Many professionals quickly associate laser scanning with creating as-builds for use by engineers or designers. However, scanning is used successfully in all stages of an asset’s lifecycle, not just at the “retrofit design stage.” This article, the third in a mini-series that describes the use of scanning in other stages of an asset’s lifecycle, covers uses in the Asset Management (or Maintenance & Operations) stage.

Overview: Bright Upside

The use of high-definition surveying for Asset Management is potentially its largest use. After all, for every one construction project, many more assets are in regular use without any construction in progress or without any construction planned for the near term.

High-definition surveying is currently used in a wide variety of Asset Management applications. Although these applications don’t comprise the majority of scanning usage today, much dialog and activities are underway that paint a bright upside in this area. For some Asset Management applications, such as calculating pile volumes, scanning has often proven to be more cost-effective than traditional survey methods. In addition to potential cost savings, two features of scanning that draw the most interest for the future in Asset Management are (1) its completeness and (2) its potential for creating 3D computer models of assets.

Today’s uses include:

• Quantity surveys for ongoing operations
• Documentation for an asset’s sale, lease or licensing
• Condition monitoring & assessment
• Tank calibration
• Spatial information support for maintenance personnel

• Regulatory compliance
• Personnel training
• “Replacement in kind”
• Forensics

In addition to these current applications, there are some very interesting emerging Asset Management applications for scanning. These include:

• GIS
• Building Information Models (BIM)
• “Intelligent plant models”

Getting the Terminology Straight

Surveying and other measurement professionals are familiar with the term “Asset Management” or “AM.” In facilities circles, professionals talk about “Facilities Management” or “FM.” In the world of manufacturing or other processing plants, the terminology that’s most commonly used is “Operations & Maintenance” or “O&M.” For the purposes of this article, they all refer to the same thing, i.e. activities that are devoted to the ongoing operations, maintenance, and use of the asset.

Current Uses

Virtually all of the current applications of high-definition surveying for Asset Management take advantage of the completeness of the survey data. This completeness translates into better quality information that has value at the time the information is used by Asset Management professionals. Here’s a quick review of today’s more common Asset Management applications for scanning:

Quantity surveys for ongoing operations—Whether it’s a pile of rock at a mine/quarry, a pile of ash at a power plant, a pile of wood chips at a mill, or a pile of coke from an oil refinery’s coker unit, laser scanning has quickly become an everyday tool for
this challenging task. Scanning is not only faster and more cost-effective, but it yields more accurate calculations and it’s safer than methods that rely on occupying points on the pile itself. In this regard, scanning has replaced conventional methods for many of these surveys. It has also replaced the method of “counting truck loads” and, for relatively small areas, it has also replaced aerial surveying.

**Documentation for an asset’s sale, lease or licensing**—American surveyors know this application as an ALTA or title survey, but the theme is generic regardless of the type of asset or the geographic location. In downtown areas, in particular, with zero setback lines and with structures that extend outward from multi-story buildings, scanning has proven to be a highly cost-effective and safe means of establishing accurate 2D plan drawings to support title documentation.

The use of scanning is not limited to legal documentation of residential or commercial buildings. It has also been used for industrial plants that are changing ownership and for public utilities that either change ownership or have to go through re-licensing in order to retain operating permits. For example, cell towers are subject to fairly frequent changes of ownership and scanning is a good means of accurately capturing and documenting all of the objects on them. Facility GIS Inc. (www.facilitygis.com) is a good example of a company that...
3Dscanning applies high-definition surveying regularly for cell towers audits.

**Condition monitoring & assessment**—High-definition surveys are typically well-suited to the task of periodic monitoring or condition assessment, provided that the site is not too large (e.g., <20 acre site) or too heavily vegetated. Two scanning features stand out here: the completeness of a high-definition survey and the ability to monitor the site or structure remotely. Often, the desire to monitor a site or structure is triggered by a concern that the site or structure may become unsafe. Scanning’s remote data capture capability delivers a good safety benefit. Scanning’s completeness can provide valuable additional data that increases the client’s confidence in the final condition assessment.

Scanning is not only used to accurately monitor “Mother Nature,” e.g., landslides and terrain erosion, but it’s also used to monitor man-made structures. When a small bulge is first detected in a large diameter cylindrical tank, scanning can be used to assess the condition of the tank to help ensure that there is no imminent safety risk. Process plants have also used scanning to monitor corrosion and to analyze the geometry of piping and equipment that is subject to vast temperature swings during its operation. In this case, the piping/equipment is scanned “cold” and then scanned again “hot.” The resulting geometries are fed into a stress analysis software to assess the capabilities of the large bore piping/equipment to continue to operate safely.

**Tank calibration**—Large liquid storage tanks require periodic calibration, as sensors within the tanks, along with calibrated geometry data, are used as the basis of calculating liquid quantities delivered from the tanks or deposited into the tanks. Laser scanning has been used for this application for many years, as the completeness of the data can provide more accurate volumetric results. A key for this application is that only the most accurate laser scanners are suited to this task, as accuracy requirements are usually quite stringent.

**Spatial information support for maintenance personnel**—At a January 2006 plant industry conference, a representative from BP’s Texas City refinery (which owns a high-accuracy laser scanning system) described an interesting, emerging practice. Plant maintenance and operations staff have started to come to BP’s Laser Scanning Services department to see if the department already had geometric information for particular areas of interest. Plant maintenance and operations staff are aware when the scanner is out collecting data in various areas of the plant. If they think that a certain area has been scanned for as-builts in support of an upcoming retrofit project, they check first with the laser scanning services department to see if the specific data they need is also available. This is a great example of how high-definition survey data can be used to serve multiple disciplines within an organization.

BP is especially keen on the use of laser scanning from a safety standpoint. Not only does scanning minimize safety risk during the initial collection of data, but by being able to re-use data that’s already been collected, plant management is able to avoid sending staff out into the plant altogether for additional trips.

**Regulatory and departmental compliance**—Scanning services projects have helped asset owners meet regulatory agency and departmental compliance requirements. One project, for example, involved a chemical plant. The plant owner was required to provide location and geometry information for arrays of exhaust stacks on a set of several manufacturing buildings. The plant owner learned about the need for this specific information on fairly short notice in the context of “…if you don’t comply, then you will be required to shut down your plant.” The time frame for collecting the information and documenting it was very short. Laser scanning was deemed to be the only viable way to meet the schedule.

In another case, a process plant had an explosion at a remote loading
facilities. Whenever there is an incident like this, the Owner/Operator’s Safety Department requests all documentation for the facility. In this case, the facility was not properly documented to Safety Department Compliance Standards, so the plant owner contracted a laser scanning service firm, S&C Technologies (www.sclaserscanning.com), to create an as-built 3D model of the plant.

**Personnel training**—High-definition surveys are used as the basis for creating 3D models of complex assets, such as plants, to aid in personnel training. Training can be in the operation of the asset (e.g., plant itself, but more often it is used as an aid in training personnel for disaster or emergency response, including evacuation. Increasingly, 3D animations are being used for this purpose, just as they are in commercial airline passenger safety videos.

**“Replacement in kind”**—In contrast to retrofit projects that involve adding new structures or modifying existing structures, many standard maintenance projects simply involve replacing an existing component or structure with a replica, as the original structure wears out, develops leaks, corrodes, or whatever. Depending on the geometry of the original structure and the relative ease of being able to remove it, laser scanning has been called on to accurately capture the geometry of the structure and surrounding elements to support such projects.

**Forensics**—Most forensic surveys are conducted in response to incidents that happen during the operation and use of an asset. High-definition surveys offer many advantages for forensic surveys, including their accuracy and completeness, the ability to collect data without disturbing the scene, and the ability to capture lots of data quickly. For reference, a feature article in the November 2005 issue of Professional Surveyor Magazine covers this topic in detail.

**Emerging Asset Management Applications**

In addition to the above current applications, there are newly emerging applications of laser scanning for Asset Management that are also of interest. Here’s a brief synopsis of some of these.

- **GIS**
- **Building Information Models (BIM)**
- **“Intelligent plant models”**

**GIS**

GIS applications of scanning are limited to date, but the future is quite bright. One current GIS application that covers large geographic areas is the use of scanning to quickly and accurately measure road/overpass clearances (vertical and horizontal). This information is used as input for computerized truck route planning.

GIS maps have historically consisted of flat, 2D images tied to databases of relevant information for specific map features. There has been much discussion of enhancing these maps with more detailed, 3D information, such as that captured by laser scanning. One of the first implementations of this may be in car navigation systems. Instead of viewing a flat map with “Dining” or “Gasoline” service icons, imagine being able to see a 3D view of the actual buildings and landmarks that are in front of you as you drive. Volkswagen of America, in conjunction with Google and nVidia, has already announced a prototype of this capability at the 2006 International Consumer Electronics Show (CES). Noting, “…it’s 3-dimensional and more real looking than anything that’s available today,” they say that “driver and passenger will be able to instinctively recognize where they are in relation to the surrounding topography, especially in urban areas that are depicted with depth and accurate size relationships between buildings and roads.”

It’s easy to imagine other GIS applications that involve clicking on a GIS map symbol and pulling up a laser scan with unprecedented 3D detail and accurate geometry.

**A Word About Scanning Accuracy for GIS**

As surveyors well know, GIS applications generally require less accurate geometry than engineering surveying applications. Surveyors know what happens next: clients’ requirements tend toward higher accuracy over time. In the case of laser scanning, it is my observation that the “re-use” justification for collecting high-definition survey data is significantly strengthened when the scan data can also be used for future engineering purposes. This is evident in the emerging use of laser scan data for plant Asset Management and can be expected to continue for other applications. So, while low-accuracy scan data is suitable for city models today, it can be expected that survey grade accuracy will be an important requirement in the future.

**Building Information Models—BIM**

Architectural design software has progressed over time to not only support 3D design, but to also add other valuable information about objects within the building. Such computer models can be used for Asset Management of the building. Leading CAD vendors, including Autodesk and Bentley, have been heavily touting this “next generation” capability to facility managers as they place the spotlight on successful users of BIM.

The application of high-definition surveying for this emerging market is obvious. What better way to capture the complex geometry of a complete building than to scan it? Scans form the basis of a 3D geometric model that is then populated with appropriate feature and attribute information to identify sprinkler heads, piping, HVAC components, safety ladders, etc. One of the drivers for BIM is for the increasing need to effectively address security planning for buildings.

**“Intelligent Plant Models”**

This is basically the same thing as BIM, but for plants. Designers of industrial plants were some of the first professionals to latch onto 3D computer design in the 1980s. 3D design reduced physical clashes during construction that had often been associated with complex new plant designs. By eliminating these clashes, 3D design cut several percent from a plant’s total installed cost. These 3D software design applications also...
include details on components, such as piping thickness and classifications, details on pump specifications, etc. to the extent that detailed “intelligent plant models” can spit out a comprehensive parts list that enables procurement staff to buy everything needed to build the plant.

Over the last several years there has been considerable discussion in the plant information technology (IT) community about the potential merits of Operations and Maintenance staff “re-using” these 3D intelligent plant design models. Visionaries have encouraged this design information re-use but the financial folks and Operations managers have hesitated. One reason for the hesitation has been concern over the cost of keeping these 3D models up-to-date as the plant is modified over time. Scanning, however, has quickly overcome this concern.

**The Ball is Rolling Downhill**—Recent comments from leaders in the plant Operations and Maintenance area have revealed that the huge success of laser scanning for plant as-builts has helped to start rolling this ball downhill. One plant design and documentation manager recently told conference attendees that her goal was to “eventually scan and model the entire existing plant in support of maintenance, operations, and future engineering needs.” She had learned from past experience that the lack of accurate plant documentation had created significant problems. As a consequence, even though a specific retrofit project may require only a 70 horizontal field-of-view scan, she instructs the crew to capture “everything” in a full field-of-view scan. This is done on the basis that the incremental cost of scanning a full field-of-view (vs. a 70 horizontal FOV) is minimal, whereas the information collected will be invaluable for subsequent needs.

Separate input from a director of a leading laser scanning service provider revealed that his company had recently landed a very large scanning and modeling services contract with an oil & gas company for a single large facility. What was most interesting about this services award was that the scanning project was funded by both the Engineering Department and the Operations Department. The company’s Operations managers wanted an up-to-date, intelligent 3D model of the plant to use for ongoing operations and maintenance needs.

**Summary**

Although high-definition surveys are used for a variety of Asset Management applications today for civil, building, and industrial plant assets, this area represents a huge upside potential for the technology as service costs continue to come down and as Asset Management professionals increasingly appreciate the benefits of the technology in meeting their needs.

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