QUICK ON THE SCENE

CRIME AND ACCIDENT SCENE INVESTIGATIONS IN BRAZIL ARE BENEFITTING FROM THE INCREASED USE OF HIGH-POWERED LASER SCANNERS THAT QUICKLY AND ACCURATELY DOCUMENT INCIDENTS WITH COMPREHENSIVE POINT CLOUDS AND IMAGES. **BY LINDA DUFFY**

Investigating a crime or accident scene is a time-sensitive activity. Laser scanning technology provides a boost to law enforcement by expediting the collection of measurements and corresponding pictures that are later used to re-create the events and determine the cause of the incident.

With over 30 million vehicles on the road in 2020, the industrial powerhouse of São Paulo, Brazil, is dealing with increased congestion on roadways, compounded by reckless driving that leads to frequent traffic accidents. The Scientific Police of São Paulo, a governmental organisation within the Public Security Secretariat, is responsible for carrying out the State's medico-legal and criminal investigations, as well as conducting studies and research in forensics. Out of 4,076 employees, there are 1,498 criminal experts who specialise in producing technical and expert evidence based on the scientific analysis of crime and crash scenes.

A great deal of their work involves responding to car crashes. Faced with growing demand for forensic examinations that require fast collection of accurate measurements, the Scientific Police went in search of a tool that could expedite their forensic activity.

"We conducted surveys using manual and electronic tools, distance gauges/wheel tapes, GPS and drones," says Karin Kawakami De Vicente, a criminal expert with the Scientific Police. "Creating schematic drawings of the crime site to scale with these methods is challenging, especially when it is necessary to close public roads to carry out measurements. In cases with a high flow of vehicles, it takes even longer because we have to interrupt the measurement work to allow traffic through."

Armed with a list of technical characteristics necessary for their forensics work, the agency researched and tested equipment from several manufacturers available on the market before selecting the Trimble X7 3D laser scanner as the best fit.

"The X7 had all the necessary technical features – accuracy, capacity, capture speed, low weight, and a high-density point cloud with excellent detail, even with dark and reflective surfaces," says Kawakami De Vicente. "Plus it self-calibrates so every scan is guaranteed to be accurate without manual adjustments, and we avoid the ongoing maintenance cost and months of downtime for annual calibration. We also like the two-year warranty, which makes the purchase economically viable for us."

Laser scanners quickly collect data to support analysis of accident scenes.

Law enforcement personnel strive to clear roadways efficiently to minimise secondary collisions.

Congested roadways contribute to the increase in accidents that require forensic investigation.

INTUITIVE WORKFLOW

In March 2020, after receiving operational training from local Trimble representative Santiago & Cintra, Scientific Police dispatched the technology to the field. The team began using the X7 laser scanner and Trimble software to expedite data collection, processing and analysis of point clouds and to produce forensic evidence reports.

For example, at a traffic accident that involves a single lane, the team collects at least three scanning points at a distance of 12 to 15 metres between the points, with approximately three minutes of scanning and 15/30 photos collected at each point. In about nine minutes of scanning and 15 minutes of repositioning the equipment, the X7 covers 36 to 45 m of linear distance and an 80 m radial distance.

"At one large multi-vehicle crash scene, we collected 60 scans, but I'd say the average is six," says Kawakami De Vicente. "It depends on the scene and the complexity of the situation."

The need for an efficient workflow and fast data collection is driven by safety concerns for law enforcement and emergency responders, as well as for members of the community.

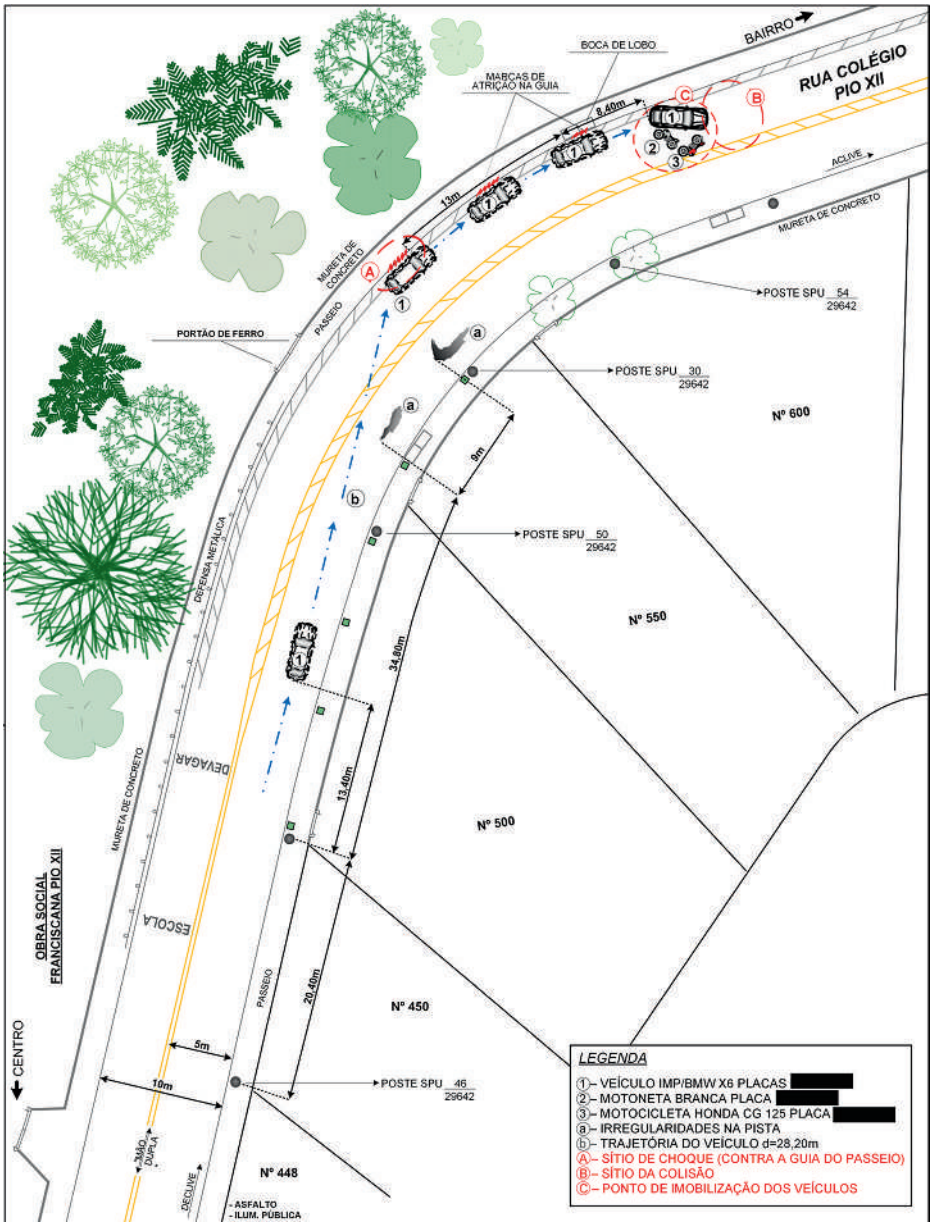
"We have found that laser scanning provides comprehensive 2D and 3D measurements with a high level of accuracy with the added benefit of reducing the time it takes to collect data," says Kawakami De Vicente. "This minimises the impact on traffic and greatly reduces the risk of secondary collisions and additional injuries."

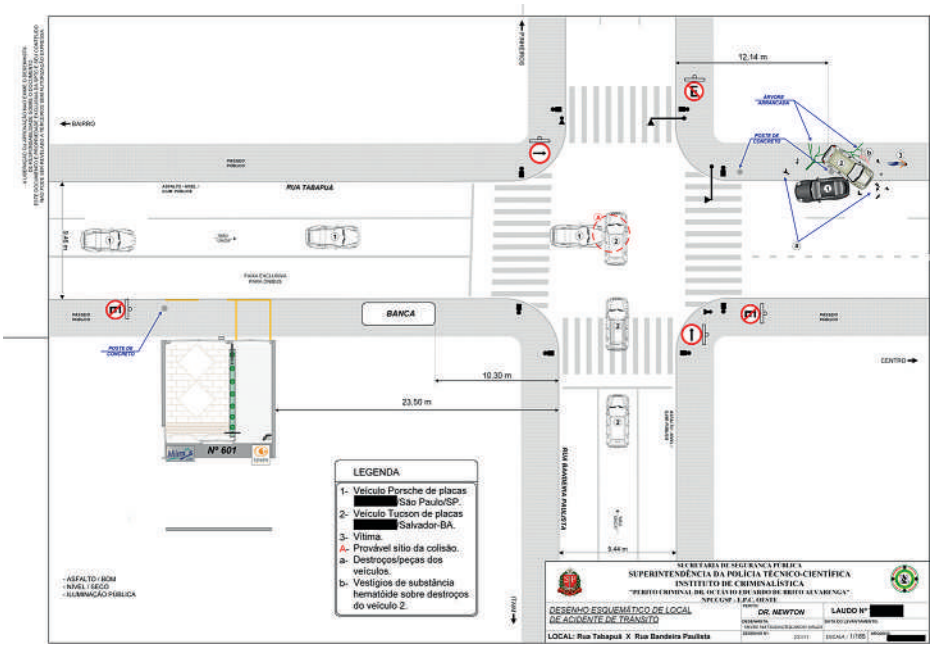
The integrated software streamlines the entire process. After exporting the scans from the X7, the files are imported into Trimble RealWorks to be automatically registered and cleaned. Necessary measurements and markings are performed in the cloud and screenshots of desired views are inserted into the evidence report.

When 3D modelling is required, the point cloud is imported into Trimble Forensics Reveal. The analyst builds the 3D model in Reveal and exports it as a video file to be sent with the report. Sometimes the videos are edited to compose a single video file with the necessary subtitles for explanation.

"Using 3D modelling and PhotoScan visualisations, we can better illustrate the dynamics of what happened by inserting evidence markers and images captured

Point clouds are used to preserve details and calculate accurate measurements to recreate the chain of events.





Investigators create schematic drawings based on laser scanner measurements.

by technical expert photographers on site, in addition to descriptions," says Kawakami De Vicente. "With the new software update, we are starting to work with direct export of Capture to Trimble Reveal, which speeds up our processing and reporting."

PRACTICAL APPLICATIONS

Laser scanning is helpful for streamlining the site survey while achieving millimetre accuracy. Based on positioning from the scanned images and point cloud, analysts produce simulated 3D reconstructions of accidents and crime scenes with animation facilitating the visualisation of the event.

The ability to switch between different viewing angles offers additional insights. When combined with other sources of data, such as traffic monitoring cameras, the analysis produces details such as speed calculations, height, distance travelled, and other necessary measurements. Drone images integrated with scan data provide a view of the site from above.

"The point cloud and pictures preserve the scene exactly as it is; they immortalise the conditions at that moment in time so there is no need to return to collect additional information," says Kawakami De Vicente. "We are able to explore different hypotheses and visualize multiple views of those involved. Our work is more thorough, and we can generate products from the 3D work that will effectively demonstrate the event as it happened."

3D models also aid analysis of fire and explosion sites without risking further injuries on site, while shooting trajectories and blood spatters are studied with the help of software that performs calculations and projects vectors to determine the source.

Using a combination of images with tags, videos, and viewers, the crime experts ascertain the factual chain of events. To preserve the chain of custody, a hash algorithm is applied to the scan registration report and evidence report, and the files are delivered on sealed media to the proper authorities for use in the investigation and in court.

Law enforcement professionals deal with crime and accident scenes in high traffic areas on a daily basis. Poor weather conditions and darkness can exacerbate the challenge of collecting evidence and clearing the area in a timely manner. By optimising work time in the field with an efficient laser scanner, operating expenses are reduced, and results are improved. The comprehensive data set allows new facts to be examined without returning to the site, and forensic software streamlines the data processing for faster reporting. Laser scanning is a highly effective technology for preserving and recreating a crime or crash scene in 3D with millimetre accuracy not previously possible.

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