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How to convince your boss to buy a laser scanner

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LASER SCANNERS capture an accurate, 360-degree digital model of a crash or crime scene. To help justify the expense, find a way to tie the use to the source of the funds.

In less than 30 years, forensic measurement methods have evolved from using tape measures to total stations, and now 3D laser scanners. So, what is a laser scanner and why should you, as a crime or crash scene investigator, use one? A laser scanner allows an investigator to capture an accurate, 360-degree digital model of a crash or crime scene, in the form of millions of X,Y,Z data points. You can use these data points, called a "point cloud," to create diagrams and obtain exact measurements of anything that was in the laser's path and review it, *years after the scene was scanned.*

For many investigators, having access to a laser scanner is changing how they approach every scene. Since the laser scanner documents everything the laser comes into contact with, there is no need to spend hours shooting specific points with a total station. Also, there is no need to go back to a scene to shoot points you didn't get the first time, hoping the evidence has not been compromised. Proper use of a laser scanner will help to capture important evidence points the first time at a scene, even if the importance of the evidence is not apparent until later.

Federal Way Police Officers Justify Purchasing a Scanner

In 2013, Federal Way (Washington) police officers Ron Potts and Curtis Tucker recognized the benefits of using a laser scanner for investigations. Corporal Potts had more than 20 years of forensic documentation experience, including extensive use of total stations. They researched various options and decided the FARO Focus^{3D} S 120 was the best choice (the X 330 model was not yet available) for their department.

Potts explained their situation, "Our old robotic total station was no longer being supported by the vendor. I was afraid of having problems with it at a scene, so we needed a new solution. We're not a big police department and each of us performs multiple tasks. We needed a scanner that would be easy to set up and use with minimal operators and which could also be used for interior scenes."

Since they knew it would be difficult to get budget approval to purchase a scanner, Potts and Tucker first did some leg work to identify possible sources of funds. They determined that there was money potentially available in their city from several sources, including:

- Drug seizure funds
- Asset forfeiture from vehicle theft task-force
- Photo enforcement revenue
- Replacement reserves for replacing old equipment
- Grants

Tucker commented, "When trying to justify the expense, you want to find a way to tie the use of the scanner to the source of the funds. For example, how many crime scenes do we have that are drug related? That's an obvious way to justify getting drug seizure money."

To get approval to purchase, they created a presentation that clearly explained the benefits of using a laser scanner to document forensic scenes. They described the restriction of their outdated total stations, with which they could only capture 200-500 points, with the chance of missing important data points. The laser scanner would allow them to capture millions of data points in less time and with fewer operators.

Another important benefit of the scanner that helped justify the expense was its ability to easily measure indoor crime scenes. This is difficult to do with a total station, but the FARO laser scanner is ideal for capturing interior scenes.

Computers, Software, and Other Expenses

Potts and Tucker were successful in convincing their police department to purchase a scanner, but there were some extra expenses that they did not consider. Due to the size of laser scanner point cloud data files, they soon learned that a more powerful computer was required. Potts and Tucker recommend securing a budget for a new computer at the time you purchase your scanner. To be successful working with FARO SCENE Software and large point clouds, you want a

computer with 32 gb of RAM, a solid state hard drive, and a high-end video graphics card. Tucker explains, "At first we thought we could use a slower computer and just spend more time processing the data, but then we had detectives always looking over our shoulder, impatient to see the results. We quickly decided we needed to upgrade the computer."

Potts also suggests working with your IT department, before you start scanning scenes, in order to ensure you have adequate storage space and redundant back-up capabilities. "The data collection requirement is massive. When we were first getting started, I got a call from IT saying you guys just maxed out the dedicated drive for the WHOLE police department…I tried to blame it on the detective's storing photographs, but eventually they found us out," Potts quipped. He recommends having separate, two-terabyte, hard disk drives for data storage and back up space. You may also want to purchase some portable hard drives or large capacity SD memory cards to use for sharing data with defense attorneys.

Other expenses to consider when pricing a scanner are software applications, software maintenance fees, scanner calibration and certification, personnel training, targets, and a canopy for scanning in the rain. Federal Way PD uses multiple software applications to work with point clouds. It often requires multiple scans to capture an entire scene, so they use FARO's SCENE Software to combine, or register, all the point clouds. Then they bring the point cloud of the full scene into FARO's CrashZone Software that has the CADZone Point Cloud module activated.

It's important to use software specifically designed for creating diagrams from point cloud data. FARO's CADZone Point Cloud Software has many features that make it easy to snap to exact data points in a point cloud and accurately draw streets, parking lots, walls, or anything else found at the scene. Pre-drawn symbols

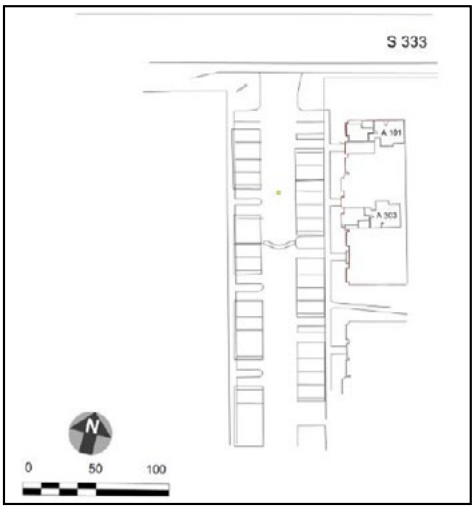


Figure 1. Corporal Potts created this site drawing from the point cloud, showing the apartments involved and the parking lot.

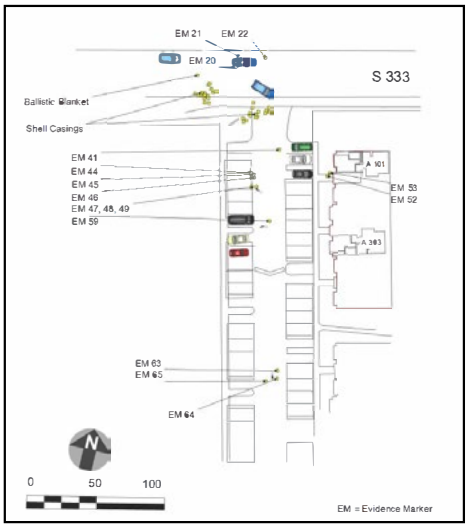


Figure 2. Potts added symbols to show vehicles, shell casings, and other evidence, based on the data points captured in the point cloud.

for vehicles, trees, bodies, and other objects can be sized and rotated to exactly match the point cloud, as seen in *Figures 1,2 and 3*. The result is a completely accurate, 2D and 3D, diagram of the scene. According to Potts, "Since a point cloud is three-dimensional, you have to learn to move around in 3D, but, if you already have CADZone software, there is not going to be much of a learning curve."

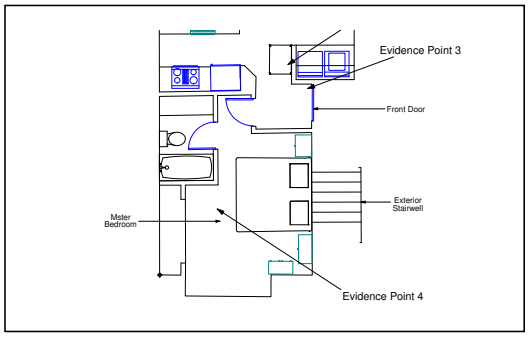


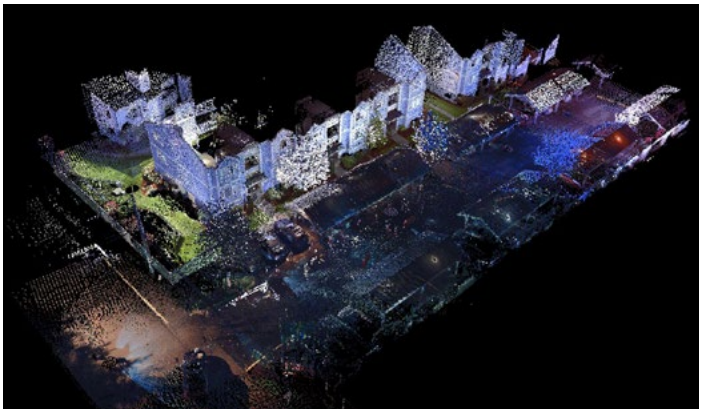
Figure 3. Individual, 2D, drawings of the apartments were created to show evidence locations.

Practice Makes Perfect

Every scanning team can benefit from formal training and plenty of practice capturing scans before they get called to a complicated scene. Potts and Tucker had completed their FARO training and had practiced scanning a house, but they now say they could have used more preparation for their first real crime scene.

Federal Way's first call to use the scanner was on a huge crime scene that included four homicide victims, one deceased suspect, officer involved shootings, and spanned multiple apartments and a parking lot. Potts was concerned that they were not experienced enough with the scanner for such a massive scene and they considered also using a total station to shoot key points.

They found out that it would take a few hours to get the department's total station to the site and they were concerned about potential changes to the crime scene while they waited. They decided to rely on their new FARO scanner. After 14 hours and 35 scans, they were satisfied that they had captured the entire scene, as shown in *Figure 5*. Potts commented, "After we registered all 35 scans, the measurements in the complete point cloud were accurate to within 1 cm. We were happy with that."



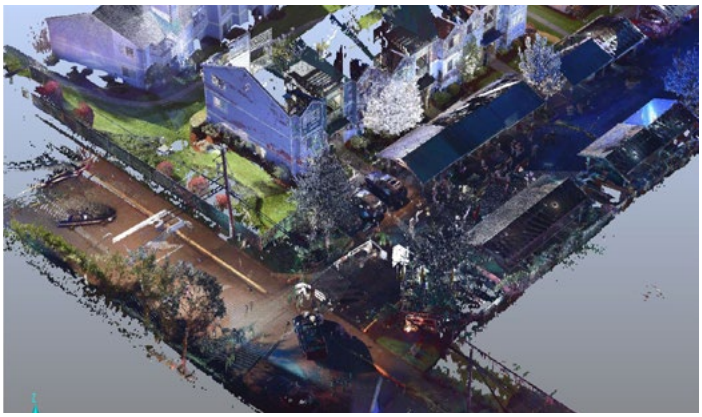


Figure 5. This point cloud was created from 35 scans at a large, multiple homicide crime scene. It was the first time the Federal Way Police Department's FARO Focus3D S 120 Laser scanner was used as part of an investigation.

This was such a huge scene and several police officers were involved, so there were multiple police agencies represented. Tucker said they had to wait to start scanning until other investigators finished their walk-throughs. "No one understood what we were doing. People kept walking in front of the scanner because they thought it was a total station. They were looking for a guy with a pole. We had a lot of educating to do and it took us much longer than we had hoped."

Because the laser scanner was such an expensive piece of equipment, their command staff's expectations were high. Throughout the night, Potts said, "They kept asking us 'When are you going to be done?' So, when you play up the time savings, don't play it up too hard because the first scenes you scan will probably take awhile."

Figure 4. Officer Tucker prepares to scan a vehicle the second time they used the FARO Focus at an actual scene. They took five scans of this scene, including one of the interior of the vehicle that showed a gun wedged between the driver's seat and the center console.

The second time they used the scanner, the process went much faster (*Figure 4*). "After 45 minutes and five scans, we had everything we needed, including a scan that showed the gun wedged in between the driver's seat and the center console. We had the scene registered and ready for viewing within an hour of leaving the scene," Potts explained.

The Scanner Doesn't Lie

The Federal Way officers emphasize that a point cloud is a complete 3D model of the scene, at the time it was scanned. Corporal Potts tells of a scene they scanned where some of the evidence markers had been removed before they arrived. He was accused of "forgetting five pieces of evidence," but when he viewed the point cloud, it was clear that those particular markers had been picked up before they scanned the scene. While the markers were not in the scene, the actual evidence was clearly visible, so he was able to include it in the diagrams. Potts comments, "The scanner doesn't lie."

Both Potts and Tucker understand that the scanner does have limitations. They have learned to overlap scans and use careful placement of targets to ensure easy registration of all the point clouds they capture at a scene. They also have learned that shiny black surfaces, mirrors, and standing water, can be problematic in a point cloud, so they have developed procedures for overcoming these challenges. For example, if there are puddles on a road surface, evidence markers or small cones can be placed before they scan to show the start and end of skid marks.

Tucker said that they keep a workflow document that is constantly being modified as they learn better ways to scan a scene and create drawings from point clouds. He also trains their unit on proper setup and use of the scanner. "It's much easier to reposition a scanner than a total station. You just pick it up and scan again. However, you need to know where it's going to scan.

Figure 6. Corporal Potts says of the FARO Focus3D scanner "You just push a button. It couldn't be any easier than that."

It's like a flashlight. If you can shine a flashlight on a point, the scanner will record it. If you are aware of any points that the laser can't touch, you can take another scan to capture them. It takes practice to learn to position the scanner so you have points that overlap in each point cloud," Tucker explains.

While every measurement method, including a laser scanner, has limitations, scanners are quickly proving to be the tool of choice for forensic documentation. Many agencies, like the Federal Way Police Department, are now using scanners to digitally capture models of crash and crime scenes. Corporal Potts says about their FARO Focus^{3D} S 120 Laser Scanner, "It's an excellent tool – you just push a button. It couldn't be any easier than that."

Ron Potts and Curtis Tucker were kind enough to share their story at the Forensic Scene Mapping conferences, sponsored by the PPI Group. You can hear more about their experiences with their FARO scanner at:

http://www.cadzone.com/point-clouds/108-point-cloud-drawing-solutions/344-ppi-seminar