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16 TIPS

to Enhance the Speed and Quality of Your Next Industrial Scanning & Modeling Project

Industrial plants may be the most challenging spaces for 3D scanning and modeling service providers to work. Not only are the spaghetti-like pipe runs and sagging conduits difficult to document precisely, the crowded and sometimes hazardous spaces in which they are located can test the ingenuity of even the most experienced reality-capture professional.

Regardless, documenting the as-built condition of a power plant, factory or water treatment facility in 3D is a necessity in today's digital world where the engineering of upgrades, expansions and restorations is accomplished with CAD software. Complicating this issue is the fact that so much infrastructure was built prior to the digital age. The best documents available (if they *are* available) are often 2D paper design plans that may or may not reflect as-built reality.

For the 3D reality-capture firm, the challenges of an industrial scanning and modeling project can squeeze from two directions. Internally, the service provider must adhere to a strict timetable to ensure the assignment is profitable. That usually means getting the field work completed, processing the point cloud data and delivering the 3D models as fast as possible. Unforeseen delays and site revisits can destroy profit margins.

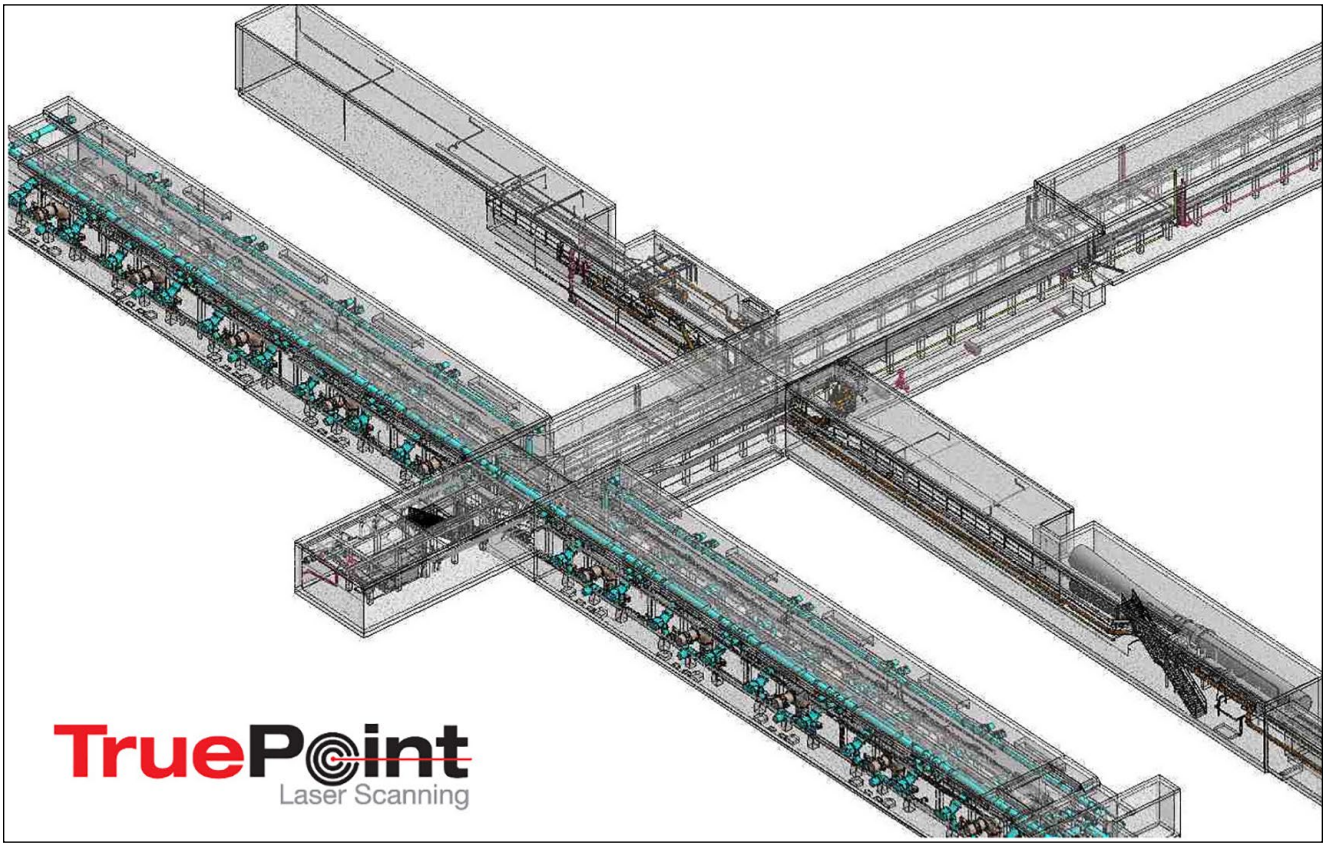
There are external pressures too. The service provider must be aware of the risks a scanning project poses to the owner or operator of the facility in question. Industrial plants have profit margins that typically depend on minimized downtime. The plant operator is just as eager to see the onsite work completed quickly and the 3D models built with accuracy and precision.

With speed and accuracy in mind, ClearEdge3D, a Virginia-based developer of the EdgeWise automated extraction and modeling software, asked several industry veterans for their recommendations on best practices and workflow tips that will keep everyone happy during an industrial plant as-built documentation project. You can download a free copy of ClearEdge3D's new report *33 Expert Tips, Tactics & Best Practices for As-Built BIM Project Success* here: https://goo.gl/38QtKw

Below are 16 ideas offered from Ryan Hacker, of TruePoint Laser Scanning in Toledo, Ohio, Rodney Lemonds and Jon Garner of Wadelynn Geospatial in Raleigh, North Carolina, based on their experiences with recent projects. Hacker offered his insights just after completing a 3D as-built project at a Toledo water treatment plant, and Garner made his comments in the wake of a successful scanning and modeling project at a coal-fired power plant in North Carolina.

BY KEVIN CORBLEY

Ryan Hacker of TruePoint Laser Scanning says, "The sooner you scan, the more value it provides."



TruePoint created an as-built BIM model of a water treatment plant be used for on-going operations and renovations.

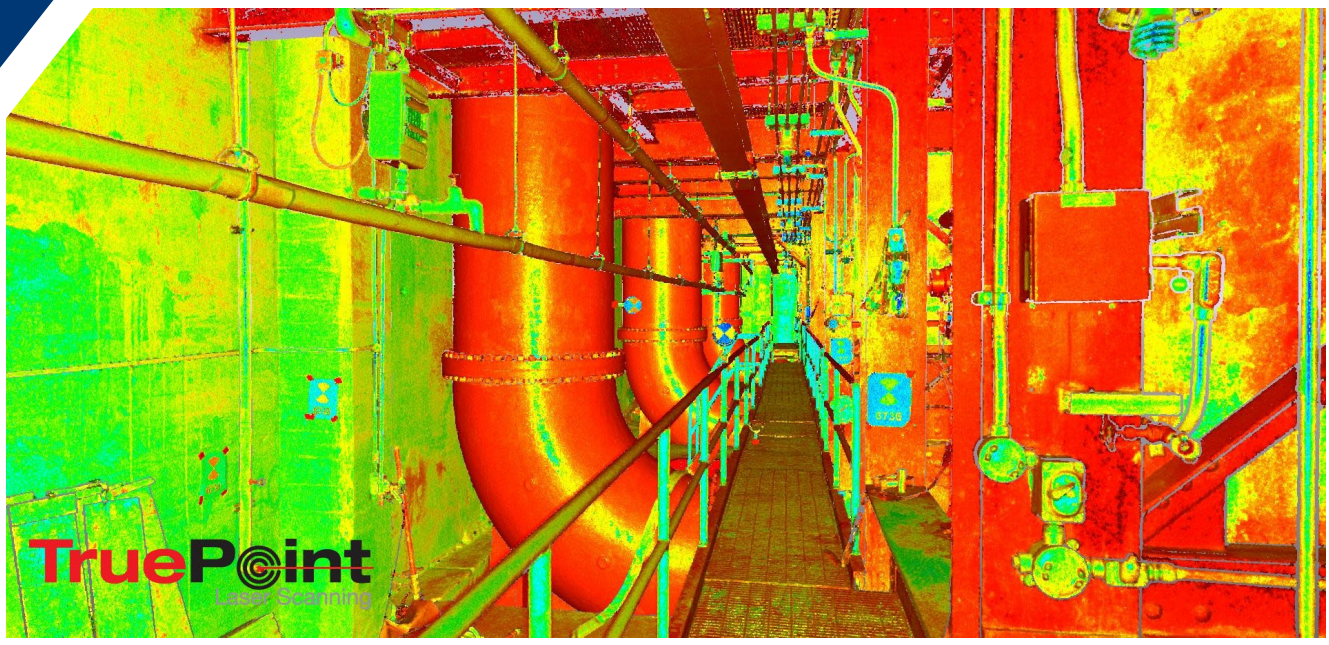
Eight Tips for Efficient Field Collection

1. **Scan early in the design/bid process**—The 3D scanning and modeling work that will be needed during the engineering and design of a planned expansion or upgrade should occur before the RFP is released to the bidding AEC contractors. And the as-built model should be included in the bid package. The contractors will bid much more accurately, which means they are more likely to complete the project on budget, on schedule and with minimal construction delays that may cause downtime at the plant.

   "The sooner you scan, the more value it provides," said Ryan Hacker.
2. **Get any 2D documents that exist**—Sure, they might be old, out of date and made of paper, but any existing plans are better than none. At the very least, these will help identify major systems in the facility so individual pipes and conduits can be identified quickly and assigned accurately to their correct families during the modeling phase.

   "Any drawings are a starting point," said Hacker.
3. **Tie the scans to survey control**—This may take slightly longer and add to the cost but will pay off in many ways. All contractors on the project will be working off a common coordinate system, making cooperation much easier. And when additional plant upgrades are planned in the future, new scans, models and construction elements will tie seamlessly into the same survey grid.

   "Use the local coordinate system—some older plants may have an established system that will require traditional survey to tie into," said Rodney Lemonds.
4. **Plan the timing and position of scans in advance**—Don't wait for the entire crew to be onsite to



TruePoint provided 3D laser scanning for a sewerage pumping station, capturing all structure, MEP and piping down to ½" diameter.

plan the scanning phase. Visit to find out when each section of the plant is safest and most accessible to scanning. Spaces will probably be cramped, so use this time to pinpoint scanner locations that will maximize line of site. If equipment must be shut down to allow for scanning, schedule with the operator as far in advance as possible.

5. **Take all your laser scanners**—Some industrial facilities have wide open spaces where a long-range scanner is most effective, but many others have small spaces with poor line of sight. They will require short-range scanners. And some plants have tight spaces between and behind large pieces of equipment that must be scanned by hand. Many will present all three environments. Bring all your lasers to the job site, and buy or rent specialty scanners that you don't already have.

   "We use FARO, Leica and Riegl scanners," said Lemonds, "and we pick the right scanner for each job."
6. **Remember that steam and vibration are your enemy**—Steam deflects laser beams, and surface vibrations under the scanner create noise in the point cloud. Unfortunately, both are common in industrial plants. During your advance visit, note where either will be a problem and plan accordingly. Shock-absorbing tripods are now available as laser mounts to reduce effects of vibration.
7. **Get to know targeting**—You're going to need every type. To establish survey control, paper targets can be taped to walls, and magnetic ones can be attached to pipes and ducts. You may even consider hanging a target with a boom down into a trench or other area that's simply too hazardous for a person to enter.
8. **Cover every angle**—Planning scanner positions is important because you can't afford to find shadows in your point cloud after you have left the site. Capture more scans than you need and make sure every area of the facility is scanned from multiple angles and directions. Scan as much of the facility as you can.

Eight Ideas to Streamline Point Cloud Processing Workflows

1. **Be ready for huge files**—Point clouds are extremely large files. Perform registration in the pre-processing software provided with your scanner, such as FARO Scene or Leica Cyclone, and then export as .PTG files, which are smaller than

other formats. Don't waste time and disk space by storing files locally on your workstations. Keep the data on removeable media, such as external drives, that can easily be swapped from one machine to another.

"Eliminate transfer time between modelers. Just unplug the drive and take it to the next guy," said Hacker.

2. **Use automated extraction and modeling**—Hacker and Garner have both enhanced their modeling workflows to use the ClearEdge3D EdgeWise software for automated extraction of pipes, conduits and steel infrastructure elements, such as I-beams, from the registered point clouds. The software identifies features, measures them and builds the 3D model with minimal manual interaction. Depending on point cloud quality, 75 percent of features are extracted automatically, paying off with significant time savings.

   "Automated extraction reduced overall modeling time by 60 percent in a recent power plant project," said Garner

3. **Take advantage of QA/QC tools**—Many older industrial plants have non-standard parts, especially flanges and valves, which are not identified by the automated extraction tools. EdgeWise speeds the process by offering a library of non-standard parts that can be used to select or customize plant features that are not manufactured today. Extracting and modeling these features can be accomplished with the software's editing tools. The same tool can be used to ensure pipe runs are connected correctly and the multiple point clouds are registered properly.

4. **Model section by section**—Modeling an entire point cloud for a large plant may be impossible due to limitations in compute power. Divide the data set into sections, based on discrete areas of the facility if possible, and then model each section completely before moving onto the next.

   "Don't leave things undone when you model a section; otherwise you'll forget about it and have to backtrack later, which tends to take longer," said Garner.

5. **Layer pipes into systems**—Take the time to assign pipes to their appropriate systems during the modeling (using 2D paper documents if available). Be aware that you may need to manually assign non-standard features to their proper systems. After the modeling is completed, export the system models from EdgeWise into Autodesk Revit, where the pipe systems will be recognized as layers.

6. **Check the Revit version**—Revit is one of the common software that models will be exported to, but make sure your version of Revit matches that of the end user, typically the AEC firm. Both versions must be the same for full compatibility.

7. **Try Navisworks for final quality check**—Export the models along with the point clouds into Autodesk Naviswork where the data sets can be overlaid to ensure the model represents the reality of the point cloud scans.

8. **Share the point cloud**—Some AEC firms might want access to the original point cloud during the engineering and design process to make a field 'visit' at the project site without leaving their office. The point cloud provides perspective and the opportunity to make accurate measurements. But few AEC firms can handle an entire point cloud file due to its size. With FARO's WebShare, you can load the point cloud into the cloud and make it available to anyone working on the project.

   "WebShare provides a light-weight scan-by-scan view for engineers who don't need the full point cloud," said Garner.

Conclusion

3D scanning and modeling firms should be ready to educate the plant owner or operator about the benefits of creating an as-built model now and in the future. They should be informed that the model will help keep expensive disruptions to a minimum while ensuring the planned construction project is successfully finished on time and without surprises.

Moreover, plant owners should be encouraged to use the as-built as the foundation for a Facility Maintenance system that will support the owner in scheduling routine repairs and pay off in eliminating unexpected plant closures due to mechanical problems.

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