The Truth about Drones
in Public Safety and
First Responder Operations

They're great tools for law enforcement, firefighters, and search and rescue, but public relations must be managed before you begin a program.

By Colin Snow, CEO and Founder of Skylogic Research

Introduction

It may not seem like it, but drones are still in their infancy and only proving themselves through the rigorous testing done privately, commercially, and by state and federal government agencies. Despite the tangible benefits that drones can provide, the public has mixed sentiments about their use by law enforcement, firefighting, and search & rescue operations.

As early as 2012, this AP-NCC poll found a third of the public fears that police using drones for surveillance will erode their privacy. But negative sentiment is changing. In 2013, an Institute for Homeland Security Solutions (IHSS) and RTI International survey found 57 percent of the general public supports the use of unmanned aircraft systems for any application. It found:
- 88 percent of the general public supports drone use in search and rescue operations
- 67 percent support drone use in homeland security missions
- 63 percent support drone use in fighting crime

Nevertheless, despite fears by segments of the public and civil rights proponents that broad use of drones heralds a domestic "surveillance state," many more believe unmanned aircraft systems (UAS) provide tremendous benefits and dividends for public safety. This includes everything from traffic accident investigation, to forensics, to fire investigation and damage assessment.

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In this paper, we'll show how drones have been used successfully in public safety and first responder operations as aerial image and data capture devices thus far, review competitive and traditional approaches using incumbent technology, discuss the opportunities and challenges posed by regulations, outline the lessons learned, and discuss what's next for drones in this industry.

Use Cases

There are good reasons to use drones in public safety and first responder operations. The main idea is, Why not send unmanned aerial vehicles into high-risk or remote emergency situations first to avoid putting first responders at risk while helping victims more efficiently? Drones have already been used in this context. As early as 2008, the Mesa County Sheriff's office in Colorado embraced domestic police drones. Since then, they've done everything from help locate missing people to assist firefighters by surveying burning buildings. In 2013, a Royal Canadian Mounted Police officer used a quadcopter with an infrared camera to find an injured person after his car flipped over in the snow in Saskatchewan.

Ventura County Sheriff's Office of California was also one of the first to use drones in the U.S. for law enforcement and public safety (See Figure 1). In 2013, they teamed with AeroVironment to evaluate limited operation within a restricted unpopulated area for training and evaluation purposes only. Since that time, deputies have deployed a drone mounted with a high-definition camera to help in SWAT operations, searches and rescues, surveillance, hazardous materials calls, and in other instances.

Figure 1 – AeroVironment Qube Drone

Image: AeroVironment

Fighting fires and assessing disaster damage

There are also increasing examples of drones being used by fire services. Drones offer a great opportunity to assess images from incidents and events (both small and large scale) that deliver additional situational awareness to an incident commander. This image-gathering capability can help keep firefighters and other responders from unnecessary danger. Camera drones can record video and/or provide a live video feed. Drones equipped with thermal imaging cameras are particularly useful because they allow operators to see through smoke and guide water application for efficient attacks. They can also help incident commanders find unseen hotspots both during and after extinguishment operations. Furthermore, drones can help fire investigators document post-extinguishment conditions at the fire scene as an aid in analyzing the fire's origin and cause.

There are other uses besides structural firefighting. Drones can provide a real-time overview of the spread of wildland fires and the potential harm to firefighters, the public, and the surrounding communities. Camera drones provide a quick and safe way to capture information relating to problems and damage that have resulted from natural disasters like floods, earthquakes, tornados, and hurricanes. This early information can help incident commanders and emergency managers understand the magnitude of impact on building infrastructure, road conditions, and dwelling safety. This information also provides insight as to what additional resources may be needed from neighboring communities and/or the Federal Emergency Management Agency (FEMA).

Table 1 – Drone Uses and Imaging Recommendations

	Photos	Live Stream Video	Recorded Video	Photogrammetry	Thermography
Critical incidents: SWAT, Bomb Team, and Hazmat Operations		✔	✔		✔
In-Progress calls involving a threat to the safety of any person		✔	✔		✔
Search and rescue operations		✔	✔		✔
Searches for fleeing suspects		✔	✔		✔
Crime-in-progress calls		✔	✔		✔
Crime scene documentation and investigation	✔			✔	
Traffic accident scene documentation and investigation	✔			✔	
Pre-fire plans	✔				
Fire burn reconnaissance	✔	✔			✔
Post-fire documentation and investigation	✔		✔	✔	
Post-disaster reconnaissance	✔	✔	✔	✔	✔

Source: Skylogic Research

Drones can also be equipped with sensors for hazardous materials detection and monitoring spills, leaks, train derailments, or other active hazmat incidents. Because they are portable, small drones are particularly adept at getting immediate situational awareness. First arriving units can quickly deploy a small quadcopter in a few minutes and stream aerial video or thermal imaging to the command post to identify threat areas.

Drones loitering over fires can also track crews and monitor their locations and progress, help warn personnel of changing or dangerous conditions, ensure evacuations, and monitor perimeters. It's important to note, however, that small multirotor drones have limitations. These include the ability to have stable flight and video in winds over 45-50 miles per hour.

Testing is ongoing on how to use drones during forest and wildland firefighting operations. Tests include the drone's capability to help identify hotspots, threat areas, crew access routes, and remotely pick up water and deliver it to extinguish the fire.

Table 1 gives a partial list of the many uses for drones in public safety and first responder operations together with the image capture and image processing that best fits the need.

Opportunities

All these use cases are vital public safety matters that civilian market drones are well suited to handle. Cities, towns, and municipalities facing strained budgets and dwindling resources may more easily be able to afford small drones than traditional big ticket first response equipment and personnel. Consequently, drones will give some local governments a bigger bang for their buck.

But would-be adopters need to know that in the U.S., the Federal Aviation Authority (FAA) controls the skies and has

Terms to Know

Photogrammetry is a technique that uses photography to extract measurements of the environment. This is achieved through overlapping imagery, where the same feature can be seen from two perspectives. With photogrammetry, it is possible to calculate distance and volume measurements. Companies use these outputs to create "point clouds" or 3D images for rendering building images.

Infrared thermography (aka thermal imaging) uses thermographic cameras to detect radiation in the long-infrared range of the electromagnetic spectrum and produce images that make it possible to see something without visible illumination. Since the amount of radiation emitted by an object increases with temperature, thermography allows one to see variations in temperature. When viewed through a thermal imaging camera, warm objects stand out well against cooler backgrounds. These images can make humans and other warm-blooded animals become easily visi-

Figure 2 – Thermal Image

Image: DJI

ble against the environment, day or night. As a result, thermography is particularly useful to the police and fire fighters and other users of surveillance cameras to find fire hotspots and humans or animals that may be in danger. (See image example in Figure 2)

created regulations (safety standards) governing the operation of aircraft. Thankfully, not all, but still some, of the Federal Aviation Regulations ("FARs") apply to public aircraft. The FAA allows first responders with an FAA certificate of waiver the ability to create their own safety standards for the pilots, the aircraft, and maintenance. Additionally, first responders can choose to also operate under the newly created and liberal Part 107 small UAS regulations if that benefits their operations more.

In the U.S., it's reported there are almost 18,000 state and local law enforcement agencies with at least one full-time officer or the equivalent in part-time officers. That includes over 12,500 local police departments and over 3,000 sheriffs' offices, and 50 primary state law enforcement agencies. The National Fire Protection Association reports that in 2014, there was an estimated total of 29,980 fire departments, of which 19,915 (about two-third) were staffed only with volunteers. Smaller law enforcement agencies and volunteer fire departments that have limited finances stand to benefit greatly because the price entry point has decreased for consumer drones (like the one pictured in Figure 3), their capabilities have increased, and the new liberal Part 107 regulations make it easier to legally operate.

Challenges

Many people do not understand that there are multiple layers of law besides the FAA regulations that are applied to drones: state, county, and local (city, town, village, etc.), and potentially all at the same time! The National Conference of State Legislatures reported on June 21, 2016, that at least 18 states have passed laws "requiring law enforcement agencies to obtain a search warrant to use UAS for surveillance or to conduct a search." One unintended effect with these unwarranted government surveillance laws is they "spill over" onto other departments in government agencies that are not law enforcement. For example, if a Florida Fish and Wildlife (FF&W) biologist wanted to use a drone for an ecological study, he would have

Figure 3 – DJI Drone with Thermal Imaging Camera

Image: DJI

to comply with the Freedom from Unwarranted Surveillance Act because another department in the FF&W enforced game hunting laws. In other words, that biologist might have to go get a warrant to look at ducks.

The biggest challenge to the implementation of drones is the public (e.g., culture, different types of personalities, needs, or wants). Here is a list of statements that will ground your drone program faster than the laws will:
• I'm about to retire in the next two years. No way is this happening on my watch. I want to protect my reputation.
• These things are just toys. Let the real men do the work in helicopters or on foot.
• I'm the county attorney. I can figure this out. It's my project now until I give it back to you.
• I know I'm unqualified to run it, but I want this so I can move up in rank!
• I don't have time. I have a bunch of other things to do.

With each of these situations, focus on trying to develop win-win scenarios with these people. William Ury's book called *Getting to Yes* is a very helpful book to negotiating win-win

Competitive Traditional Approaches

Helicopters (aka "choppers") are the mainstay of aerial support for public safety and search and rescue operations – and some agencies have many of them. For example, the Los Angeles Police Department (LAPD) Air Support Division, which was a pioneer in aerial policing, has 17 choppers. Their air support division remains the nation's largest such operation. For 20 hours a day, LAPD usually has at least two airships in the sky.

Police choppers are routinely used for traffic stops (if they involve wanted or allegedly armed-and-dangerous suspects), property crimes (to spot burglars, car thieves, and taggers), perimeters (to help cops on the ground to set up dragnets for an array of suspects), car chase pursuits (so ground units know when to back off to avoid endangering other drivers), and violent crimes in progress (for the fastest possible response).

But for many operations, police helicopters have serious limitations that small drones don't have. At low altitude (1,500 feet and below) choppers have to fly in circles because hovering becomes dangerous. In the event of engine failure, a helicopter would have no momentum to glide to a crash landing. News choppers (which typically hover) are so much higher that they don't face this problem. To generate some air speed, police helicopters keep moving. While drones will not supplant their use entirely because they are limited to operations within visual line-of-sight and maximum altitude of 400 feet above ground level (AGL) - or, if higher than 400 feet AGL, remain within 400 feet of a structure - there are many circumstances that do not require a fully equipped helicopter. It is already proven that drones can assist with lifesaving operations at a significantly reduced cost to the taxpayer.

deals and will have much application in navigating the human problems blocking implementation.

Lessons Learned:

How Not to Run a Drone Program
Back in 2010, the Houston Police Department (HPD) purchased an Insitu Scan Eagle and conducted a private aerial demonstration, but the invitation was marked "no media allowed." News crews on the ground and a helicopter in the air pounced on this opportunity to film it, but officers threatened the news crews by saying a no fly zone was in place, which was false. The HPD was forced into hastily setting up a news conference when they realized that the whole event had gone public. During the news conference, the HPD assistant chief responded to the question of whether these drones would be used to ticket speeders by saying, "I'm not ruling anything out." The backlash prompted Mayor Annise Parker to scrap HPD's plans for using drones when she took office. The same news channel that reported on the HPD incident again reported in 2011 that the Montgomery County Sheriff's Office, a Houston area law enforcement agency, is prepared to launch an unmanned drone that could someday carry weapons.

Here is the important take-away. The best thing you can do is get the media on your side from the beginning by being upfront, honest, and transparent BEFORE you conduct a demonstration. Understand that the media influences public perception. Announce the demo, hold a press conference, and invite all the press out to the demo. Your PR nightmare could cause problems for your neighboring law enforcement agencies. Many people hate the idea of law enforcement possessing the drones, but have very little objection to the fire department using them. You might want to consider the drone operations be run out of the fire department for PR and maybe legal reasons.

Drones in Search and Rescue Best Practices
The 2015 Texas Memorial Day floods caused devastation, but also an opportunity to field drones for disaster response. Coitt Kessler, Program Manager of the Austin Fire Department Robotic Emergency Deployment (RED) Team, and Gene Robinson, head of Unmanned Aircraft Operations for the Wimberley Fire Department, created a white paper on the experiences and lessons learned which you can download via sUAS News here. They report that drones — and at one point 16 manned aircraft — were used for disaster relief for multiple days, but not without problems. Problems included multiple rogue manned and unmanned aircraft being operated within the temporary flight restriction, the loss of communication abilities via cell, the line-of-sight problems with handheld aviation radios, and the ability to request FAA approval to operate in the area.

Here are the key take-aways:
• Multirotor aircraft are quick to launch and should scout out ahead of the manned aircraft to identify people needing rescuing.
• Fixed-wing drones for mapping might be difficult to launch due to trees and terrain so the drone might need to be launched in a clearing.
• All drone operators on the ground must have long-range handheld radios for communication and must coordinate with Incident Command.
• Develop a plan to get FAA approval for the drones for extenuating circumstances.

What's Next for Drones in Public Safety and First Responders

Up until recently the market for drone use by public safety and first responders was dominated by a few manufacturers like AeroVironment, Aeryon Labs, Boeing/Insitu, Draganfly, Lockheed Martin, and Microdrones – most of whom have repurposed their military drones for civilian use. But these are expensive solutions. Still, for many agencies, purchasing from these vendors make sense, especially if they want a solution that comes with training and support.

For those that don't have big budgets, there are other solutions. As mentioned above, smaller law enforcement agencies and volunteer fire departments with limited finances stand to benefit greatly because the price entry point has decreased for consumer drones and their capabilities have increased. For example, DJI, the world's largest drone manufacturer, makes a removable thermal camera that can be paired with a DJI Matrice 100 drone and provide an estimated flight time of 30 minutes. DJI also announced that it is training first responders in Europe to use drones in rescue operations. The project, which will be rolled out in partnership with the European Emergency Number Association (EENA), a Brussels-based NGO, could improve efficiency and save lives. That said, we expect more low-cost / high-value solutions from companies like DJI as competition for these customers in the U.S. heats up.