.

"Fortunately, our work with GPS, robotic technology and the SmartNet reference station network has provided us a fairly good database of positions and even as-built building surveys in and around the city to a centimeter accuracy," says Mak.

As well, local contractors and engineering companies are looking to VHS technological expertise to facilitate infrastructure and public works projects. Project owners often require surveys in the UTM coordinate system and many engineers have no idea how to do this, especially on long routes where traditional methods are woefully inadequate.

Using UTM allows VHS to integrate into the larger GIS communities and easily incorporate digital copies of zoning maps, flood plain maps, provincial mapping products, etc. The firm already has an existing database of the 40,000 surveys (available at www.landsurveyrecords.com) it has completed and is planning to georeference these surveys using publicly available base data—making it much easier for the public to find old surveys.

Mak concludes, "We're so technologically advanced compared to some other companies in Southern Ontario. Many are coming to us to perform surveys because we can do it faster, cheaper and more accurately. Thanks in large part to technology, we've positioned ourselves as a valued business partner throughout the region."

Vicki Speed is a freelance writer based in Denver, Colorado.

The Leica SmartNet Southern Ontario network, which includes a total of 50 GNSS reference stations in southern Ontario, is available to surveyors and engineers 24/7 with broadcast correction service to most RTK receivers.

Mak explains, "These are small errors when viewed on a site-by-site basis. But, when we combine all the data together into a single map, the errors are multiplied considerably. SmartNet eliminated that problem for us. With the network, we're able to standardize all surveys into the UTM coordinate system and realize extraordinary benefits in terms of accuracy and consistency."

With GPS and the SmartNet reference station network, VHS surveyors can consistently tie projects into real world WGS84 coordinates and constrain their total station work with GPS control. The next move was to start doing all of their work in the UTM coordinate system, the adopted coordinate system for Ontario.

"The TPS1200 total station's ability to automatically manage scale factors

for every setup, collect all data in UTM and still allow a user to perform calculations in ground units (even in imperial) without having to worry about scale factors is huge," explains Mak. "Combine this with the ease of moving seamlessly between GPS and TPS and the whole process works like magic with centimeter accuracy."

Another significant advantage of working in UTM was that VHS surveyors could easily overlay surveys onto orthoimagery which is available either for free or at a low cost.

Mak says, "Many of our standard surveys now go out with high resolution imagery which the clients love and find a significant value in. In terms of consistency, we have even greater advantage. It used to be that every project had its own