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Routing Pipe in a Crowded Facility Using a Scanner, ReCap Pro, Revit, and Navisworks

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Learning Objectives

- Learn about the scanning workflow for the Leica BLK360 and ReCap Pro for mobile
- Discover how various stakeholders could benefit from using this technology
- Discover how a point cloud can be useful without being converted to a model
- Check for interferences between a Revit or other 3D model and point clouds in Navisworks

Description

While scanning technology is nothing new, improvements in its ease of use are expanding its applications. Using a Leica BLK360 scanner, two designers without prior survey or scanning experience captured a large portion of a wastewater treatment plant's tunnels and connected facilities in four days, in preparation for a design project. New piping is to be installed in these existing facilities, which are already crowded with piping and equipment—a common scenario in similar long-established facilities. A rough routing drafted in Revit software was added to Navisworks software, along with the point-cloud files, enabling direct interference checks between the two without converting the point cloud to a model. Attendees will discover the detailed workflow they should apply to use this technology, and learn how it was used on this project in Ohio.

Speakers



Megan Miranda is a professional Civil Engineer from Columbus, Ohio with a keen interest in improving how work is performed and delivered utilizing innovative digital techniques. She has been practicing design with Arcadis for 8 years, designing water and wastewater treatment systems for municipalities, conducting GIS-based analysis to support decision-making, utilizing BIM tools for quality control, designing custom scripts to enable collaboration between firms, supporting development of an online project and construction management information system, developing digital engineering tools, and providing training for utilizing emerging technologies.

Megan holds a Bachelor of Science degree in Civil Engineering from the Rose-Hulman Institute of Technology, as well as a Master of Science degree in Environmental Engineering from the University of Houston. She is also a certified Professional Engineer (PE), Geographic Information Systems Professional (GISP), Envision Sustainability Professional (ENV SP), and Construction Documents Technologist (CDT).



Seth Grimes is a Design Lead with a practical approach to integrating emerging technologies and their associated workflows. For 19 years, he has been developing municipal wastewater treatment plant designs spanning the U.S. from Arcadis's Columbus, Ohio design center. He has coordinated all project phases including planning, preliminary design, detailed design, and construction. As a process designer, Seth has widespread experience in the design of many treatment processes. He led facility layout designs for two new treatment plant campuses and most recently served as a discipline lead for one of Arcadis's most advanced BIM projects. This included integrating new workflow concepts using new and experienced project staff and coordinating this work across multiple Arcadis offices and over a dozen teaming firms.

Seth holds an Associate of Applied Science in Mechanical Engineering Technology from Marion Technical College. He is also an Envision Sustainability Professional (ENV SP) and Construction Documents Technologist (CDT).

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Project Background

Information about the Facility

Since its original construction in the early 20th century, the wastewater treatment plant where this project took place has been modified numerous times. While there is a wealth of drawing records, there is no single unified record of what is currently installed at the plant. The plant currently flares excess methane gas from their anaerobic digestion process and wants to repurpose the excess gas to provide heat and power for the facility (commonly known as cogeneration, or 'cogen'). New engine generators need to be installed, along with gas conditioning and metering equipment. New gas, steam, and water piping needs to be routed through the existing underground personnel tunnels and basements, avoiding the numerous other pipes and equipment already in service.

The End Goal

The client needs 2D drawings and specifications showing how all the new equipment and piping are to be installed, ready for a contractor to bid on. The most challenging aspect of this project is finding and communicating a suitable route for the new piping that minimizes conflicts with what is already there. Conflicts could result in expensive change orders or require rework if there is no easy resolution.

Pain Points from the Usual Approach

Typically for a project like this, at least one designer needs to make numerous visits to the site to take measurements by hand, sketch different options, and take photos. Each time a new route is considered or someone discovers they need one more measurement in a certain spot, they need to wait until someone makes another visit to gather more information. Sometimes, field staff gather the wrong dimensions. Photos never seem to capture quite what you need, or it is hard to tell where something was taken. Photo quality can be an issue – too blurry, bright flash, no flash, wrong angle, etc. Certain areas can be difficult or hazardous to measure by hand, so dimensions may be estimated based on nearby objects. Photos taken on site need to be organized and saved to the team's workspace to share with the larger group. Hand sketches need to be drafted to communicate potential routing options. Each site visit presents additional safety risks from slips/trips/falls, vectors, and hazardous materials.



SAFETY RISK

Risks and Rewards – Weighing the Pros and Cons

It is always challenging to try a new approach, even with clear benefits. Over time, scanning technology has become increasingly user-friendly, cheaper, faster, and better quality. A professional surveyor is no longer needed for every scanning project. Our design team understood scanning our project areas would give us a very thorough, accurate model of the existing facilities, allow us to take measurements at any time from the office, provide spherical

photos showing the relative position of each location, and allow us to check for interferences between our proposed piping and existing utilities and equipment. However, it was a new process for our team, so there were no guarantees it would go smoothly or give us the results we expected. In our case, the potential benefits outweighed the risks and we decided to pilot the technology. The equipment was obtained as a 1-week rental¹ for about \$1,000 to minimize financial risk versus purchasing a scanner for \$16,000. How did we do? Stay tuned to find out our full process and our conclusions by the end of the project.

Required Hardware and Software

Scanning

The bare minimum needed for scanning is the Leica BLK360 Scanner with a charged battery. However, for our project and for most practical applications, a tablet and other accessories are very useful.

Scanner and Accessories

The Leica BLK360 scanner is often sold or rented along with a 'mission bag' and several accessories, including a carrying cover for the scanner itself, two extra batteries, an additional wall charger, a car charger, and a fold flat tripod.



LEICA BLK360 MISSION KIT



TRIPOD ADAPTER

In our experience, the included tripod was too short and the locking mechanisms for the legs were a bit unreliable. Instead, we opted to use our own standard camera tripod² combined with a tripod adapter³. The tripod adapter can accommodate either a standard 1/4-inch screw or the 5/8-inch screw found on the baseplate of most standard tripods. For high shots, we combined a standard tripod with a monopod to gain extra height.

The scanner is also designed to be used on a tabletop, so it does not require a tripod. The base of the hard plastic carrying case can be inverted to serve as a scanning platform for the scanner on any flat surface. For a full day's work, we found having 3 fully charged batteries was enough for medium-density scanning. The carrying case was great for protecting the scanner while walking outdoors or through dusty or humid areas.

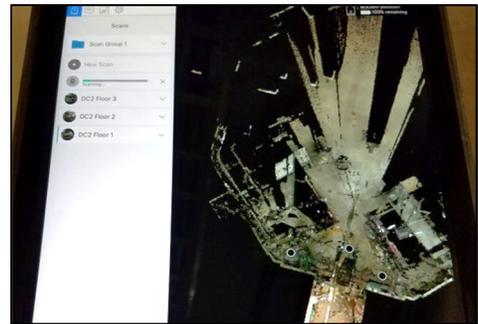
¹ Rental provided by RPG Squarefoot Solutions

² https://www.amazon.com/gp/product/B01LQX0P8Q/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

³ <https://shop.leica-geosystems.com/buy/accessories/blk360-tripod-adapter>

Tablet

While the Leica BLK360 can be used with either Cyclone REGISTER 360 or ReCap Pro for data handling, the workflow for ReCap Pro seemed far more efficient and seamless for our project. Using a tablet with [ReCap Pro for mobile](#) in the field allowed us to send commands to the scanner, check remaining battery life, preview the spherical photo while scanning was still underway, register each scan as we progressed through the site, and view a plan view of all completed scans so far.



RECAP PRO MOBILE SCREENSHOT

To utilize ReCap Pro, we needed an iPad Pro with ReCap Pro for Mobile installed, as well as an Autodesk subscription for the software. We also used a protective case for the iPad and brought a power bank to keep it charged during a full day's work with constant usage.

Importing and Processing

Computer

Any PC running Windows or a Windows virtual machine can be used provided it has enough disk space to accommodate large point cloud files and a decent graphics card. It may be useful to purchase an external hard drive to either store the point cloud files or to free up space on the main hard drive. It must also have ReCap Pro and iTunes installed. ReCap Pro is needed to import the files from ReCap Pro for mobile, and iTunes is needed to recognize the iPad. For a full list of current PC requirements to run ReCap Pro, please see the Autodesk Knowledge Network article available [here](#).

Tablet

The iPad Pro with the captured scans also needs the [BLK360 app](#) installed. While the ReCap Pro for mobile app is used to communicate with the scanner and process the scan information, the BLK360 app is needed to delete scans from the scanner. In addition, a data transfer cable is needed to export the scan information to the computer.

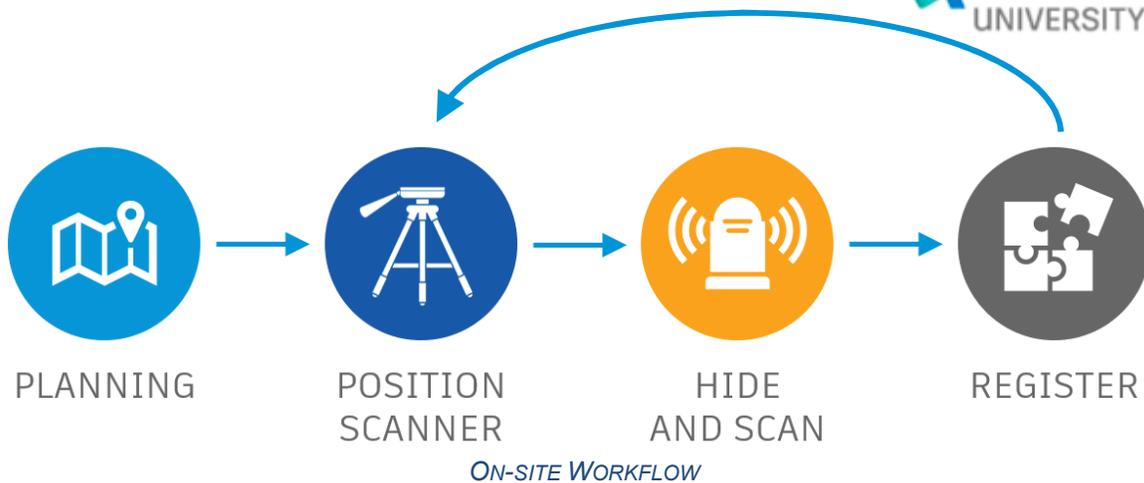
Interference Checks

The PC with scan information needs Navisworks Manage installed in order to run interference checks, along with any 3D models to be checked for interferences. Navisworks accepts a large variety of 3D model types. For our project, the new piping was modeled in Revit.

Point Cloud Capture and Processing

On-site Workflow

Four main steps made up our on-site workflow: planning the route, positioning the scanner, hiding and scanning, and registering the point clouds.



Planning the Route

While a detailed plan is not *truly* necessary, it can be very helpful to have a rough idea of how to approach the project before arriving at the site. These are some key questions we considered while developing our plan:

- How large is the area to be scanned?
 - The Leica BLK360 scanner captures objects extremely well within 5-10 ft (1.5 – 3m) with a max range of 164 ft (50 m). At max range, the points become very spaced out and do not capture detail well.
 - The recommended scanning distance is 32.8 ft / 10m.
- What accuracy is needed?
 - At the recommended scanning distance, the BLK360 has 6mm accuracy. As distance increases, accuracy will slightly decrease. At 20m, there is 8mm of accuracy.⁴
- Where are good break points?
 - One large point cloud for your entire project may be too cumbersome to utilize effectively.
 - It might help to think of how your BIM modelers are going to break up the facility and follow suit. This will help them import the point clouds into their models as needed without further splitting or combining.
 - Scans captured as separate projects on ReCap Pro for mobile can be combined later if needed. Scans captured as a single project can also be split, but it is easier to combine several smaller projects as opposed to splitting one large project.
- Single or multiple levels?
 - Along with the size of the area, consider if you will be able to capture everything you need at a single elevation, or if you need to allow more time to capture multiple levels in the same plan area.
 - Scans can be linked in the field even when changing elevation. When scanning stairways, it worked well to scan once at the top and bottom.
- Crowded or open areas?
 - If the areas you want to scan are crowded with equipment, you should plan to take more scans to account for all the interference and get the

⁴ <https://shop.leica-geosystems.com/blog/blk360-frequently-asked-questions> (Question 8)

angles you need. The places available to place a tripod may also be limited, so it may take longer to figure out the best approach in the field.



CROWDED AREA

- Any key areas of importance?
 - Be sure to plan to take extra scans around any key areas as needed to capture all angles.
- Any time restrictions?
 - If your time is limited, prioritize which areas are the most important and leave others as optional if time allows.
- What scan quality is needed?
 - Scan density can be set to low, medium, or high. There are also HDR options for improved image quality in high contrast places like near a window or in bright sunlight. At the lowest settings, a single scan takes about 2 minutes. At the highest settings, a single scan takes about 9 minutes. High-density scans also use more battery.
 - Scan settings can be adjusted for different individual scans within the same project. They will still register together without any issue. You can save time by saving high-density scans for more critical areas.
 - Most scans for our project were set at medium scan density with HDR Off. Scans took about 3-4 minutes each.
- Is the area repetitive?
 - Some areas, like long hallways, tunnels, or repetitive spaces (like parking garages) are harder to scan than others. The software may have difficulty automatically registering scans to one another since it cannot find unique features to match. When scanning these areas, it is best to [use markers and targets](#).⁵

Positioning the Scanner

There are a few things to keep in mind to ensure placing the scanner goes smoothly:

⁵ <https://shop.leica-geosystems.com/blog/blk360-frequently-asked-questions> (Question 12)

- Start in a central location
 - If scanning a large room, for example, starting from the center of the room will make it easier to register other scans to that central point as you continue to scan.
- Take extra care to level the first scan
 - Each project will base the vertical axis from the first scan. This can be corrected manually by applying coordinates, but if a little more time is spent leveling the first scan, it makes things easier later on.
- Before starting the first scan, open all doorways to allow for one continuous scan. Clear any areas as needed for tripod placement. It is best to avoid moving things once scanning starts to avoid 'ghost' objects in the scans. These can be cleaned up manually later on if needed, but a little planning can go a long way.
- Check the place you want to set the tripod for any drips, spray, or any other environmental hazards. Keep it clean.
- Stand where you want to put the tripod and crouch if needed so your eye level is where the scanner will set. Look around from that position to verify you will capture what you need.



SEE WHAT THE SCANNER WILL SEE

- Avoid placement near bright lights or shiny surfaces for best image quality. While the scan itself will be fine, the colored point cloud will look odd (black areas, white areas, odd color tones).
- When in doubt, just scan it. Scans are quick so scanning something is often quicker than debating about whether or not it is worth scanning. If it is not needed, it can be deleted later.

Hiding and Scanning

After placing the scanner, you get to play a little game of hide and seek to avoid including yourself in the scan. The tablet can communicate with the scanner using the Wi-Fi signal emitted by the scanner up to approximately 164 ft / 50 m according to Leica⁶. In our experience working in underground tunnels with a lot of concrete and metallic machinery, the effective range was closer to 60 ft / 18 m.

Columns, corners, doorways, and large equipment can provide helpful cover. If the scanner is placed high, you can also stand in the blind spot directly beneath the scanner, which expands like a cone the higher it is placed. If there is simply no cover, you can also manually erase yourself from the point cloud later. If you are a good runner, you could also manually start the 10-second timer by pressing the button on the scanner itself and sprinting out of view.



AVOIDING BEING SCANNED

Each fully charged battery lasted about 20 medium-density scans. Having 3 fully-charged batteries ready at the beginning of the day allowed us to work without needing to recharge them. However, we did use a power bank to keep the iPad topped off. Its display was almost constantly in use and it needed to communicate with the scanner frequently.

Registering

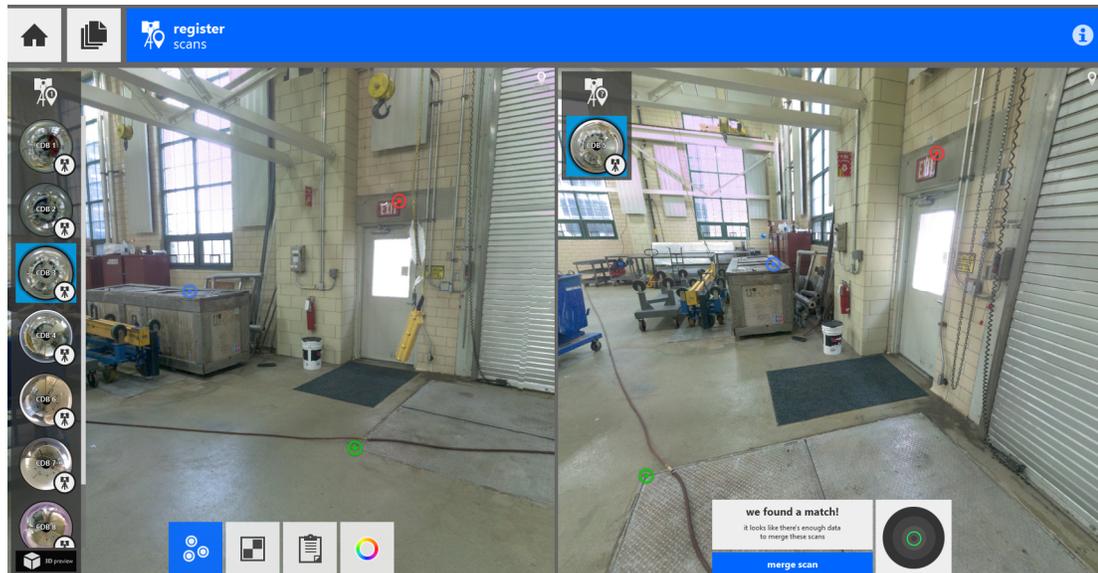
While the next scan was underway, we found that was a perfect time to register the previous scan. There was no need to finish one scan's registration before setting up the next scan. This kept the work moving at a swift pace and minimized downtime.

In most cases, the software was able to automatically recommend a high-quality match between the new scan and the previous scan. However, it would sometimes struggle. If it did not find a good match, there were two options – change the scan it was matching to, or perform manual registration.

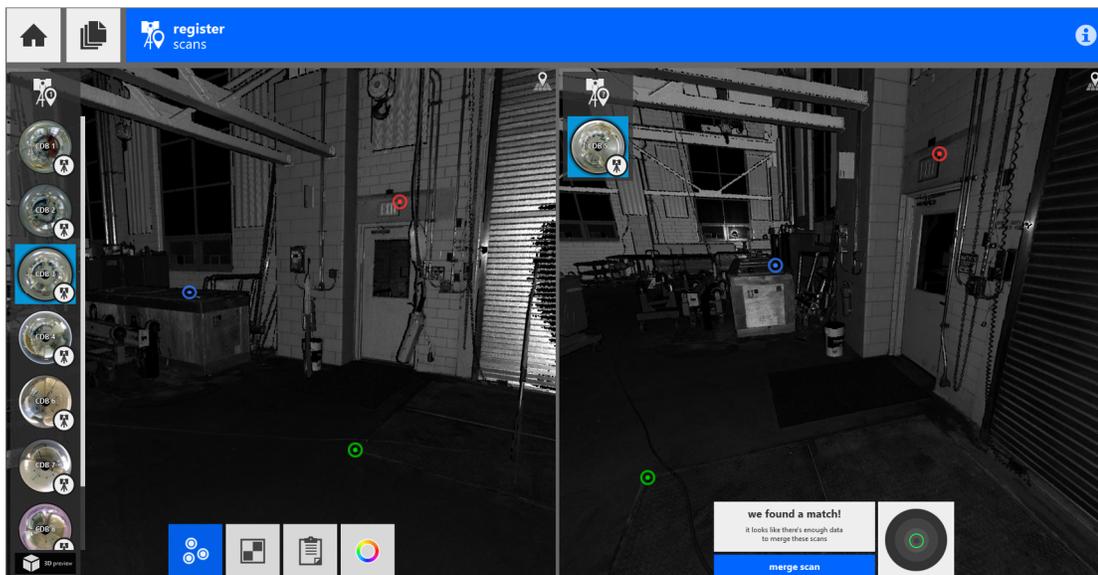
The manual process was very straightforward – the iPad would display a split screen with the scan to match on the left and the new scan on the right. It allowed us to select three corresponding points on each side, then used that information to try again. For example, if a sign on the wall was visible from both scans, we could tap the sign on both scans to provide one of the three points needed as input. If manual registration was still unsuccessful, that meant the scans were too far apart and required an intermediate scan to stitch them together well. Images can be displayed with RGB coloring or intensity,

⁶ <https://shop.leica-geosystems.com/blog/blk360-frequently-asked-questions> (Question 2)

which helped in poorly-lit areas. It worked best when choosing points on flat surfaces at varying elevations and as far away from each other as possible.



MANUAL REGISTRATION (RGB)



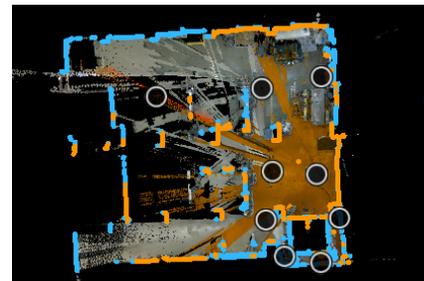
MANUAL REGISTRATION (INTENSITY)

When a good registration match was found, the program provided information on three parameters to help depict the quality of the match. These values were also provided with color coding to show whether those figures were good or poor at a glance⁷.

⁷ <https://knowledge.autodesk.com/support/recap/troubleshooting/caas/sfdcarticles/sfdcarticles/ReCap-What-do-Overlap-Balance-and-Points-6mm-mean.html>

- **Overlap:** a percentage of common features throughout the project. A higher percentage of overlap ensures that features that are shadowed or occluded behind objects in one scan (such as behind a column) are visible in one of the other scans.
- **Balance:** shows the percentage of common features in the scan. If you were scanning a parking lot with few three-dimensional features, you could get the two surfaces to overlap with a small error, but they still might not be registered well because they could slide in relation to each other. A balance value greater than 20% indicates that this has not happened.
- **Points < 6mm:** shows the percentage of overlapping points within 1/4" (or 6mm) of the corresponding feature in the project. This value should be greater than 90%.

Along with these parameters, it also provided a preview of the new plan view of the scans registered so far combined with the new scan. Certain matching elements were highlighted in orange to provide more of an indication of how it matched the two together. It could be helpful to quickly verify walls, columns, or other defining features were aligned well. The software always asked for confirmation before registering a scan, so we had complete control.



PLAN VIEW PREVIEW

Office Workflow

After gathering all the scan data in the field, the data needs to be imported to ReCap Pro (for PC), reviewed and adjusted if needed, and the transferred scans need to be deleted from the scanner and iPad to clear space for more scans. While not required, adding coordinates can also be helpful when preparing files for interference checking.



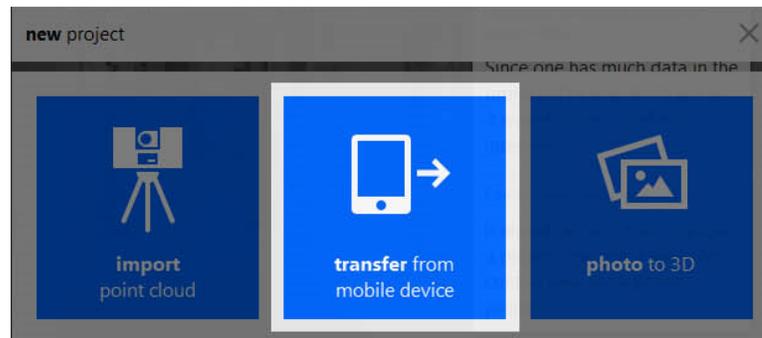
OFFICE WORKFLOW

Importing Scans

Importing scans from the iPad to ReCap Pro (for PC) is a simple process:

- Choose 'New Project' from the home screen
- Choose 'transfer from mobile device'

- Choose the project you want to transfer from the iPad
- Register scans (if needed). If all scans were registered in the field as you progressed through the site, this is already done.
- Index scans – this is simply part of the project creation process
- Launch to view and edit – this allows you to see the point cloud and spherical photos.



IMPORTING SCANS FROM IPAD TO RECAP PRO

Reviewing and Making Adjustments

There are many ways to review a point cloud for quality assurance in ReCap Pro. If any issues are discovered, scans can be re-registered as needed.

- **Registration Report:** This provides a comprehensive list of all registered scans in the project with their Overlap, Balance, and Points < 6mm properties.

scans			
scan name ▼	overlap	balance	points <6mm
CDB 1	32.6%	36.2%	100.0%
CDB 2	65.9%	47.3%	100%
CDB 3	69.6%	42.5%	99.9%
CDB 4	35.3%	29%	100.0%
CDB 6	12.2%	22.2%	100.0%
CDB 7	9.9%	48.3%	100%
CDB 8	23.0%	40%	99.7%

REGISTRATION REPORT

- **3D Model View:** This view allows navigation through the point cloud with Pan, Orbit, Window, Look, and Fly navigation tools, as well as normal mouse controls for visual inspection. Individual scan locations can be zoomed to, grouped together, or toggled on and off. Points can be selected either as a rectangle or custom poly area and deleted with the Delete key.

- **Extents:** in the 3D model view, the extents can be adjusted to focus on a limited area of the model or hide the walls/floor/ceiling across the whole model.
- **Scan Location Groups:** By dragging one scan on top of another scan, a Scan Location Group is created with both scans. This group can be assigned a unique color or toggled on/off together.



3D MODEL VIEW OF POINT CLOUD

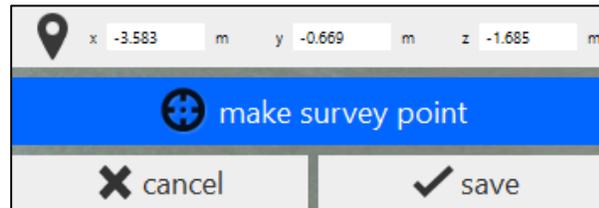
- **RealView Mirror Balls:** The circular, semi-transparent balls in the project show where each scan was taken and display the spherical photos taken at each location. They are shown in both the 3D Model view as well as when inside any individual RealView mirror ball.



REALVIEW SPHERICAL PHOTO VIEW

- **Applying Coordinates (Optional):** Applying coordinates to your point cloud makes it easier to combine with the 3D models used for interference checking, but is not required. To add coordinates, first identify 3 'survey points' in your scanned area where you know the x,y,z coordinates. While in registration mode,

select a RealView mirror ball where a point is visible, then click the spot, click the map marker icon, and enter the coordinates information. Finally, click 'make survey point' to finalize. When returning to the 3D view, it will reposition the point cloud to match the coordinates set.



ADDING A SURVEY POINT

- Export options:** The .rcp file type still requires access to the original data saved to a different folder. The .rcs file type, on the other hand, is a standalone file type but only includes the point cloud, not the RealView photos. There are also options during the .rcs export process to simplify the point cloud by setting the maximum point density anywhere between 1mm and 100mm.

Deleting Information from the iPad and BLK360

Even in the field, as soon as the iPad receives the scan information from the scanner, it can be deleted from the BLK360 using the BLK360 app. Scans need to be deleted one at a time from the app. The scanner can hold approximately 100 medium scans, so it is good practice to clear them all out between uses.

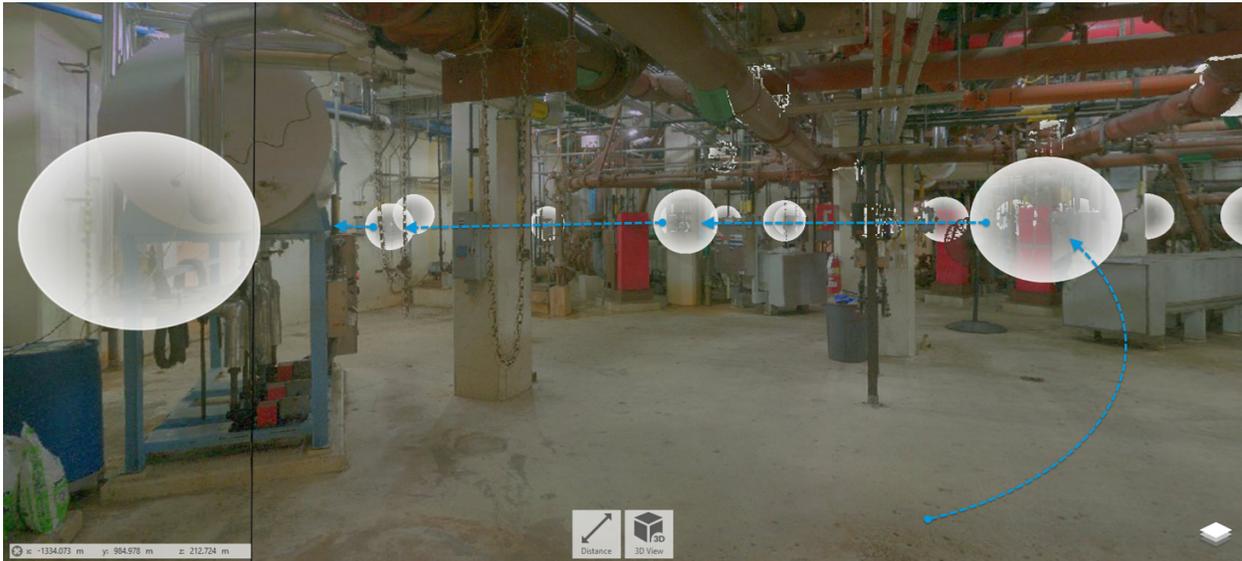
Once files are imported to ReCap Pro (PC) from the iPad, the projects can be deleted from ReCap Pro for mobile. However, the iPad pro has far more relative storage capacity and we discovered we were able to store the entire project's data with room to spare. This allowed us to more easily add to scans from previous days as needed if we discovered weak spots after reviewing the point clouds in the office.

Potential Uses

Virtual Site Visits

Along with the primary benefits from having point cloud information, the spherical RealView photos can be used to take a virtual site tour of a facility from anywhere. Clicking on a sphere allows a person to move from photo to photo to 'walk' through the facility. Each RealView sphere allows full 360 views in all directions, as well as zoom options.

In addition, mark-ups, measurements, and notes can be added to any place on any photo. Those could be used to point out critical pieces of equipment, key areas to check during inspections, hazards to be aware of, or anything else worth noting.



VIRTUAL SITE TOUR WITH REALVIEW MIRROR BALLS

Measurements

Another great benefit of simply having a scan of a facility is the ability to take measurements directly from the point cloud. If a scan is captured at the beginning of a project, well before the design team knows which measurements they need, the point cloud can be shared so measurements can be taken from the office without scheduling more site visits. Additionally, measurements can safely be taken for any scanned surface, even if near the ceiling, down in a pit, or near hazardous materials.

Three distance measuring tools are available:

- **Ortho:** Measured along the x-, y-, or z-axis
- **Free:** Distance between 2 points
- **Surface:** Measured orthogonally to any surface

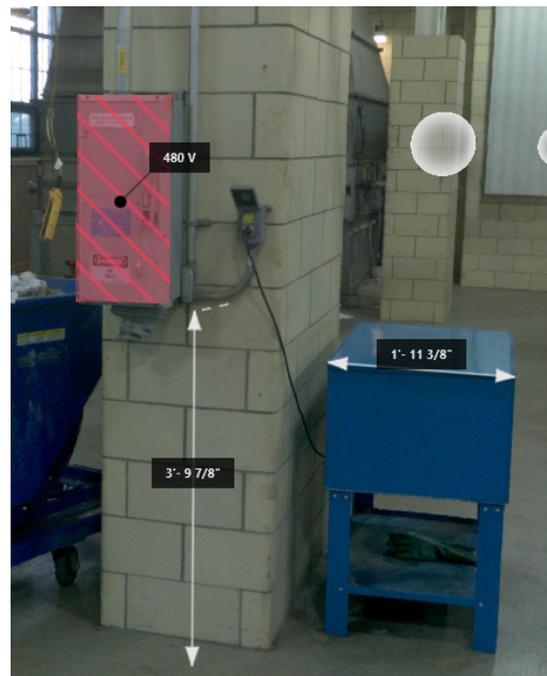
Two angle measuring tools are available:

- **3-point:** The angle formed by 3 points
- **Faces:** The angle formed by two faces.

The program is also smart enough to recognize pipe shapes and provides a Pipe Snap On/Off option to allow measurements from pipe surfaces.

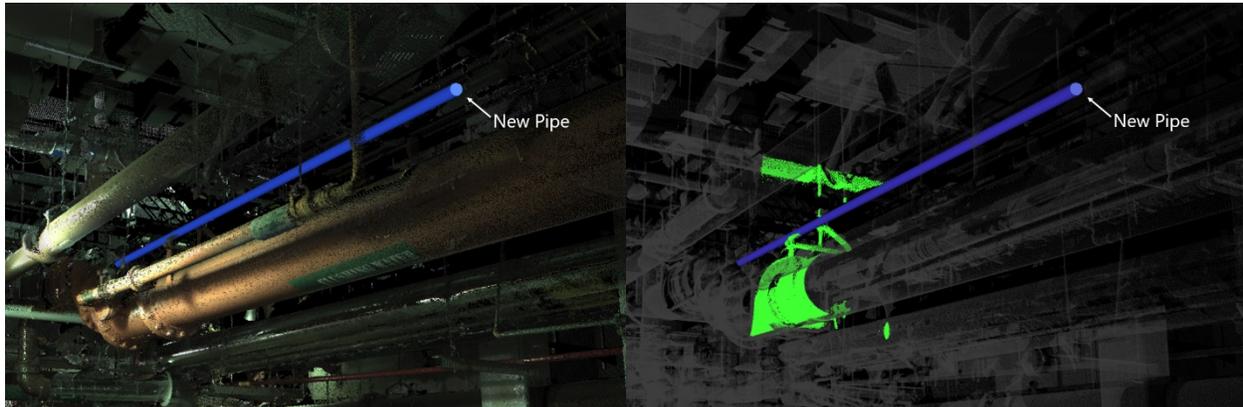
Interference Checking

A point cloud can be directly compared to a 3D modeled object in Navisworks Manage to check for conflicts. The point cloud can be used without converting any part of it to 3D objects. The



MARKUPS AND MEASUREMENTS

illustration below shows an interference detected between an existing pipe hanger captured in a point cloud and a proposed new pipe.



INTERFERENCE BETWEEN A PIPE HANGER AND 3D PIPE

Compatible Models

Navisworks Manage accepts a wide variety of 3D model objects, including the following:

3D Studio	IFC	NX	Sketchup
ACIS SAT	Inventor	Parasolids	Solidworks
AutoCAD	JT Open	Revit	And more
Catia	Microstation	Rhino	
DWF	Navisworks	RVM	

For a comprehensive list of compatible models, see [this Autodesk publication](#).

Navisworks Settings

Certain settings need to be selected in Navisworks for it to recognize the points from the point cloud when checking for interferences:

- From Home, click 'Clash Detective'
- Choose 'New Test'
- For Selection A, choose the new 3D modeled objects
- For Selection B, choose your point cloud
- Under Settings, choose Clearance as the Type option. Tolerance can be left at 0 to detect all clashes or increased if you want to decrease the sensitivity.
- Click 'Run Test'

Once it finishes running, Navisworks will produce a report of the results.

Results

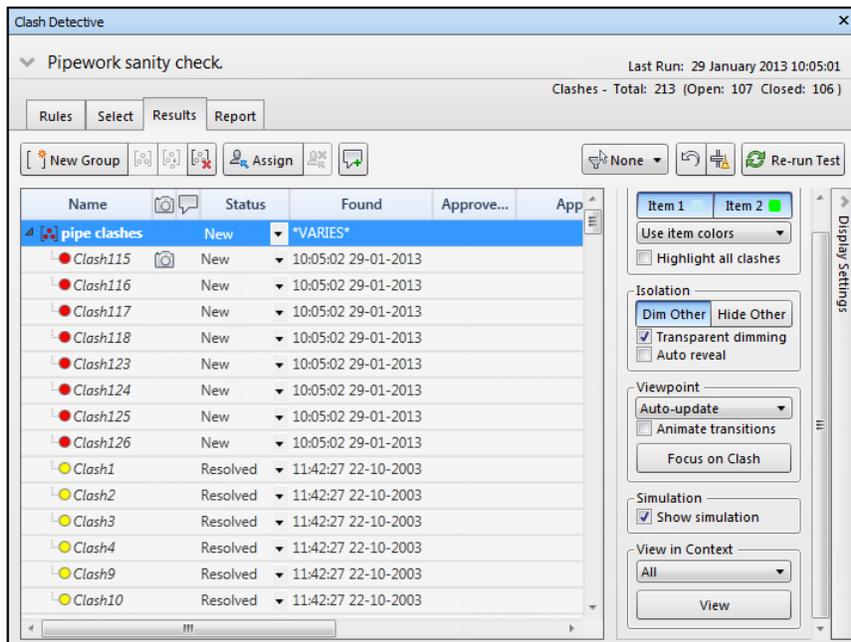
The results pane lists every clash on its own row with many options to view and handle each one:

- Zoom to each individual clash to see where it is

- Apply custom highlighting to point out certain clashes
- Assign clashes to team members for correction
- Update the status of each clash as it is resolved or in progress
- Group related clashes together
- Dim or hide other nearby objects to see clashes in crowded areas more clearly
- Auto zoom to each clash from a starting perspective to get a better feel for where each clash is. This can be helpful in areas with several similar structures.

Clash Detective also remembers previous clashes and maintains the associated information, like status, when re-running tests.

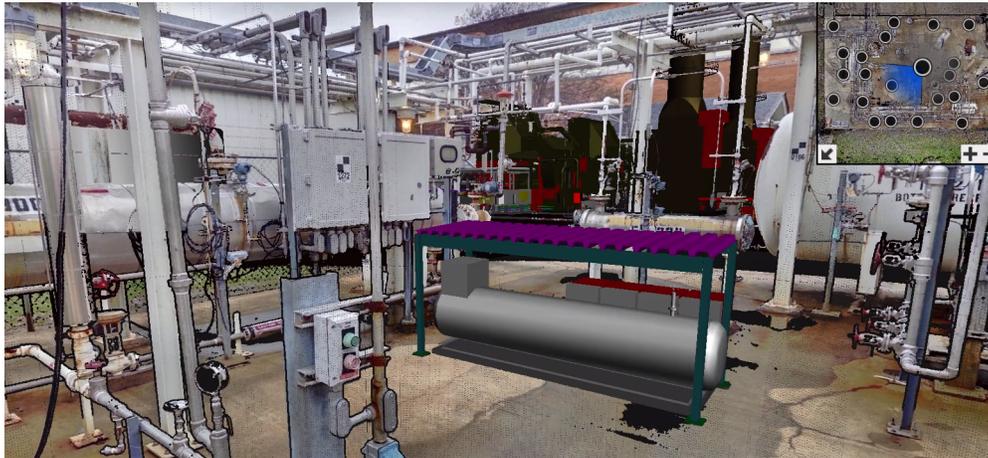
For more information on how to use all the great features of Clash Detective, see the Autodesk Knowledge Network [Clash Detective User Guide](#).



NAVISWORKS MANAGE CLASH DETECTIVE

Augmented Photos

The RealView Photos captured during the scanning process can be blended with Navisworks (nwd) models using the 'Attach Project' beta option. For this to work, the point cloud and Navisworks model need to use the same coordinate system. This can be helpful when trying to convey how improvements will look in an existing building. While this can also be done with point clouds, the RealView photos look more seamless and polished.



REALVIEW PHOTO BLENDED WITH NAVISWORKS MODEL USING 'ATTACH PROJECT'

Confirming the Benefits

At the end of the pilot, we took some time to reflect on our goals and expectations vs. our experience using this new technology. As expected with anything new, there was a learning curve, and mistakes were made, but overall, it was still surprisingly easy to pick up and use. We also discovered new benefits we had not originally considered.

- **Increased data capture for less cost:** Compared to traditional methods, while the pilot was of similar or slightly higher cost due to the learning curve, doing this again with a streamlined approach could realize a cost savings of approximately 40%.
- **Reduced site visits:** Less travel cost, lower risk of slips, trips, and falls, exposure and vector
- **Reduced modeling labor, with practice:** Some training needed to understand how to effectively utilize point clouds
- **Improved design accuracy:** Accurate point cloud capture vs. hand measurements or inaccurate design drawings from previous projects where construction did not closely follow the design
- **Potential for fewer and simplified drawing sheets:** No need to re-model existing pipe for our purposes
- **Bridging workforce skills gaps:** No need to train new people to do things the traditional way if the new way is cheaper, easier, and more accurate
- **Whole design team enabled to take measurements as needed:** No need to request a measurement and wait
- **Can create enhanced visualizations to communicate ideas with the client:** Point cloud views, RealView photos, augmented photos with Navisworks models
- **Client will retain a point cloud for future use:** Could prove useful if they decide to commission a BIM model for the facility

Overall, this pilot was considered a success and proved itself a good option for future projects at existing facilities. While taking a new approach to an old problem can seem challenging, we hope this course helps you make informed decisions for your own projects.