

# How Technology is Transforming the AEC Industry

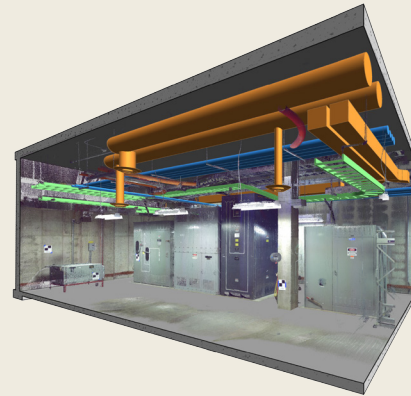
By Andy Johnson

Technology evolves rapidly. Staying current is a challenge—especially as it relates to the architecture, engineering, and construction (AEC) industry. Developers and owners can gain an edge by understanding how we currently use technology to save time and money, while ultimately improving facility management processes over the life cycle of a campus or building.

One way to save many hours—sometimes many days—is by using laser scanning to capture current facility information. When working on improvements to an existing building, we can capture aspects of all elements through laser scanning. This technology helps us dimension the office by bringing us to the site virtually. We use this technology extensively for items like power delivery electrical vaults and crowded existing mechanical conditions. The information allows us to precisely and accurately design our engineering improvements around a facility's existing conditions.

A case in point involves a recent renovation of several mechanical rooms. Briefly scanning the environment on-site allowed us to take the information back to the office to complete our analyses and detailed design. This saved approximately two weeks over manual verifications, and also the need to create as-built drawings. We determined that, in total, we could save up to four weeks in documenting the pre-existing mechanical rooms.

Through laser scanning we typically bring several weeks' worth of field measurements and verifications into the office in only a day or two; and this information provides exceptionally accurate documentation of existing conditions. There are times when we can design directly alongside a laser scan. That means that there is no additional work needed to create an as-built building information model (BIM). Since we can scan above ceilings, minimal intrusion is required.



**Laser Scan:** Upgrades to an existing electrical switch station were able to be designed and validated against a 3D point cloud developed from a laser scan. The high definition scan offers the benefit of extensive photos, field dimensions and clearances, while minimizing the amount of time in a hazardous high-voltage location.

Be aware, however, that there can be downsides, which is true with any technology. With laser scanning, remember that these are just “points” and we don’t have intelligent information about the objects that have been scanned. As a result, there is some re-work required to create native geometry in the design software. Software vendors are creating more ways of automating and translating these “points” into smart objects. Currently, re-creating design models from scans is still a manual operation, though automation is progressing and current technology offers significant time savings.

## Augmented Reality and Virtual Reality

Augmented Reality (AR) and Virtual Reality (VR) are other technologies that offer great benefits to the developer, owner, and facilities team. It is logical to recognize that people can visualize 3D models better than traditional 2D plans. It is abundantly valued in cases where owners and the project team need to visually understand an architect or engineer’s design intent. Use of these tools generally provides quicker buy-in, more informed owner feedback, and a faster way for an owner to recognize changes that might be essential or impactful.

Virtual Reality puts the viewer in a computer-generated simulation of the built environment. Through the use of the same technology that drives video games, project stakeholders can navigate a project. Lighting, finishes, maintenance considerations and more can be viewed in realistic scale. Artistic and photo-realistic renderings have always been highly valued in the design process. This immersive technology can now be used to view all angles of a project. VR headsets or head-mounted displays in combination with a game controller make navigation intuitive and fun.

Augmented Reality is a technology that layers computer-generated elements on top of existing reality. Imagine using a camera on a tablet or smartphone to view an existing office building on the screen. Now imagine visualizing new furniture in the office on the same screen. As you point the camera around the space, the computer-generated graphics of furnishings appear throughout the room. The use of Augmented Reality is not only valued in the planning and design phases but also can be used in both construction management and ongoing facilities operations and maintenance. It allows the overlay of information connected to databases on top of real-world equipment and assets. This is most significant for long-term operation of a facility, and offers many time savings as well as greater ability to impact planning and future building decisions.

Could you imagine walking down a hall and seeing the complex array of piping as you point your tablet up—despite the fact that it is concealed above a ceiling? The ability to use tablets and phones to overlay information on top of plans is an effective use of this technology. On occasion, people feel symptoms similar to motion sickness when using a VR headset. A standard projector, computer monitor or tablet can also be used. From an AEC point of view, the downside to Virtual Reality is that the design effort requires someone with skills akin to a video game designer to take files from a design model into a Virtual Reality platform. Initially, it may take several weeks of a learning curve for an engineer or architect to prepare a model. Even with an experienced design team, the client should expect a few days to update designs.

### **Construction Collaboration Tools**

Automation offers opportunities for all levels of design, construction, and facility management. Initially, NV5 developed a proprietary commissioning tool for inspection and testing to document our commissioning process. Today, commissioning tools are on the market that integrate with other construction management tools so that all contractors and subcontractors have access to a real-time database. When a vendor updates equipment information, all parties can observe and use that information. Again, this is hugely beneficial to an owner in terms of improving speed of delivery, reductions in errors, fewer delays, and greater historic context for future planning efforts. Mobile access to building information models and all types of construction-related documents means that same-day changes are available to all team members because of the streamlined capacity of the system.

### **Rise Above the Cloud**

The power of the cloud to allow instant access to all information from all team players has totally changed the way we design buildings and deliver construction projects. This connectivity allows instant access to issue lists, quality control checklists, safety items, schedules, etc. It provides unlimited opportunities for photo and video documentation. Since the information is accessible by phone, tablet, or laptop, it can be edited offline and uploaded when an Internet connection is available. Soon, these construction tools will also tie in with Augmented Reality.

For those of us at NV5, this technology is especially valuable due to the large number of clients who depend on us for facility commissioning services. Commissioning system readiness checklists and functional performance test results can be shared with all project stakeholders in real time. An example of the success this has provided has become a common scenario: A commissioning agent identifies an issue and assigns it to a specific trade contractor. The contractor or vendor is notified with an immediate automatic notification. The responsible party typically resolves their issue in a much faster time than in the previous workflow—issues that used to only be published at

weekly meetings. On a few occasions, issues have been mistakenly assigned to the wrong person. This mistake could have meant an added week, but is now resolved within an hour.

Cloud-level collaboration has such compelling value, creating a win-win situation for all project participants. It reduces the need to duplicate and re-create information—from design-to-construction, then into the operations of a facility. The opportunity for data loss is significantly reduced. In addition, owners can benefit from the ability to populate operations and maintenance software with far less effort at project handover.



**Access to Data:** During construction, access to data is becoming immediate. Test results, field reports, photos and more are shared in real time. Shown is BIM data of a boiler in a central utility plant.

### Seeing Into the Future

Imagine having all project data in a consistent format that can be imported into an owner's operations software. Imagine having information models that can be leveraged through the entire life cycle of a facility. In one case, we helped an owner to input all building information and documentation for a hospital tower within a matter of days. Not long ago, that effort could have consumed a year. How much impact does this statement really have? Consider it in context. If data is not immediately input into a building operation database, information can be inaccurate or obsolete within months or weeks. The result? Data loss can occur and problems can arise.

Even with the massive improvements in technology systems and automation today, owners still often populate databases from thousands of pages of PDFs and spreadsheets—even hard copies of equipment manuals and cut sheets! The costs of system upgrades and the hiring and training of data managers can steer corporate leaders away from a greater technology investment. However, today's reality is that data loss and the re-creation of data costs owners billions of dollars a year. A study published by the National Institute of Standards and Technology estimated that inadequate interoperability costs \$15.8 billion to the facilities segment of the U.S. construction industry each year.<sup>1</sup> Imagine the impact of saving just 5% of that total number over the next 30 years—an investment in the people and systems to make building operations more efficient could truly make or break a company's bottom line. Owners should push to capture facility data in a usable format through the construction process.

The upfront expense of design and construction is only a small portion of the total life cycle cost. Operations and maintenance have a significant opportunity for improvement in cost and performance. Design and construction professionals need to better understand what digital capabilities are available and practical for current use. Improvements to our fractured system is a shared responsibility.

Andy Johnson is the BIM manager at NV5. Andy has trained 600+ people and served as a consultant to over 50 architecture and engineering firms. He has provided building modeling services and technology applications for many sizes and types of buildings, including industrial, civic, education, health care, hospitality, housing, justice, and retail. Contact him at: [andy.johnson@nv5.com](mailto:andy.johnson@nv5.com)

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