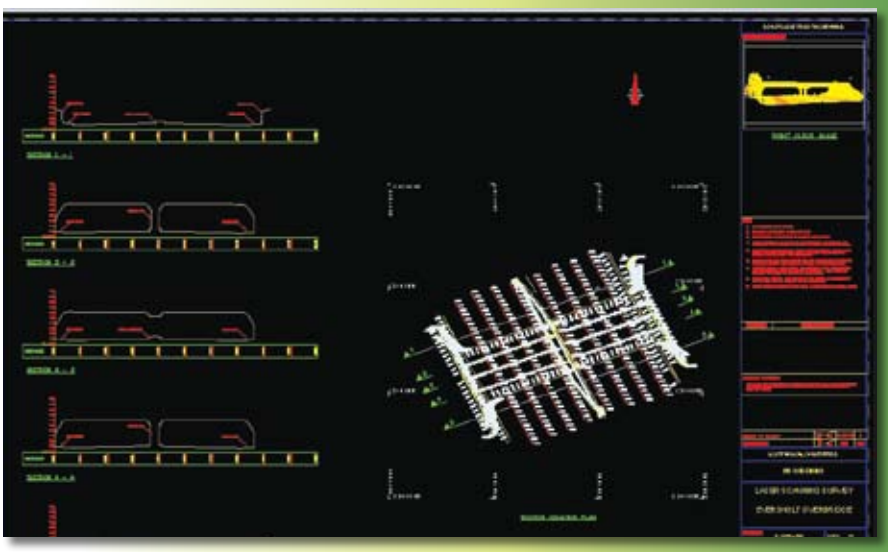
Getting Easier ..... Part 3: In the office, continued

Parts one and two of this three-part series described hardware and software advances that have made laser scanning much easier in the field and office. Part three completes the topic by covering advances in primary user interfaces for office software.



▲ This bridge survey deliverable was created from scan data using the latest point cloud software with a CAD-like interface and advanced automation. Office time to create it was 30 percent less than doing the project conventionally. The CAD tech used on-screen instructions to learn the software—*image courtesy: Scott Wilson Group plc.*

"Point Cloud" Plug-ins for CAD

The first big, "easier-to-learn" advance in laser scanning software's primary user interface was the 2000-time-frame development of affordable "point cloud" plug-ins for AutoCAD, MicroStation, and other CAD applications. The plug-in exposes scan points in the CAD display, without actually loading them into a CAD file. Scan points are only loaded into a CAD file when a user selects, acts on, or processes specific scan points. Compared to trying to directly load/import large scan data sets in CAD applications, point cloud plug-ins have allowed users to work more efficiently with these same data sets within their familiar CAD interface.

Generally, for point cloud plug-ins today, the number of "point cloud specific" tools in the CAD plug-in is far fewer than the number available in standalone point cloud processing software. There have also been CAD-related limitations in the quality of 3D visualization and in the speed of displaying large scan data sets when navigating through point clouds with point cloud plug-ins.

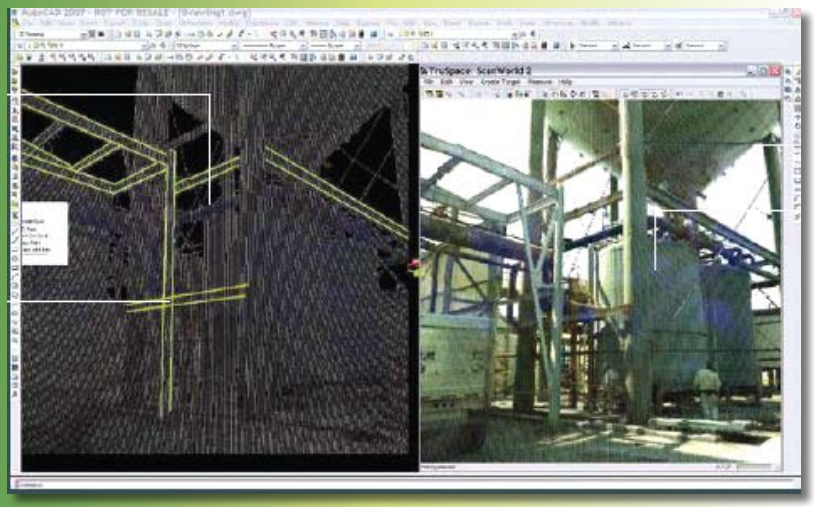
Despite these limitations, plug-ins can sharply reduce training time for working with point clouds. For example, basic training classes for high-end, standalone point cloud processing software typically run three to four days and may not even cover all features and workflows. Training time for a CAD user on a point cloud plug-in typically takes four hours. Many commands for working with scan data, such as measuring distances and creating linework, are CAD commands that the user likely already knows.

Point cloud plug-ins have made it easy to compare final map deliverables against raw point cloud data in CAD as a QA check. They're also popular for creating 2D building drawings and in plant retrofit design. Here, designers use raw as-built, laser scan data directly within 3D plant design software to check proposed retrofit designs for possible interferences with existing structures. In many cases, this process of using raw scan data eliminates an intermediate step of converting laser scan data into an as-built CAD model. The raw scan data is also generally more complete and realistic than an as-built model.

As beneficial as point cloud plug-ins have been, standalone point cloud software remains equally popular. As noted above, 3D display, manipulation, and viewing have not been as powerful in the CAD environment as they have been with standalone point cloud software, especially for large scan data sets. These shortcomings lead to extra office time. Two advances in CAD plug-in applications have helped address these shortcomings.

One approach uses pictures overlaid on point cloud data within the CAD application. Pictures provide an intuitive interface for users, especially for creating linework. Although using pictures within CAD as an interface can be very friendly, users also have to act very careful here. Depending on the quality and density of the underlying point cloud data and the accuracy of the alignment of the picture with the scan data, relying on picture overlays for creating deliverables can lead to inaccuracies in the extracted results. To date, this accuracy issue has limited the popularity of this approach among surveyors and other measurement professionals.

A second, very recent advance is the introduction of advanced CAD plug-ins with a separate full-dome, panoramic viewing window. Panoramic viewing not only provides friendlier viewing than via a traditional CAD interface, but it can also let the user rotate and maneuver scan data in CAD much faster than using a traditional point cloud plug-in.



▲ Advances in point cloud plug-ins include a separate panoramic viewing window, for faster, easier viewing of laser scans within CAD.

Standalone Software

With data collector emulation interface

One of the most well-received advances in standalone point cloud software for surveyors was the 2002/2003 introduction of a data collector interface as part of the overall office software interface. This is also known as a "virtual surveyor" interface.

Within a virtual surveyor interface, an office user can view and select specific scan points, code them, attach attributes, etc. from a feature code library just like a rod person uses a field data collector to code and identify points surveyed conventionally. Once scan points are selected and coded, the tagged points and associated codes can be exported into standard mapping software for creating final client deliverables. Users can import existing feature code libraries into their point cloud software and/or create new ones as needed.

Conceptually, this approach brought the field collection of survey points into the office, where a CAD tech could virtually walk the site (much faster and often more safely than a rod person would be able to get to these same points) and code/identify scan points … without ever having visited the site!

With this approach and with all "individual scan point"-based office software approaches, a user is relying on individual scan points rather than averaging or modeling a large number of scan points. This then requires that each individual scan point have sufficient accuracy to meet project requirements; hence, users who want to take advantage of this approach need to make sure that their scanner provides the required accuracy for each scan point.

Application-specific interface

Some standalone point cloud software packages are "application specific." These have a limited number of features, so their simplicity can make them relatively easy to learn. Terminology and the look and feel of the primary interface for these application-specific packages are also often familiar to someone who works in that specific industry. Today, such standalone point cloud software exists for mining, for forensics, for topographic surveying, for industrial plant, and for architectural projects.

One obvious drawback is that they are not as versatile as the more feature-rich, multi-application packages. Another drawback is that users who want to pursue different types of applications have to buy multiple packages, learn multiple user interfaces, and get office support from different software vendors. However, if users are focused heavily on a specific application and if standalone point cloud software is available for that application, then application-specific packages can be viable options.

Emulation of survey CAD interface

Many readers have seen 3D perspective views of point clouds that are very eye-catching. These are cool to look at, but such 3D views are not common to standard survey mapping software. Instead, an interface is now available that has a familiar plan view as the large screen, supplemented by a familiar section view, elevation view, and, if desired, a 3D perspective view … all of the same scan area. This multi-view environment is very familiar to CAD mapping techs.

The primary interface also provides step-by-step, on-screen instructions for doing each key task, e.g. selecting a scan point for inclusion in the topographic map. Within this framework, users apply a virtual surveyor approach for creating maps.

When a user clicks on a point in plan view, that point is also automatically identified in the section view and in any other view that is displayed on the monitor. This provides the user with greater confidence that the points he/she is working on are the right points for the task at hand.

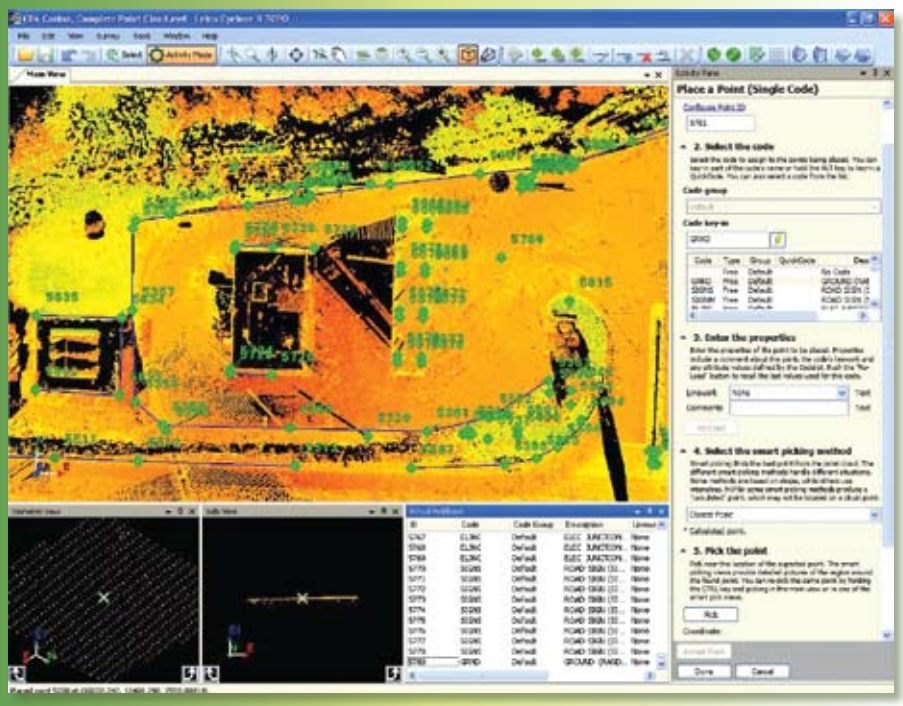
Two Users: Case Study Examples

The following two case study project examples are from two different survey users with some of the newest type of point cloud software. In particular, the point cloud software emulates a friendly survey CAD interface, includes step-by-step, on-screen instructions, and features advanced automation. The two users have reported and compared office aspects associated with this latest point cloud software against office aspects based on doing the same project conventionally.

User example #1: site survey

Glahe & Associates (*www.glaheinc.com*) reported highly positive results on a large topographic survey of an Indian casino site in the summer of 2008 for a potential expansion.

Based on site logistics, fieldwork included laser scanning, RTK, and total station use. Had the project been done 100 percent conventionally, it would have taken a month in the field with a one-person RTK crew plus a two-person total station crew (480 man-hours). Using a scanner where they could, they cut total field labor by more than 40 percent



▲ Standalone point cloud software with an interface that emulates survey CAD software and includes on-screen guidance enables organizations to use mapping techs with no prior experience in processing laser scanning survey data.

Case study for survey of nineteen bridges

	With scanner + new point cloud software (actual)	With scanner + virtual surveyor approach (est.)	With 100% conventional survey + standard software (est.)
Field labor	38 man-days	38 man-days days	120-180 man-days
Office labor	19 man-days	38 man-days	30 man-days
Total labor	57 man-days	76 man-days	150-210 man-days

◀ Standalone point cloud software with advanced automation helped the The Scott Wilson Group reduce their office costs for a laser scanning survey of 19 bridges—*Data courtesy: Scott Wilson Group plc.*

to 280 man-hours. The scanner gathered about two-thirds of the data points actually used in preparation of final deliverables.

On the office side, project manager Eron Singleton was faced with a demanding project schedule. Previously, Eron had done all point cloud processing himself. This time, however, the schedule didn't allow for it. He needed help, so he added a CAD tech to the project to help with point cloud data processing … even though the CAD tech had never previously worked with point cloud data. Eron believed that with the new point cloud processing software, he could get the tech fully productive with minimal training. He turned out to be right.

Singleton trained the office CAD tech on the new software in two hours. Singleton was also available to answer questions "over the cubicle wall" as Singleton also processed scan data. The CAD tech spent one week on the project, extracting about a quarter of all of the survey points used for the deliverables. Singleton and his colleagues completed the entire topographic survey project on schedule. Total office hours (using scan, RTK, and total station data and creating final deliverables in AutoCAD) were the same as they would have been had the project been done 100 percent conventionally.

In this case, the new software saved the company a week of schedule and gave the company the flexibility to use standard CAD mapping staff who had never previously worked with point cloud data. Overall for the project, high-definition surveying saved the company 40 percent in field labor hours and had no impact on total office labor hours.

User example #2: nineteen bridges

The spatial solutions and surveys department of the Scott Wilson Group (*www.scottwilson.com*) used this latest type of software for a laser scan topographic survey of nineteen bridges.

Each bridge area to be surveyed was approximately 27,000 sq. ft. Deliverables included a plan map, five cross-sections, and 3D linework. Actual office time to go from point clouds to final deliverables with the latest software for point clouds was eight hours per bridge. This was quicker even than the estimate to convert traditional survey data into final deliverables (12 hours per bridge) and half the time of the data collector emulation/virtual surveyor approach (16 hours per bridge).

In addition to saving 25 to 50 percent of office labor on the project, another interesting aspect was training. The office professional who used the new software was an experienced point cloud software user. However, he did the 19-bridge project using the newest software with no training on it at all—he used only the on-screen, step-by-step guidance.

Thanks to continuing innovation, laser scanners and point cloud processing software have become significantly easier to learn and use. Today, some of the newest point cloud software requires little to no training. This reduces investment costs and gives organizations more flexibility in deploying standard CAD techs to create deliverables from high-definition survey data.

In addition to advances that have made point cloud software easier to learn and use, office productivity using point cloud software has become very competitive with office productivity based on conventional surveying for many projects.

Geoff Jacobs *is senior vice president, strategic marketing for Leica Geosystems, HDS, Inc.*