26 Best Practices for Guaranteed Scan-to-BIM Success

FREE AEC INDUSTRY REPORT

Brought to you by Scan-to-BIM University

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Today, a broad range of industries are recognizing the tremendous value of building information modeling (BIM). This presents an opportunity, both for providers who want to expand their businesses by offering new scan-to-BIM services, and for companies to take on the work themselves and reap the full benefits of the BIM methodology.

But it also presents a problem: There is a severe lack of educational resources to help novices get started and approach their first scan-to-BIM projects with confidence.

That's why we gathered together a roster of recognized leaders in scan-to-BIM for an educational series. Over a series of three Scan-to-BIM University webinars, these experts shared their hard-learned best practices, as well as a variety of tips and tricks to help even beginners succeed at scan-to-BIM.

Hardware Selection

1

Find the right scanner(s) for your application

If you're brand new to scanning or looking to use it on one of your projects, it can be tough to determine which scanner is right for you. Matthew Byrd, CEO of Nexus 3D Consulting has a suggestion: "The best thing to do is to talk to a diverse group of people in your industry that can help educate you on your project type," he says. "They can help you determine your use case, what accuracy you need, and your ultimate deliverable—and what hardware you'll need to get there."

He adds that you should be careful when people tell you that one brand is the only way to go. "Guess what?" Byrd asks. "They all work great. What's best for you comes down to is the use case and the industry."

Byrd also notes that there are a number of different types of scanners out there—including handheld, mobile, and a variety of tripod-based options—and each one is better in some situations and worse in others. This makes it important to consider using a mix of tools to get the best results.

Hardware Selection

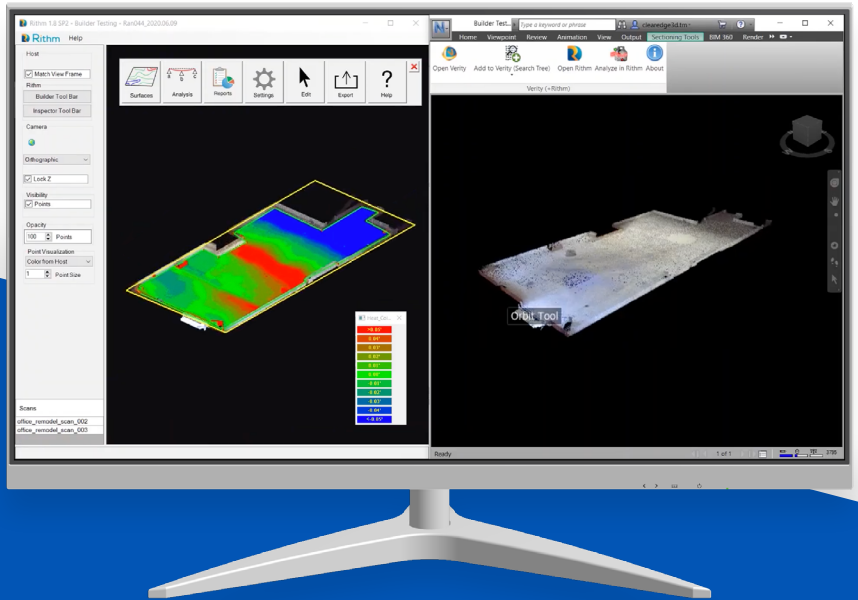
2

Pick the right computer

The processing tool is just as important as the scanner, says "Laser" Larry Kleinkemper, CTO of service provider Lanmar Services and an architect with over 20 years of experience. Here are his recommended specs as of 2020—keep in mind that these numbers are subject to change in the future.

- RAM: At least 32 gigs to avoid crashes when working your point clouds.
- Storage space: "These files are big, so you'll need a lot of space. We have a 50-terabyte server, but the more space, the better."
- Video cards: 4 gigabytes or more.
- Processor speed: "We go for the highest speed possible," he notes. "We also look for intelligent overclock so if the processor gets too hot, it'll back off so you don't melt the unit."

When in doubt, our experts note, you should max out your specs because 3D technology is demanding on a computer and will only get more demanding as time goes on. Just don't waste your money on pro-grade gear—consumer-grade hardware will do the trick.



3 Don't be afraid to ask for help

It's easy to run into snags as you're learning the ropes, says Matthew Byrd. If your project runs into problems, or you have questions, ask someone in your industry. Many experienced scan-to-BIM providers (like our experts) would be happy to educate you or provide feedback.

4 Take the time to understand your client's needs

All of our experts agreed that the most important tip for project success is communicating with the client to understand their wants and needs. Keep in mind that their level of knowledge is unlikely to be as high as yours, so you may need to have a lot of conversations to determine their needs and understand their expectations. (As a bonus, however, you may be able to talk them out of paying for a service they don't need.)

Jacob D'Albora, director of BIM and FM services at McVeigh & Mangum Engineering, says his team expedites the process with a simple online form. Here are just some of the questions the form asks:

- What are the onsite conditions? Is there active lighting or power? Is it abandoned?
- What teams in the organization are using the data?
- What accuracy does each team need? Do they require 90° angles in the model for a construction document? Or are they looking for a true as-built?
- Do you need MEP modeled at a different accuracy than walls? Do you want higher accuracy for your equipment?
- What's the full scope of the project? Does it include the outside? The roof? Above the ceiling?

Project Planning

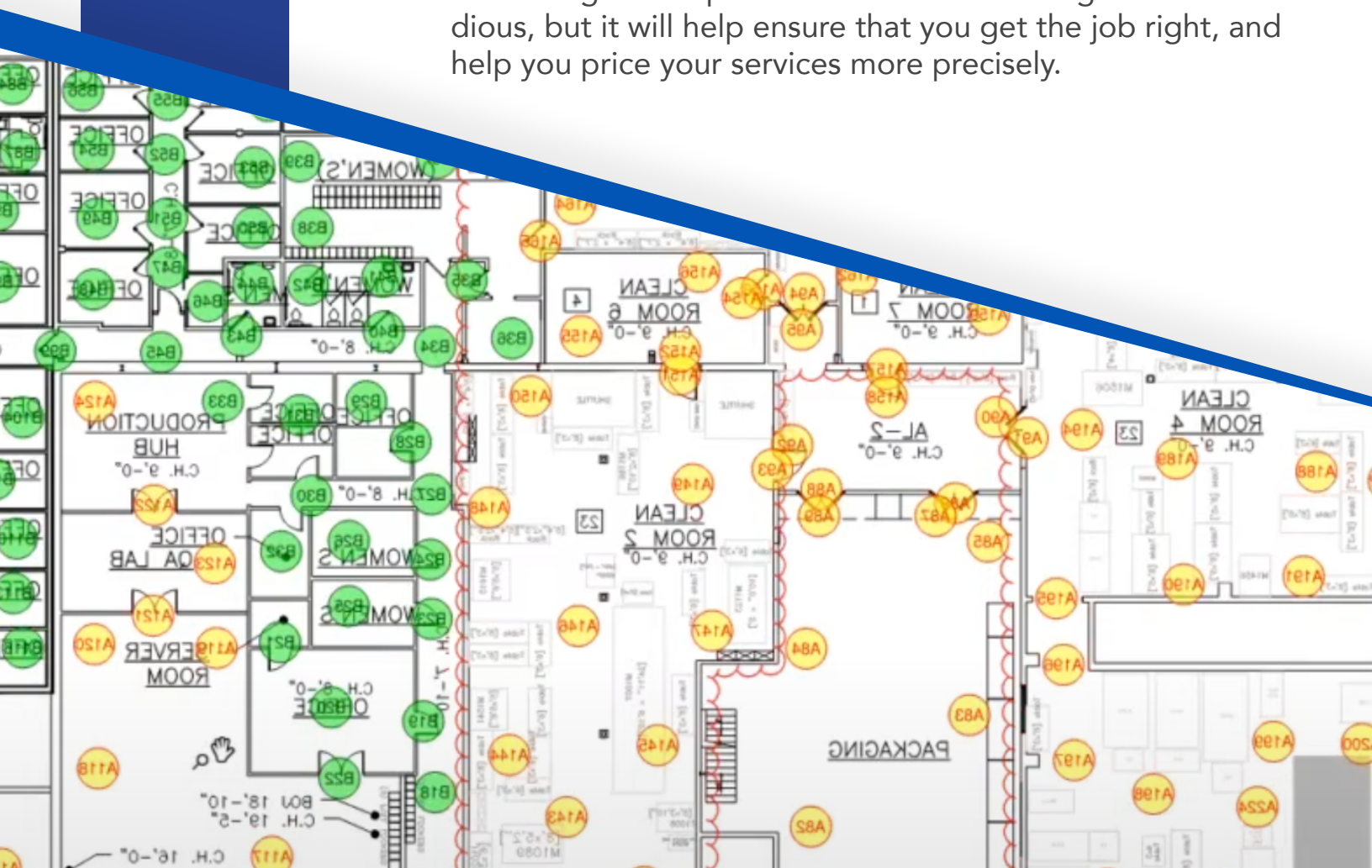
5

Make a scan plan for every job

Good planning is fundamental to a quality capture, says Kelly Cone, VP of product management at ClearEdge3D and a veteran of the AEC and scanning industries.

"When you're a beginner," he says, "you're gung ho, you go out and set the scanner up and do some captures and it's great fun. Then you get back to the office—and you can't get your data to fit together. You can save yourself this trouble by making a plan. There's no magic scanner button that makes it all work."

This plan should include all the necessary information about your scan, like what scanner you will use in what parts of the site, what areas will require an extra scan, where you'll place targets, how you'll perform registration, and so on. Answering these questions ahead of time might seem tedious, but it will help ensure that you get the job right, and help you price your services more precisely.



6

Think twice about scan density and photos

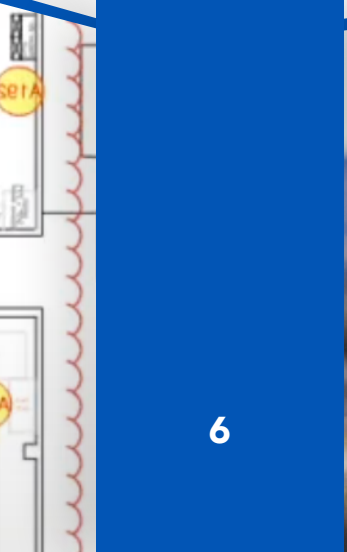
It can be tempting to perform every scan on high density with photos. Don't do it, says Lindsay Prichard-Fox, owner of TiverBuilt LLC, a residential design-build company in New York. You can speed up your field work considerably by using lower-density scans or capturing without photos whenever possible. "We do a lot of our projects at a medium density," she says, "and we go at a pretty nice clip."

7

Use control to combine data sets from different tools

If you use a combination of capture tools in the field (which you should seriously consider), you'll need to take extra care to be sure you can register your scans together into a single point cloud at the end of the project. Here, you can save yourself a lot of trouble by setting proper control targets.

Kelly Cone offers an example: If you're using a drone and a terrestrial scanner, make sure to set ground control points, and to capture the ground control points in both data sets. This will give you the common information you need to align those two data sets in your software with minimal effort.



Data Acquisition

8 Capture less accurate data in smaller chunks

There are a lot of jobs where you'll want to use a mobile scanner or photogrammetry to augment a more accurate device, like a terrestrial scanner. The problem is that these technologies can create drift over larger areas, making the data more difficult to work with in the registration step.

To solve this problem, you might use a good survey-control network with targets (as mentioned above). You can also try capturing data with the less accurate tools in smaller chunks. For example, capture one room at a time with your mobile scanner, then register those rooms together into a cluster. By keeping your captures small, you'll minimize drift and make registration simpler.

9 Use multiple types of targets

Targets come in two forms, stickers and spheres. Though sticker targets are the most convenient, Larry Kleinkemper notes, spheres are superior in certain circumstances, so you should mix and match to get the best results.

He gives the example of long corridors, where it would be difficult for the scanner to catch a clear view of a sticker target in the middle. "In this case, we want spheres hanging out in the middle and sticker targets at the very end—that combination works really, really well."

10 Take extra steps to level your scans

There are few things that can ruin a good scan project as easily as data that's off level. If you have a lower-cost tripod, chances are that it uses an IMU for leveling, which often leads to errors over larger projects. Luckily, there are more than a few ways to solve this problem.

Lindsay Prichard-Fox suggests investing in a steady tripod with a good level. Kelly Cone puts a laser level on top of the scanner and uses the laser to align paper targets on the walls. By setting these targets at a specific elevation, he has all the data he needs to correct levelness errors in post-processing.

11 Triple-check your accuracy

On major jobs, Larry Kleinkemper employs multiple tools to triple-check his data's accuracy. "If you're only using one tool on a big project," he says, "then you can't know if it's gone out of calibration or not."

First, his team sets up targets and uses a total station to lock them into survey coordinates. Second, they perform a laser scan, being sure to capture the targets. Third, they use what he calls "poor-man's control," which involves using a laser disto to measure the distance between targets on the asset's rim.

In post-processing software, he draws a line between those two targets in the point cloud and notes the distance. Then he checks that against the distance indicated by the survey, and the distance indicated by the disto. "If two out of your three instruments agree," he says, "you're golden. If one of them is saying something very different—you know what's out of calibration."

Data Acquisition

12 Take one extra scan, just in case

Registration workflows use overlapping information to tie your individual scans together into a single data set. But what if you didn't capture enough overlapping information while you were in the field?

"If you don't have it, you don't have it," says Sean Doyle, reality capture manager at BOND Brothers. "You can't force two things to register if you don't have the overlap." That's why, in situations like doorways, or when he's connecting a scan above ceiling tile with one below it, his team will take "five extra minutes to run one extra scan—it will save you hours on the backside."

13 Take detailed field notes

Even if you plan carefully, you will make a lot of decisions on the fly when you're in the field. Greg Hale, CTO and BIM execution coach at HaleTIP, says that you can save yourself a big headache back in the office by taking a notebook into the field.

While your scanner is capturing, record information like set-up number, scan location, targeting method, and how you planned your registration. This gives the technician doing post-processing the information they need to get the job done—and provides a valuable reference even if they were the one who performed the scan in the first place.

Hale says his team will also make special note of important areas, like a doorway in a central corridor that acts as the only access to an entire wing of the building. "If you mess up that one little corridor," he says, "nothing else works. So we'll often highlight those areas and say, do targeted registration here just in case."

Pre-processing and registration

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Don’t treat cloud to cloud registration like it’s magic

Cloud to cloud registration, which uses the overlap between one point cloud and another to tie them together, won’t work all the time.

Many situations can cause this registration method to fail. Matthew Byrd notes that areas with moving objects like trucks can convince your software that there are walls where no walls exist—and mess up your registration. On top of that, buildings with mirrors and glass can cause problematic reflections in the data, with errant points in impossible locations. “The point cloud will look like an Avengers movie,” Lindsay Prichard-Fox says, and notes that these errant points make cloud to cloud registration difficult.

For the best chances of making cloud to cloud work, clean your data. “An absolute key part of getting good results,” notes Kelly Cone, “is to clean your data—scan by scan—before you register.”

15

Use targeted registration if you can

Larry Kleinkemper says that using target-based registration is your best friend, because it offers a safety net when cloud-to-cloud fails. Hanging targets takes so little time—if you don’t need them and cloud-to-cloud works as expected, you haven’t wasted any effort.

He notes that targeted registration can also offer additional benefits like enhanced registration, which “sucks those scans together even tighter.”

Pre-processing and registration

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Distribute your survey control

Survey control, which involves placing targets and then mapping them to survey coordinates with a total station, is the gold standard for ensuring precise registration. But don't think you can control a few parts of your scan and get a final data set that is completely error free.

"Even survey control can drift," explains Sean Doyle. He recalls a project that required his team to scan .25 miles of train track, and they were having "a heck of a time getting their data to register at the end." After working with a survey team to check the data, they found that the survey control was distributing a small error across the whole scan.

The answer? It's simple, he says: "get that control distributed throughout the whole project."

17

Use hybrid registration for insurance

The hard truth is that no one registration method can handle every possible situation. That's why you should be using a hybrid registration for security. Combine all three methods—cloud-to-cloud, targets, and survey—on almost every project. "If you rely on any one of them, on a job of any size," says Kelly Cone, "you will invariably run into a situation where it fails miserably and you are left holding the bag."

Pre-processing and registration

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Use hybrid registration to optimize your workflow

Hybrid registration is also good for speed and efficiency. If you're capturing above ceiling tiles, for example, try Sean Doyle's hybrid workflow: Capture your scans below the ceiling with targets. Perform another connection scan that captures those targets and the space above the ceiling tiles at the same time.

Now, when you capture your scans above the ceiling, you can use cloud-to-cloud registration to tie the scans together. Then it's as simple as connecting them back to the area below the ceiling using the connection scan.

"This kind of hybrid scan," he says, "is really important to speed and efficiency and getting the detail you need. It's about thinking outside the box—how can I have good speed, good local accuracy and good project accuracy?"

19

Weight your constraints

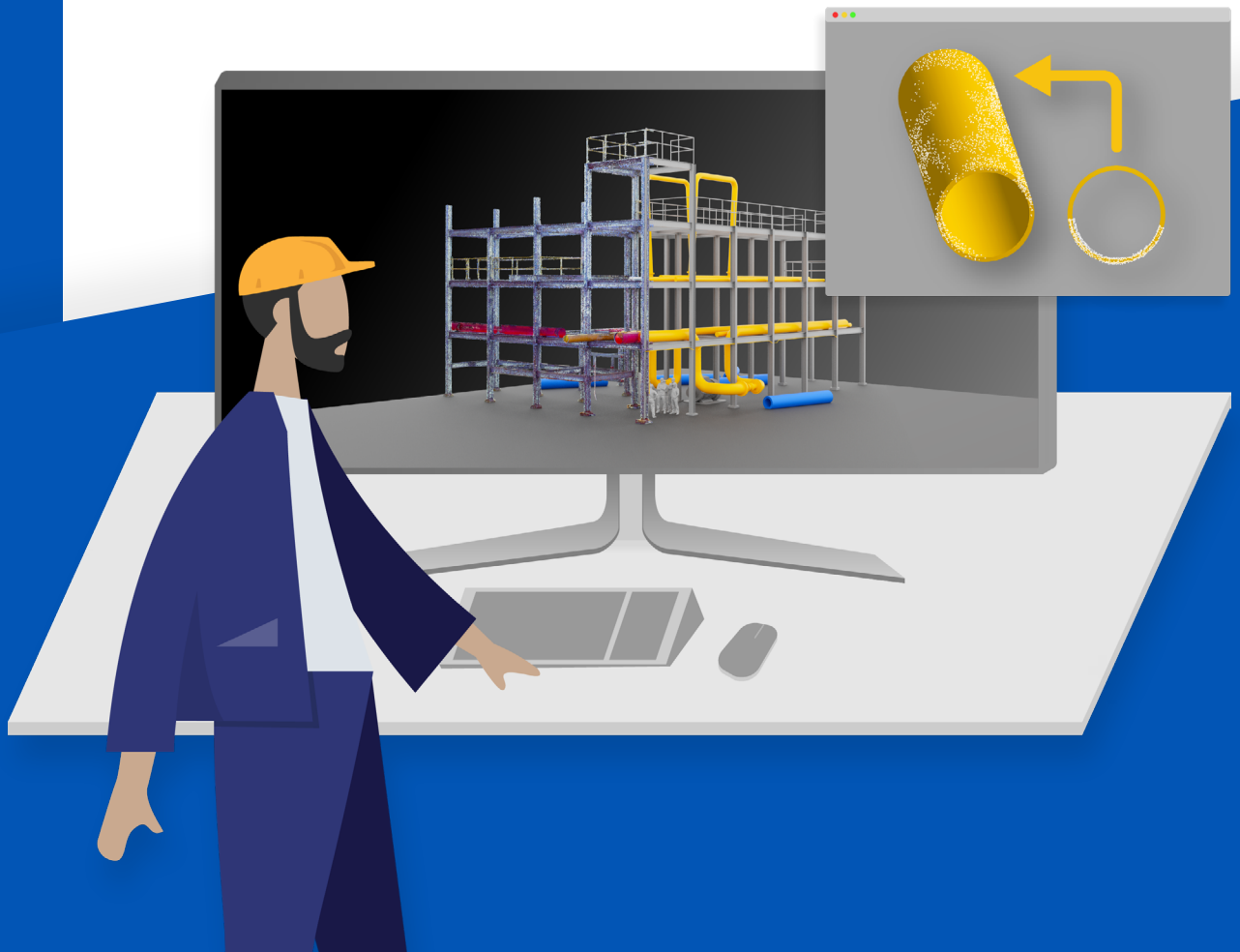
More advanced registration tools allow you to control the weight of constraints like surveyed targets or cloud-to-cloud registration. Use this function to tweak the registration, and achieve the best possible results, by changing weights and seeing how it affects the data.
You can also use the function to troubleshoot. If a registration goes bad, try isolating the bad constraint by de-weighting them one at a time until your results improve.

20

Start out with a quick QA

It sounds simple, but QA checks are crucial to a smooth project. When Jacob D'Albora's team brings a file into their modeling software, they change the point cloud to a single color, and pull a section box all the way through the model to look for discrepancies and registration errors. "You'll be able to go five feet at a time and say, oh look at this duct. It's two feet over from where it's supposed to be. Let's get that fixed."

Greg Hale notes that you should pay special attention to your point cloud's rotation. "With a larger structure," he says, "if the building is rotated, even a smidgen—and I mean like 0.1 degrees—over the distance it's going to have dire effects on things like column lines. Down the line in the deliverable for architects or engineers, it's going to really throw them for a loop."



21

Pick the right modeling methodology

There are three primary ways you can approach the modeling work.

- Manual tracing: Use whatever authoring tool you have to "eyeball" and trace over the point cloud.
- Manual extraction: Use a specialized tool. You select the object, and the tool performs statistical analysis to fit a shape to it.
- Automated extraction: A specialized tool attempts to find all of a specific type of object, for instance piping or walls, and model them automatically.

So what works best? Manual tracing and manual extraction are ideal when you have a small number of objects to model. Automated extraction is the way to go when you have a lot of repetitive modeling to do, like a long run of piping. "It gives you a much better starting point," says Greg Hale. "And it's so much more accurate to let the algorithms do the vast majority of the work. Then, you come back to QC, and you'll still have to do some tracing—but about 70-80% of that work is already done."

22

Sometimes it's better to hand over the point cloud

When a client's work requires precise dimensions, sometimes it's better to hand over the point cloud itself, argues Mark Labell Jr, head of innovation at SSOE Group.

He argues that it can be extremely valuable in certain circumstances to adapt the point cloud for your client's needs. For example, if one of your client's teams will need detailed data for fabrication, consider cutting the point cloud down, and including only the locations they want to work with. This will enable them to take exact measurements and fabricate with confidence.

Modeling

23

Save your data at different states

Even if your client asks for a nominalized 90° model, be sure to save it in the intermediary steps as you work. Whereas the nominalized model might be perfect for an architect, the "as-built" that you developed it from could be very helpful for a contractor who is performing coordination.

24

Clash detect the model against the point cloud

As you're starting to get to the end of your modeling, says Greg Hale, and you have QA'ed it by eye throughout the process, take one more step: Try running a clash detection between the point cloud and your model. "Why the heck would anything clash? Well, maybe you straightened out a pipe, or a column, when in the field they're actually bent, or they're deflecting."

You might also determine other errors, for instance that a beam is modeled wrong for conduit to run through it. This gives you one method for catching discrepancies and correcting your model before the final handoff.

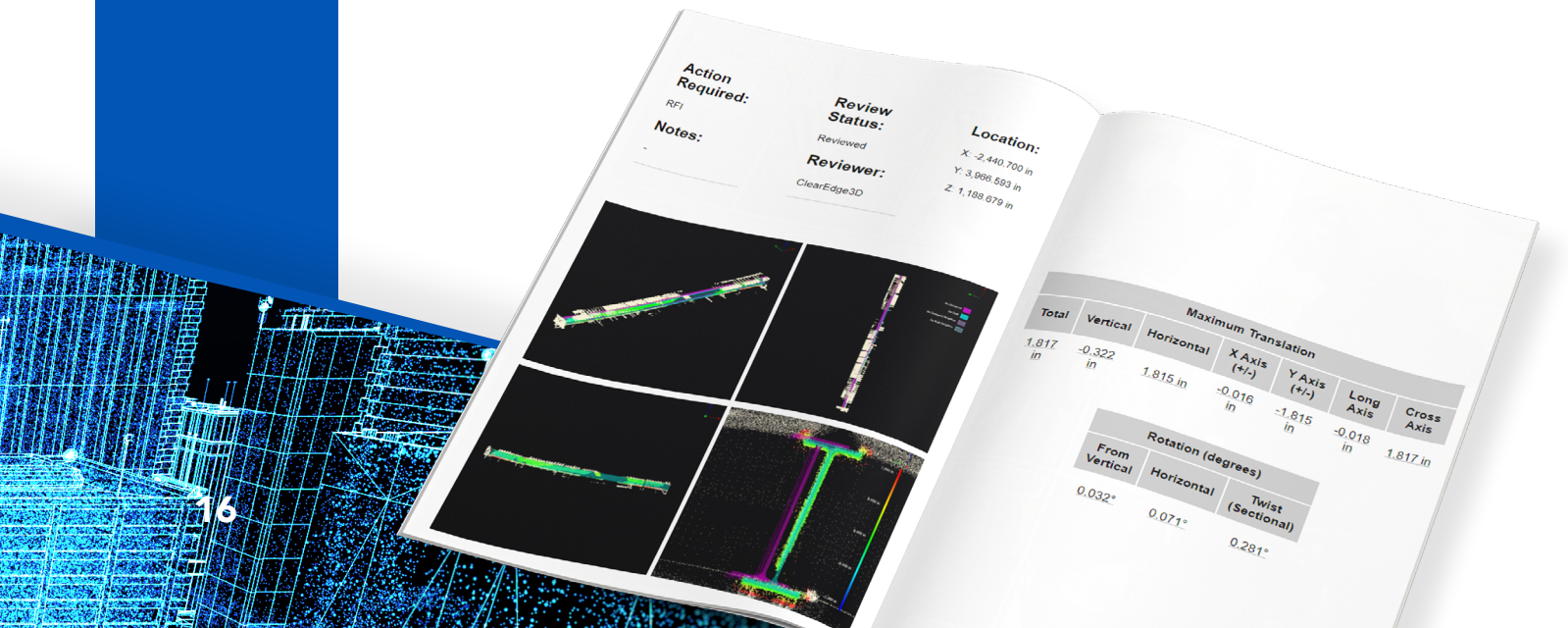
25 Have one more person look at the model

Once you have completed the work, and QA'd it by every method you can, ask someone else to look at it.

"Sometimes you sit there and register a project, and you slice stuff, and cluster it and target," says Matthew Byrd. "You've done drafting, modeling, and so on. And you've looked at it for so long, you can get lost in the data. This is where having a third party, one more of your guys come in and say, Okay, I think this is good. It just takes one more set of eyes to do a quick QA."

26 Offer a QA/QC report alongside the model

As part of Greg Hale's QA process, his team will record data for the asset, like pipe diameters, elevations off the floor, dimensions of column grids and other details that are often included in a Revit model. "But we'll also lay out a report for that," he says. "Saying, here's the model, but also what we found in it—whether that's a floor-level analysis or a bunch of pretty pictures that helps them get a sense for what's included in the architectural model. It's essentially like that old paper deliverable saying, here's a report of everything you're getting."



Want to know more?

It's hard to believe, but this is just an overview of the highlights from our three Scan-to-BIM University webinars. For even more in-depth information on Scan-to-BIM, watch the webinars, STB 102-105 classes and the related Q&A sessions here. And be sure to join the Scan-to-BIM University linkedin group here. You'll gain access to a community of experts and colleagues who can answer your questions and help you troubleshoot your most complex projects.

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