



Title

Using UAS Technology in Collision and Crime Scene Reconstruction

State

Washington

Category

Emerging and Innovative Technologies

Contact

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Project Initiation Date

April 27, 2017

Project Completion Date

December 31, 2018

Executive Summary

The law enforcement profession is always looking for ways to do our jobs better, faster, safer, and improve the quality of life for the citizens that we serve. In many instances, the use of new and emerging technology allows us the opportunity to do exactly that. Progressive law enforcement leaders are willing to “think outside of the box” and leverage technology to meet their agency’s goals and objectives.

Leveraging technology within state government often provides additional obstacles and hurdles that are challenging to overcome. It takes a high level of perseverance and patience to develop new policies and procedures, gain support of internal and external stakeholders, secure requisite funding, conduct proper research and development, and to complete adequate testing to prove the concept.

The Washington State Patrol’s Criminal Investigation Division (CID) had been looking for ways to reduce road closure time associated with the investigation of collisions and crime scenes on State Route and Interstate roadways. Traditional methods of detectives using hand measurements, total stations, and 3D laser scanners resulted in lengthy road closures, often hours long, at each of these investigations. The challenge of reducing road closure time and congestion, especially along the I-5 corridor, was an issue of constant complaint and discussion at the highest levels of state government. The question, “What are you doing to reduce road closure time and congestion?” led to an evaluation of emerging technology.

In January 2016, the CID leadership began evaluating the use of Unmanned Aerial Systems (UAS), often referred to as “drones”, as a tool to expedite the forensic mapping of collision and crime scenes in Washington state. Washington had issued a moratorium on all UAS use by state agencies; however, that moratorium was set to expire on June 30, 2016. Once the moratorium was lifted, CID leadership began meeting with the Governor’s staff, internal and external stakeholders, the American Civil Liberties Union, the Washington Association of Prosecuting Attorneys, and others to refine our draft UAS policies and procedures and clearly define the scope of our UAS program. In January 2017, a set of CID policies and procedures had been approved by all stakeholders and we were approved to move forward with the next steps. On April 27, 2017, Chief Batiste approved the agency’s CID to initiate a UAS pilot project within the metropolitan counties along the I-5 corridor. The goals of the UAS program were:

1. Reduce road closure time associated with collision and crime scene investigations
2. Improve the quality of forensic mapping capabilities within CID
3. Improve officer safety

The agency’s UAS program has proven to be a resounding success! All program goals were achieved through the pilot project and the use of UAS technology was deployed throughout the agency statewide. The pilot project resulted in a significant reduction in road closure time and congestion associated with investigations, greatly improved CID’s forensic documentation

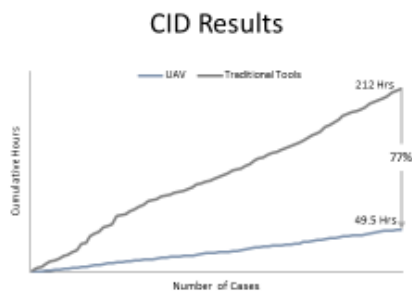
products, and improved officer safety as investigations were conducted from the air rather than in the congested roadways.

The initial pilot project concluded on December 31, 2017 and Chief Batiste authorized an expansion of the UAS program statewide. CID trained and equipped all of its 42 detectives and expanded the program statewide. In addition, Chief Batiste authorized a further expansion of the UAS program to include 15 Field Operations Bureau (FOB) line troopers.

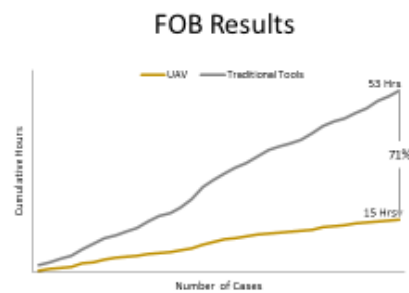
From January through September of 2018, CID detective and FOB troopers used the UAS technology in 126 investigations resulting in a combined 75 percent reduction in road closure time (a total of 200.5 hours). The Washington State Department of Transportation estimates that each minute of State Route and Interstate road closure time has a negative economic impact of \$350. The success of the UAS program not only reduced road closure time and congestion, it also reduces negative economic impact to the State of Washington.

Key Results- 2018 Road Closure Time Reduction

January-September, 2018



- 91 investigations
- 162.5 hours road closure time saved (77% reduction)
- At \$350 per minute- saved \$3,412,500



- 35 investigations
- 38 hours road closure time saved (71% reduction)
- At \$350 per minute- saved \$798,000

Concept

Initially, the concept behind using UAS technology to forensically document collision and crime scenes seemed to be fairly straight forward. Detectives could mark the collision or crime scene as they traditionally do, fly a UAS over the scene to take high resolution digital photographs, and then use commercially available software to generate a data point cloud. Using the UAS would seemingly take far less time than traditional methods of scene documentation which included baseline-coordinate hand measurements, total stations or 3D laser scanners.

During the initial pilot project we quickly learned that bringing this program to fruition would require a comprehensive look at our complete IT infrastructure and making significant changes and improvements. The following includes highlights of each piece of that puzzle:

Standardizing Equipment

The agency's CID is divided into 13 regional offices staffed with detectives. Since IT purchases were previously not well planned or coordinated, each of the 13 regional offices used slightly different hardware (total stations and 3D laser scanners), computers, software, cellular phones, etc. One of our first steps and accomplishments was to standardize our technology platforms in each of the 13 offices.

UAS Evaluation

The CID leadership and detectives evaluated numerous UAS platforms before finally making the decision to purchase DJI Mavic and DJI Matrice UAS platforms. We purchased one DJI Matrice for each of the 13 regional offices and also purchased one DJI Mavic to be personally issued to each detective. The idea was that all detectives are trained and qualified to use one standardized platform for efficiency.

Cellular Phone

The CID leadership and detectives evaluated various types of controllers used to operate the UAS hardware. All CID detectives were issued iPhones and we activated the Wi-Fi hotspots on each device. The DJI UAS platforms allow the iPhone to double as the navigation screen for the flight controller. Additionally, our agency's IT department loaded specific applications onto each iPhone which allowed detectives to quickly and efficiently communicate flight requests and plans with the FAA and local air controller towers.

Software

Detectives standardized their software to include Trimble Forensics Reveal, Trimble Realworks, and Pix4D. This software package was used by 42 detectives statewide but proved to be expensive to purchase software dongles for that many detectives. With the assistance of our agency's IT personnel, we were able to establish a system to network these software licenses and reduce the number that we paid for annually by 75 percent.

Computers

The computers issued to detectives were not capable of providing the processing power necessary to allow the software packages to process the data point clouds generated by the 3D laser scanners and UAS platforms. We tested and ultimately purchased Dell Precision 5820 Towers for each of the 13 regional offices. Those computers were designed for this type of work and reduced our processing time by 80 percent compared to the standard issued computers.

Training

The CID leadership created a new position of a “Technology Liaison” detective. This position became the technology expert for CID and was instrumental in creating training curriculum for all software applications, UAS flight operations, FAA Part 107 training and certification, point cloud data merging and manipulation, and working with software developers to create and modify current software that is already currently on the market. This position provides all required training to detectives and troopers throughout the evolution of the program, to include updated training as new software updates are released.

Data Storage and Transfer

The point cloud data created by the Trimble and Pix4D software typically exceed 5GB in size. It quickly became apparent that we needed to develop additional secured server space that allowed us to store these large case files for years moving forward. Additionally, detectives needed to share these files amongst themselves and with prosecutors in a secure and efficient way. Our agency’s IT personnel worked with detectives to design a secure server that allows them to securely store and share the files.

Merging Data Point Clouds

One challenge that was overcome was the ability to merge two point clouds that were created from our laser scanner and UAS. The laser scanner is able to create detailed point clouds at the expense of time, while the UAS is able to map large areas quickly at the expense of finer detail. The Washington State Patrol was able to take advantage of both by merging their respective point clouds together using common or overlapping points of the area. This allows large scenes to be quickly documented while still capturing the important details. Although multiple hardware is being utilized, used together we are able to save time and open roadways faster without sacrificing evidence.

Significance

As of December 31, 2018, the Washington State Patrol has taken the UAS program from idea to reality. With standardized hardware, software, computers, training and interoperability between all equipment, detectives can respond to collision and crime scenes and complete their forensic mapping and investigation 75 percent faster and produce higher quality final products for prosecutions. The UAS policies and program development have received positive accolades within Washington State and nationally. Several law enforcement agencies are currently in the process of developing UAS programs using Washington State Patrol’s model.

CID leadership have been invited to speak about UAS program development in numerous Washington state and national conferences and professional panels over the last year.

The success of CID's UAS program has resulted in positive ripple effects within other divisions and programs within the Washington State Patrol. The agency's SWAT team has recently been approved to begin using UAS technology in Special Weapons and Tactics (SWAT) team activities. The CID leadership and detectives are assisting SWAT leadership with similar policy and program development. In addition, other divisions have begun initial UAS program evaluation for the use of UAS technology in the management of wildland fire fighting operations.

Impact

The original pilot project goals for the UAS program were as follows:

1. Reduce road closure time associated with collision and crime scene investigations
2. Improve the quality of forensic mapping capabilities within CID
3. Improve officer safety

Goal 1

The data collected during the pilot project shows that this goal was achieved (see chart in Executive Summary). When used by detectives, use of UAS technology resulted in a 77 percent reduction in road closure time. When used by troopers, UAS technology resulted in a 71 percent reduction in road closure time. Combined, detectives and troopers reduced road closure time by more than 200 hours which greatly reduces traffic congestion, secondary collisions, and the need for lengthy detours.

As mentioned in the Executive Summary, traffic congestion on State Routes and Interstates result in a negative economic impact to Washington State. Based on research and studies, it is estimated that each minute of State Route and Interstate road closure time has a negative economic impact of \$350. Saving 200 hours of road closure time, or 12,000 minutes, eliminates a negative economic impact of \$4.2 million to Washington state.

Goal 2

Goal 2 has been achieved in several ways. Using the UAS technology in conjunction with 3D laser scanners allows for a higher quality final product and advancements with the applicable software programs allow for great capability. 3D laser scanners are great for producing detailed data sets but are not ideal for capturing details that are higher than the scanner and out of direct line of sight. UAS technology is ideal for producing top-down data sets but is not ideal for capturing side profiles. Using both technologies and merging the data point clouds together allows our detectives to produce excellent data sets that cover all angles of the scene. Using both technologies together allows detectives to provide higher quality products to prosecutors and involved stakeholders.

Additionally, the UAS technology and software enhancements allows detectives to provide various high-quality "fly-through" animations of collision and crime scenes. These options did

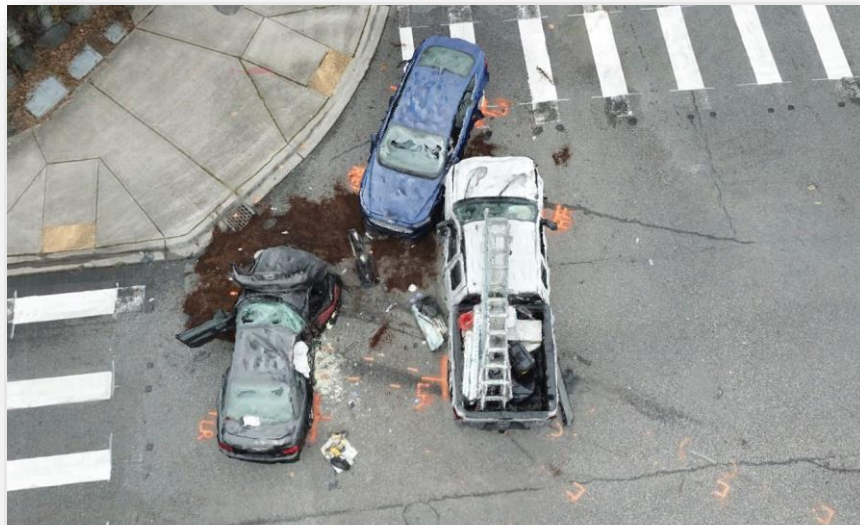
not exist for detectives prior to the UAS program. The “fly-through” animations are extremely valuable for prosecutors when presenting cases to judges and juries.

Using UAS technology has allowed detectives to capture a much larger portion of the overall collision and/or crime scene for illustrative purposes. Prior to the UAS program, forensic documentation was largely limited to the immediate collision or crime scene. With the UAS technology, detectives can capture hundreds or thousands of feet out from the actual scene in order to provide illustrative perspective to judges and juries. This larger perspective is extremely beneficial in complex investigations involving criminal and civil liability, time over distances analyses, high rates of vehicular speed, sight obstructions, etc.

Goal 3

Although difficult to quantify, we believe that Goal 3 was achieved. When using baseline-coordinate hand measurements, total stations, and 3D laser scanners, detectives are required to spend large amounts of time in the roadway collecting evidence and data. When using the UAS technology, detectives can stand in a position of safety, outside of the roadway, to collect evidence and data. The safety of our personnel are always of the utmost importance and every minute that we can get them out of the roadway, where they are exposed to the dangers of passing motorists and other hazards, improves their level of personal safety.

Additionally, lengthy road closures and the congestion that results, often result in secondary collisions. Each year, several Washington State Patrol vehicles are struck by impaired or inattentive motorists at collision investigation scenes and traffic stops. By reducing the amount of road closure time by 75 percent at collision and crime scene investigations, we believe that we are reducing the vulnerability of our WSP first responders.



Sample UAS point cloud from a vehicular homicide