RC9759

Laser Scanning: How to Capture the ROI

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Learning Objectives

- Understand what laser scanning is and where it came from

- What applications there are for laser scanning

- How to justify the cost for such a service

- Tracking the ROI

- Lessons learned

Description

Laser scanning has become a very prevalent topic in the architecture, engineering, and construction industry over the last several years. While the software and hardware has dramatically improved, offsetting or justifying the costs can be a challenge. Rather the project is driven by schedule or cost constraints. What have been the challenges involved in overcoming these hurdles and recouping the benefits that scanning has to offer? This class will take a transparent look at the purchase and use of Brasfield & Gorrie, LLC's, first laser scanner. We will explore the additional challenges as well as the metrics used to prove value. This class is geared toward those considering the purchase of, or who have just recently purchased, their first scanner, or who want to learn more about the technology

Your AU Experts

Scott Cloud oversees **Brasfield & Gorrie, LLC's**, *regional implementation of Virtual Design and Construction (VDC) services, supporting over $1 billion worth of projects. With over 11 years of experience in the architecture, engineering, and construction (AEC) industry, he has been involved in a diverse range of projects ranging from healthcare to large commercial to heavy industrial and sports/entertainment. Scott has a passion for technology and the discovery of the "new," and his out-of-the-box thinking has led to many successful developments of new processes, workflows, and ideas.*

Mitch Carroll *is the lead for the laser scanning technology within* **Brasfield & Gorrie's** *Virtual Design and Construction (VDC) department. With experience in the AEC industry for over 13 years, he has found the true value in this technology. Over the past few years he has been implementing laser scanning into the company to help improve quality of information, improve quality control and help predict potential issues before they occur in the field. With the teamwork of others and himself the laser scanning technology has shown great potential to be an ongoing source of revenue for the company. Mitch has a respect and passion for anything to do with construction, engineering and design.*

What is Laser Scanning?

History & Timeline of Technology
- Created in the 1960s using light, mirrors and projectors. 3d scanning was a difficult process that took a great deal of time and was not always as accurate when comparing to today's standards. Hardware limitations stifled the growth of this technology for many years to come.
- In 1985 lasers were first used to scan along with white light and shadowing analysis technology to jump start the development into what you see today.
- First Commercial terrestrial scanners showed up on the market about 20 years ago. The two companies known for being pioneers were Cyrax (USA) and RIEGL (Austria).

FIGURE 1: SOME OF THE FIRST SCANNERS ON THE MARKET BY CYRAX   FIGURE 2: RIEGL'S EARLY SCANNER

How does it work?
3d scanning is the process of collecting measurable data from reality and computing it into a usable format. This can be done in many different ways with many different results. For this presentation, we are concentrating on terrestrial laser scanners. These machines use a laser to create the 3d scans. The equipment sends a laser from the machine, and then analyzes what happens to the beam. Each time the machine does this, it shows a result by placing a survey point on the relative position of any object surrounding the equipment. Most commercial machines today do this at a remarkable rate, and are capable of recording close to a million points a second. These terrestrial machines sit stationary on a tripod much like traditional survey equipment. While sitting stationary, the machine itself can send the laser out a full 360 degrees using mirrors to record a full representation of the surrounding items. Once this is done many of these machines can go back adding additional information such as color to these survey points by taking photographs while the machine is in the same stationary location. Though this is not a perfect process it does create a full reality capture of the surrounding area. This process is repeated at multiple vantage points, and then combined to create one large scan. There are many methods to do this and many proprietary methods used throughout the industry. Each of them using specific algorithms and methods developed for their specific scanner and software.

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What does it create?

Mapping:

This is a 2d representation of a scan project that has been created to show the full scope of a scan job. It first shows a map view of where each scan took place. Then allows a closer look into each scanning position. Once being placed in each position, the scanner will allow you to take measurements, along with many other features, while in the 360 view created by the scanner.
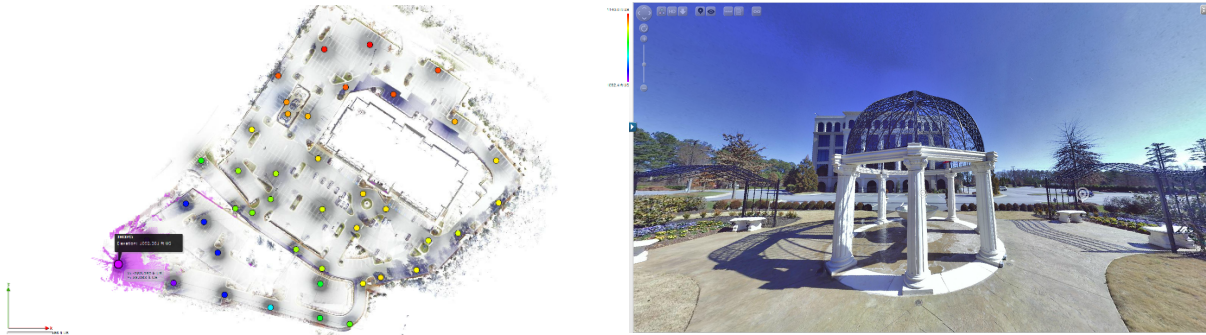
Pointcloud:

A pointcloud is exactly as it sounds. It is a mass of points showing a representation of each point the scanner has collected. A pointcloud is the end product from the scanner, which is then analyzed, altered, and purged to create a clear reality capture of an object or area. This can then be used for multiple purposes from site analysis to 3d printing.
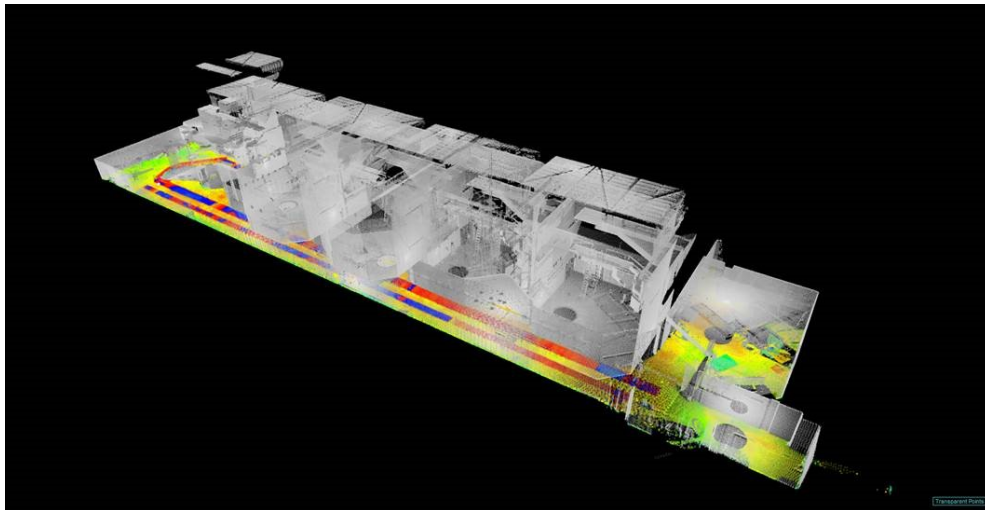
What are the Applications?

Why is there a need?

Before getting into all the applications, we first took a step back and asked the company if there was a true need for laser scanning. The answer was not as clear as one may hope. We had to take a few steps back here to see if the concept was a valid need before proving the technology developed adequately.

What are the Applications?

As-Builts

Creating accurate site as-builts has been one of the most common applications for laser scanning within our company. Many projects are constantly evolving, and it becomes very difficult to get accurate as-built information from the field. By laser scanning, we are able to retrieve current conditions and incorporate them immediately into our design models. This can be done for 2d and 3d applications thanks to the advancement in the technology.

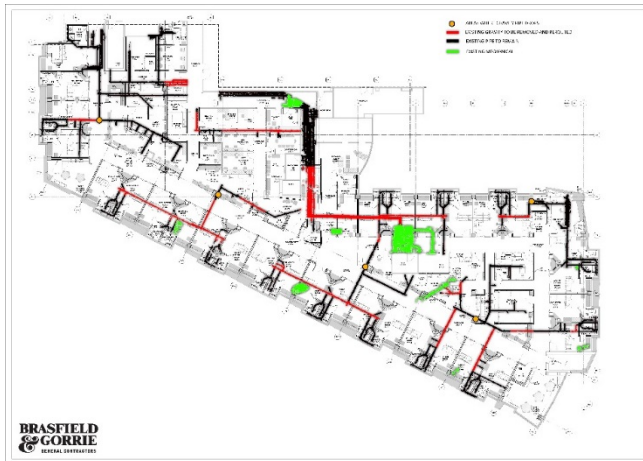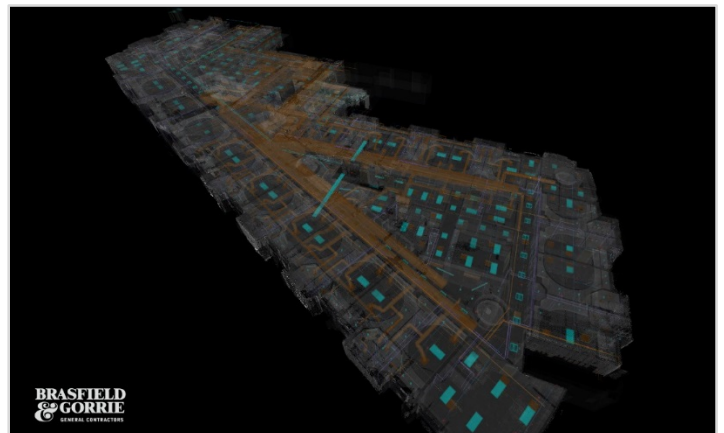FIGURE 3: 2D DRAWING SHOWING DESIGN CHANGES FROM SCAN

FIGURE 4: 3D COORDINATION INCORPORATED THE CURRENT SCAN INTO THE VIRTUAL FUTURE DESIGN

Preconstruction

## Early Site Analysis / Eliminating High Risk Safety Items

One of our key goals as a company is to create the safest environment possible for our workers. In the images below we show how we used scans to eliminate workers getting too close to electrical lines, while at the same time getting accurate and useful information for basic site logistics.

FIGURE 5: EARLY SITE ANALYSIS OF POWERLINES GOING THROUGH A JOBSITE
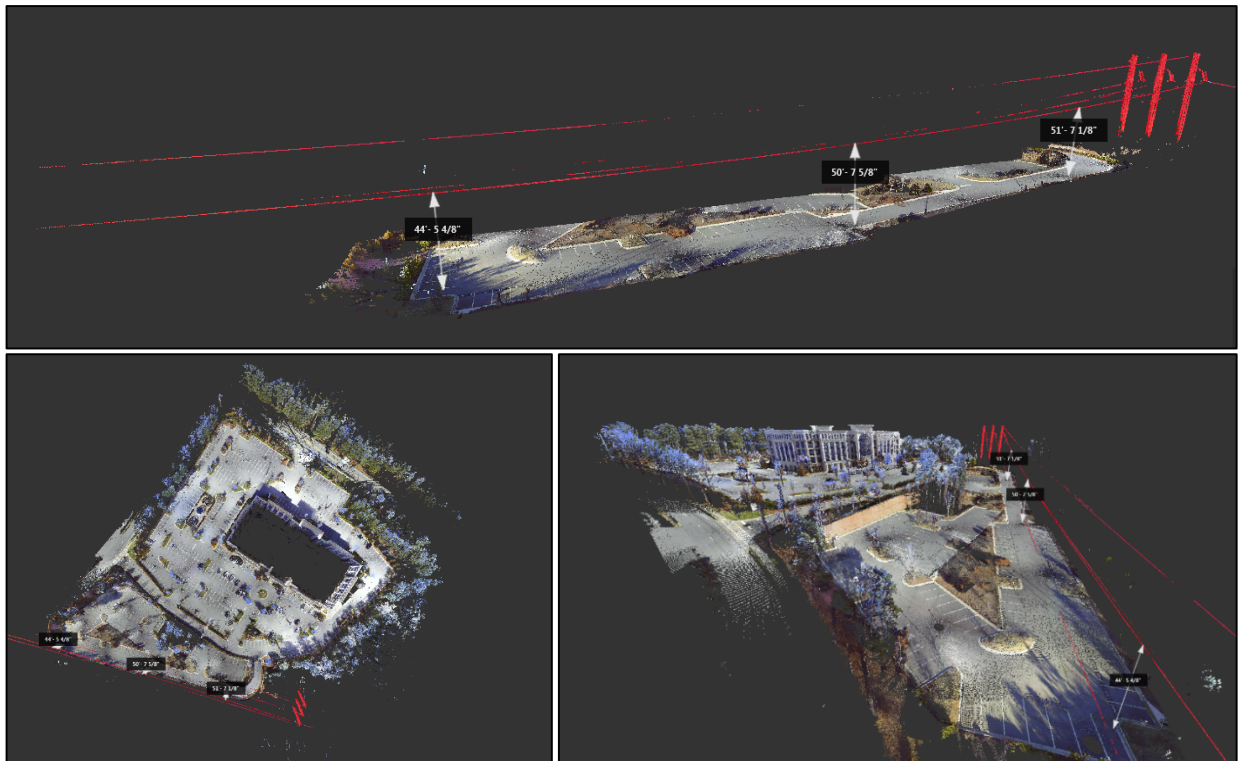
Insurance / Record Keeping- Columbus

This scan was taken to capture the existing conditions of all of the surrounding buildings. The buildings being removed from the site were surrounded by historical buildings in the downtown Columbus, Georgia. To make sure we had no impact on the surrounding areas, we scanned all the surroundings and the interior of the project once demolition was done.
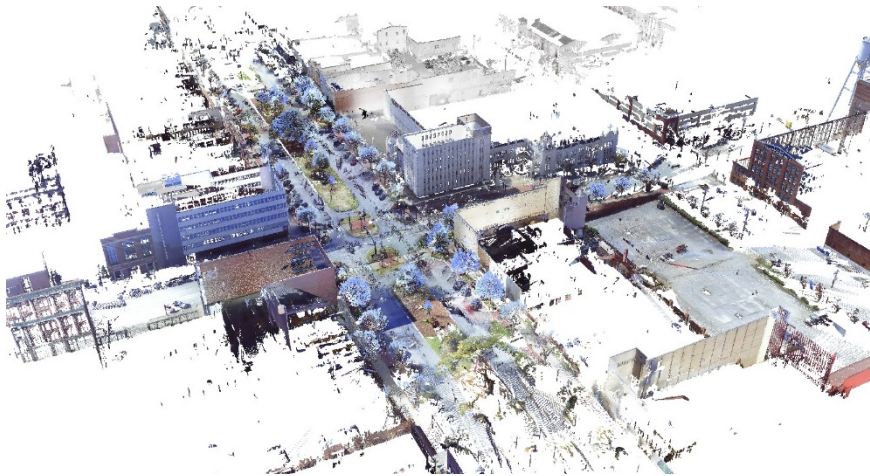
Progress Documentation- Aquarium

The Georgia Aquarium has been an ongoing project, and we have had multiple scan projects to give us current progress information throughout the construction. With constantly changing designs and construction needs scanning became vital to coordinate this ongoing project.
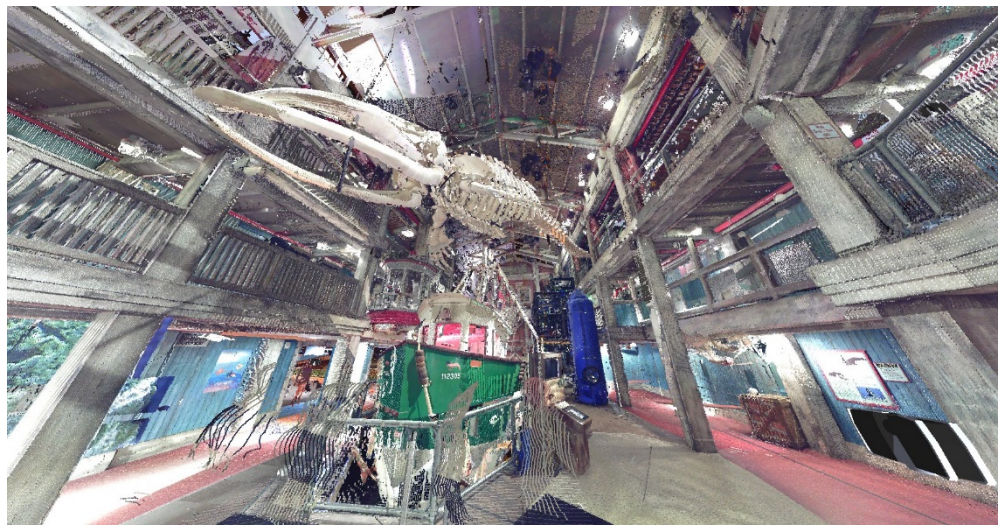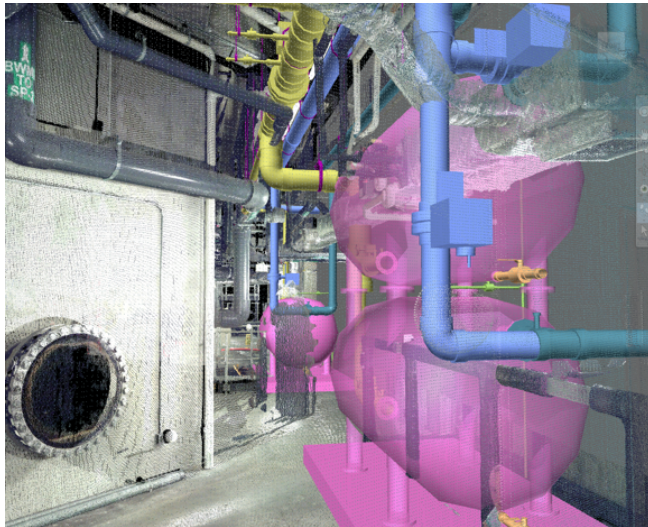
Virtual Site Access

Though virtual site access is a byproduct of the scanning process, it has become extremely useful for our project teams. Many times we have quick site data needs, which results in repeated site visits, causing countless man hours lost in traveling. In addition to this, virtual access has also given us a new and easy delivery method to the owner.
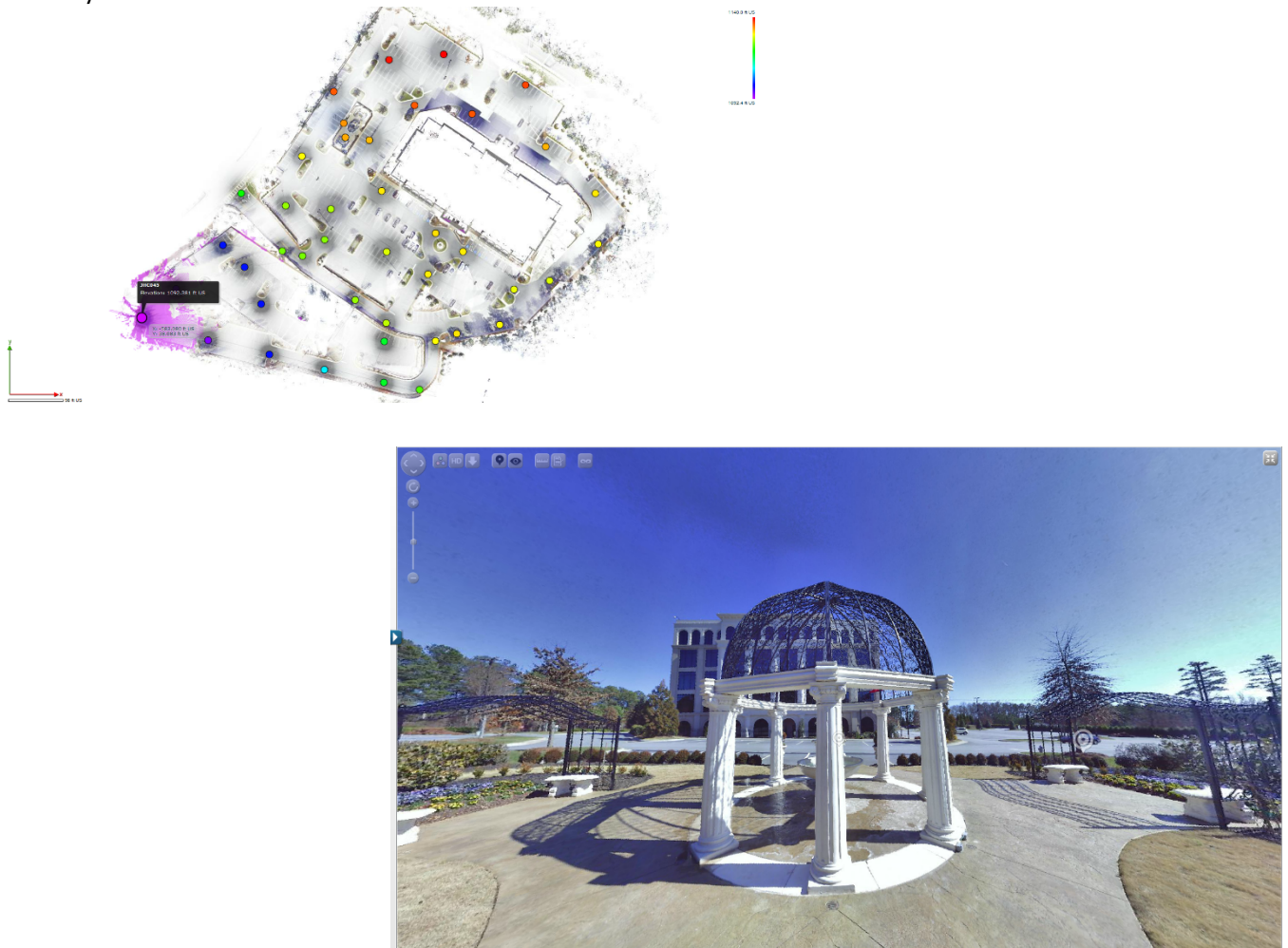
QA/QC

Quality Control and Quality Assurances (QA/QC) are vital to a construction company, and for years it has been difficult to bridge this gap between what is specified in the office and what is actually installed in the field. With scanning we have been able to verify and correct, if necessary, any discrepancies found out in the field before causing major issues later in the project. The importance of this cannot be understated. What once took a dedicated team of surveyors and field engineers extra time, now can be spent on their necessary daily tasks.
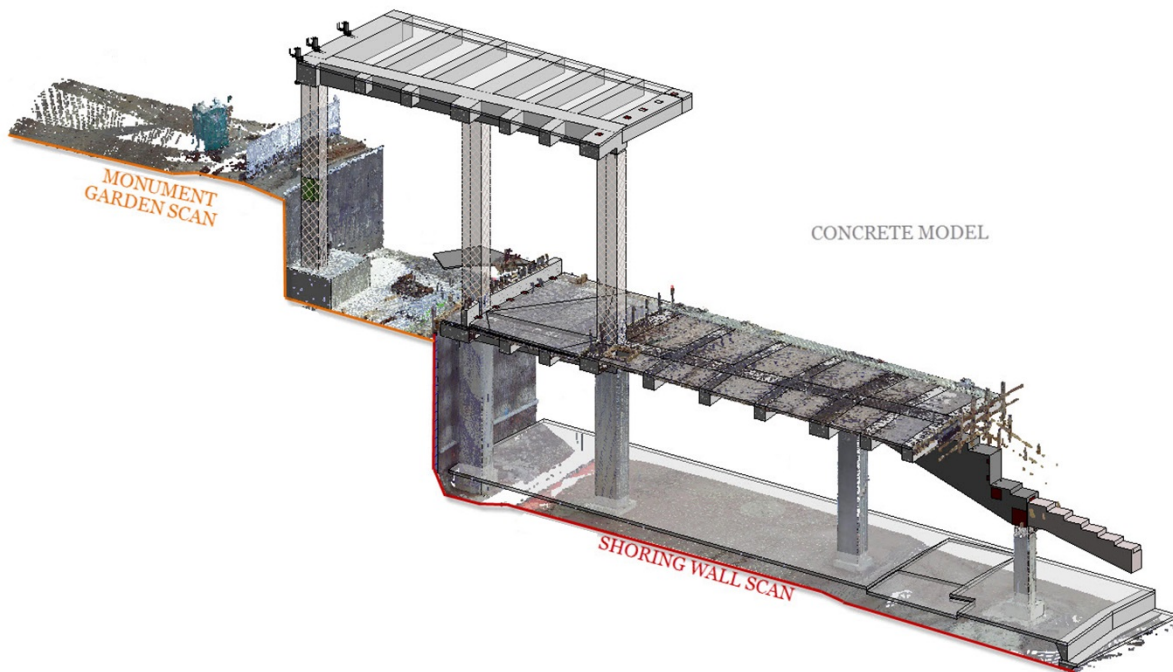
Marketing

Laser scanning does what was once impossible due to financial restrictions. It allows the full AEC team to make progress from the start with a strong unified foundation. This has proven to be a powerful marketing tool. Before, being able to express value engineering and show savings to an owner tended to be a time consuming process. Laser scanning has proven to save valuable time on the front end modeling existing and future conditions, while still allowing progress on projects to begin much sooner.

How do you pay for it?

Step 1: Questions we had to answer
- How do we intend to use it?
- What does the upcoming demand for this technology look like?
- What cost items are there outside of the scanner equipment itself?
- How do we market this internally and use it to its full potential?
- Do we want to provide these services externally?
- What additional risks are we taking on by self-performing this service?

Step 2: Evaluate the Market & Manufacturers
- Pros and Cons to each manufacturer.
    - This needs to be done for the software as well as the equipment itself
- Compare cost of each manufacturer.
    - Define exactly what you need for deliverables to see which package is better for you.
    - Some manufacturers provide the equipment and software in one package for all your needs. Where others provide each broken out and can add additional costs quickly after purchase.
    - Look at the ROI for each package your looking at.
    - ***Do hands on testing for each on your own before you purchase***

Step 3: Develop a charge model to support the present and future costs
- Scanners initial purchase
- Forecasted growth for additional scanners / hardware/ etc..
- Project work/ Project demand (12 months/ 24 months/ 36 months)
- Assign Costs to bill to jobs
- Compare costs with 3rd party companies & market

Step 4: Develop a plan to implement scanning on each project
- Who is doing the work?
- How is this paid for?
- What are we offering exactly?
- What are our limitations?
- Where is additional support to use the scan?

Tracking the ROI

Depicted Cost +Cost of Growth
This must be company specific …

Our Forecasting
Accounting for our growth and demand we predicted our equipment would be paid off within 36 months.

Our results
After careful planning and many quick turnarounds, we have found the growth was much faster. As a result, we have seen a steady line of profit after the first 8 months of purchase. With the growth of this technology only increasing, we are predicting to see these results will only get better with time.

Lessons Learned

- Targets vs No Targets
- TSA / The Importance of travel with the scanner
- Tips and tricks for scanning in high traffic areas
- Sharing Files
- Weather conditions and limitations give different results
- Reflective material presents challenges…
- Setup location strategy
- The Curiosity factor with by-standers
- Computer hardware for registration
- Be prepared to be surprised with every job
- Back-up batteries
- How to explain deliverable to customers
- Target placement size vs distance
- Aligning scants to control coordinates
- Evaluate Scans (Color Lies!)
- Scan Resolution / Quality vs Distance /Density