

Building and Managing a Successful Public Safety UAS Program: Practical Guidance and Lessons Learned from the Early Adopters



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Final Report to the National Institute of Justice

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Letter from the President of the National Police Foundation

Dear Colleagues,

As with many emerging technologies, unmanned aircraft systems (UAS) promise improved efficiencies, increased operational capabilities, and significant cost savings for law enforcement and public safety agencies. UAS can greatly reduce the amount of time and staffing needed to conduct a missing person search or document the scene of a traffic accident, and they can provide valuable aerial perspectives to improve the situational awareness of officers during high risk operations. These efficiencies and capabilities are critical in an environment of challenging staffing levels and budgetary constraints.

Yet, this technology is not without its risks and challenges. Agencies that may now be able to afford to deploy aerial assets may lack personnel with the fundamental aviation knowledge to operate aircraft safely and proficiently within the National Airspace System (NAS). Furthermore, the community may be understandably concerned about enhanced surveillance capability UAS technology can provide, if used in that manner.

The National Police Foundation, with support from the National Institute of Justice, has developed this report as a resource to aid law enforcement and public safety agencies in leveraging and deploying UAS technology in a safe, effective, and responsible manner. The report relies on the lessons learned by agencies that were among the very first to acquire and successfully deploy UAS for public safety operations, and it complements the National Police Foundation's [Center for Unmanned Aircraft Systems in Public Safety](#) and its [Guidelines to Enhance Community Trust](#), developed with support from the U.S. Department of Justice's Office of Community-Oriented Policing Services (COPS Office). It is through the systematic collection and dissemination of this type of lessons learned from innovators within and outside of our field that we can advance policing.

The National Police Foundation would like to offer a special thanks to the York County Department of Fire and Life Safety, the York-Poquoson Sheriff's Office, the Michigan State Police, the Mesa County Sheriff's Office, the Alameda County Sheriff's Office, the Federal Bureau of Investigation, and the Miami-Dade Police Department. Without their support for research and their desire to help other public safety agencies across the country, this report would not have been possible.

We are also indebted to the officers, deputies, agents, and staff that made our site visits and interviews possible. Specifically, we would like to thank Commander Tom Madigan, Sergeant Matthew Rogers, Sergeant Andrew Cohen, Director Ben Miller, Deputy Chief Chris Sadler, Major Ron Montgomery, and Supervisory Special Agent Mike Rogers. Their dedication to public safety and their subject-matter expertise are testaments to the professionalism of their respective agencies, and they exemplify the great men and women that serve our communities across the country.

Finally, we offer our special gratitude to Chief Donald Shinnamon (Ret.) for the long hours and hectic travel schedule he endured to ensure the research was completed, and Director Eddie Reyes for his guidance, work ethic, and enthusiasm during the early stages of the project. The project would not have succeeded without their hard work and dedication to advancing public safety.

Sincerely,



Jim Burch
Interim President
National Police Foundation

A. Introduction

It happens countless times each day—police are called to investigate a crime, assist with a traffic crash, search for a missing child or endangered adult, or respond to any number of other calls for service. During rapidly unfolding incidents, officers depend on gaining situational awareness as quickly as possible to effectively manage an incident and bring it to a successful conclusion. For other incidents, it may be necessary to document the scene for further investigation and later presentation in court. In many of these cases, an aerial perspective can be of great value in quickly and effectively gathering critical information for law enforcement. For the small number of agencies with traditional manned aircraft, air support may be requested to assist.¹ For the vast majority of law enforcement agencies in the U.S., however, air support is simply not routinely available.

By the mid-2000's, the military was growing increasingly reliant on unmanned aircraft systems (UAS) on the battlefields of Iraq and Afghanistan.² Hand-launched aircraft had given warfighters on the ground the ability to see over the next hill or around the corner without endangering troops.³ With the perceived success of the technology in providing such situational awareness, discussions began about how unmanned aircraft could be used to support public safety operations. There was great interest, but a variety of obstacles made it challenging to integrate UAS technology into police operations.

Over a decade has now passed since those early attempts to transfer the technology, and the use of small unmanned aircraft systems (sUAS) is becoming more common as the technology is now widely available and affordable for the general public. Even so, research has identified only 599 state and local law enforcement agencies (out of almost 18,000 agencies in the U.S.) that are using the technology.⁴

As sUAS technology continues to mature and the barriers to its use continue to shrink, law enforcement, and public safety more generally, will likely see a proliferation of the technology, some of which has already been seen over the past two years.⁵ As such, there will be many agencies, particularly those lacking aviation experience, that will require education and guidance in establishing and maintaining an effective, lawful, and publicly accepted sUAS program. This report aims to address that need by discussing the benefits and applications of sUAS technology; examining major obstacles to successful implementation; identifying important considerations and lessons learned in building and managing an sUAS program; and providing examples of developed programs. It is intended that this report will help not only those agencies interested in starting sUAS programs, but also those agencies looking for guidance on how to sustain and grow their existing sUAS programs.

This report is intended primarily as a resource for public safety UAS program managers, both those with and without prior aviation experience. Accordingly, the areas of primary consideration for implementing and managing a UAS program are organized as sections in the report for ease of reference, with descriptions of the studied agencies provided as examples. **Section B** provides an overview of sUAS technology and its possible applications, and **Section C** outlines major obstacles the early adopting agencies encountered when developing their UAS programs. **Section D** provides a brief description of each of the agencies in the study, and **Section E** addresses a critical initial step in developing an sUAS program—gaining political and community support. This section discusses how each of the studied agencies secured support, then provides some general

1 Gettinger, D. (2018, May). *Public safety drones: An update*. Retrieved from <https://dronecenter.bard.edu/public-safety-drones-update/>

2 Smith, J. (2016, April 20). *Exclusive: Afghan drone war – data show unmanned flights dominate air campaign*. Retrieved from <https://www.reuters.com/article/us-afghanistan-drones-exclusive/exclusive-afghan-drone-war-data-show-unmanned-flights-dominate-air-campaign-idUSKCN0XH2UZ>

3 Associated Press. (2008, January 1). *Military relying more on drones, mostly in Iraq*. Retrieved from http://www.nbcnews.com/id/22463596/ns/world_news-mideast_n_africa/t/military-relying-more-drones-mostly-iraq/#.XCY81c17lyw

4 Gettinger, D. (2018, May). *Public safety drones: An update*. Retrieved from <https://dronecenter.bard.edu/public-safety-drones-update/>

5 Ibid.

guidance on the topic. **Section F** then outlines the major areas to address in an agency's UAS operations manual and offers some examples as to how the studied agencies conduct their operations. **Section G** highlights some points of consideration when acquiring unmanned aircraft and offers a few resources to use as guides. **Section H** discusses the critical importance of data collection and how data can be utilized to drive a successful UAS program. This section offers an overview of federal, state, and agency reporting requirements and provides recommendations about the data agencies should capture during UAS operations. Finally, **Section I** offers lessons learned from the studied early adopters, and **Section J** discusses the future of UAS technology in public safety. A glossary of key definitions important for a basic understanding of aviation and unmanned aircraft operations is included in the **appendices** of this report, along with a variety of other resources that will be referenced throughout the document.

The information presented in this report was gathered through interviews, documentation review, and site visits at six law enforcement agencies across the country. These agencies include the Alameda County (CA) Sheriff's Office, the Federal Bureau of Investigation, Miami-Dade (FL) Police Department, Mesa County (CO) Sheriff's Office, the Michigan State Police, and the York County (VA) Fire Department/York-Poquoson Sheriff's Office Joint UAS Program. All of these agencies were early adopters of sUAS technology and provide both unique experiences and common lessons learned that can benefit other law enforcement and public safety agencies.

It is important to note that, while there are many types of unmanned aircraft varying significantly in size and capability, the focus of this report is on small unmanned aircraft systems (sUAS).⁶ These are typically lightweight, battery-powered aircraft that can be deployed from a patrol vehicle, capable of carrying high-definition optical and/or thermal imaging cameras.

⁶ For example, the battlefield-tested Black Hornet weighs only 1.16 ounces and provides live video feed to its operator up to a mile away. At the other end of the scale, the U.S. Air Force Global Hawk, a high altitude, long endurance surveillance aircraft, has a wingspan longer than a Boeing 737 passenger plane.

B. Overview of sUAS Technology

Benefits of Air Support for Police Operations

An aerial perspective, whether to support ongoing operations or to document an event, can be invaluable because, simply put, more can be seen from the air. For example, consider a situation where police are dispatched to a crime in progress inside a multi-story building. Officers respond and establish a perimeter. Two officers are needed to watch the four sides of the building. The roof cannot be seen from the ground. An aircraft, though, whether it be an airplane, helicopter, or sUAS, can see the roof and most of the four sides of the building at the same time, without exposing perimeter officers to danger. The information provided by the aircraft can improve situational awareness and tactical response, and at the conclusion of the event, the video documentation can provide critical evidence at trial, as well as training material for future events.

In search applications, aircraft, especially those equipped with thermal sensors, can cover a larger area than officers and other personnel on the ground and do so in less time. Furthermore, aircraft can search areas that are dangerous or inaccessible for ground personnel.

Aircraft are also particularly useful for documenting incident scenes. Aerial photographs provide a unique perspective for later presentation in court and, as will be discussed, facilitate forensic photogrammetry, which can enhance and expedite scene documentation and subsequent analysis.

In the words of one of the early adopters, Ben Miller, the former UAS program manager at the Mesa County Sheriff's Office, *"There is no doubt of the benefits of using UAS for law enforcement. In tactical operations, the ability to see the whole picture is critical to decision makers on the ground. Crime scene reconstruction is also greatly aided by seeing the picture from the air."*

Relative Costs of Manned vs Unmanned Aircraft

While the benefits of air support are widely recognized, most law enforcement agencies simply do not have the financial or technical ability to own and operate manned aircraft. There are approximately 18,000 law enforcement agencies in the U.S., yet only 268 local and 50 state law enforcement agencies have manned aircraft.⁷ Still fewer provide around-the-clock air support. The result is that most law enforcement agencies do not have access to air support for normal operating activities.

The advancement and proliferation of sUAS technology, however, is making air support much more affordable and attainable for public safety agencies. Compared to manned aircraft, unmanned aircraft are significantly less expensive to purchase and operate:⁸

- **Acquisition Costs:** A new helicopter can cost millions of dollars, while professional quality sUAS, with optical and thermal-imaging cameras, cost thousands of dollars.⁹
- **Hourly Operating Costs:** Operating costs for small unmanned aircraft usually amount to the cost of the electricity to charge the aircraft's batteries, which is miniscule in comparison to the fuel costs of traditional manned aircraft. Other costs could include replacement parts, such as batteries and propeller blades. When these are factored in, the cost per hour rises, but not significantly. For example, Mesa County calculated the direct cost of their UAS flight operations to be around \$13 per hour.

⁷ Gettinger, D. (2018, May). *Public safety drones: An update*. Retrieved from <https://dronecenter.bard.edu/public-safety-drones-update/>

⁸ See the National Police Foundation's *sUAS and Public Safety* infographic for a visual representation of the cost comparisons: <https://www.policefoundation.org/suas-and-public-safety-infographic/>

⁹ Gettinger, D. (2018, May). *Public safety drones: An update*. Retrieved from <https://dronecenter.bard.edu/public-safety-drones-update/>

- **Training Costs:** Pilots of manned aircraft require extensive training, certification, and proficiency to fly police missions, whereas pilot requirements for unmanned aircraft are much less extensive. Furthermore, because hourly operating costs are significantly cheaper for unmanned aircraft, the cost of flight time to obtain proficiency is cheaper.
- **Maintenance Costs:** Manned aircraft can require expensive maintenance procedures, while unmanned aircraft usually only require software upgrades and the replacement of small parts, which can typically be performed by trained pilots/operators.
- **Storage Costs:** Unmanned aircraft are typically carried in hard cases in police vehicles, thus nearly eliminating the storage costs typically associated with manned aircraft.

Given the cost savings, unmanned aircraft may be a viable option for agencies that desire air support but cannot afford to deploy traditional manned aircraft. It is important to note, however, that sUAS are not currently considered a replacement for manned aviation, but rather a supplement to traditional aircraft. Despite their ever-growing capabilities, sUAS cannot yet perform all of the functions of manned aircraft, such as medical evacuations, rescue hoist operations, and the deployment of high-powered searchlights to illuminate large areas. Furthermore, airspace access, night operations, and flights over populated areas are still easier using traditional manned aircraft.

Evolution of sUAS Technology in Public Safety

The use of unmanned aircraft technology by the military dates back to World War II when radio-controlled airplanes were used. The development of unmanned aircraft continued but was revolutionized in 1995 with the development of what would become known as the Predator, manufactured by General Atomics. The Predator, a long endurance, single engine airplane carried video cameras that could live stream imagery from 60 miles away. This gave battlefield commanders an aerial platform to continuously monitor enemy activity and became the military's preferred surveillance tool.¹⁰

Military action in Afghanistan and Iraq greatly accelerated the use of all types of UAS, including small, hand-launched aircraft that gave ground troops the ability to see the area around them and identify potential threats.¹¹ By the mid-2000's, the potential for small systems to support public safety was realized, and the discussion about how to integrate sUAS into police operations began. The first certificate of authorization for a law enforcement agency came in early 2008 when the FAA authorized the U.S. Customs and Border Protection to fly a General Atomics Reaper (a variant of the Predator and later called the Guardian by CBP) along the border.

Early public safety UAS were primarily hand-launched small airplanes of the same type used by the military. Hand-launched airplanes, however small, require an area to land, which limited their utility. Early VTOL (Vertical Takeoff and Landing) aircraft, which had gasoline-powered engines, were loud and cumbersome. Battery powered, lightweight multi-copters began to emerge in the late 2000's and facilitated greater use of the technology. Additionally, with the miniaturization of sensor technology, smaller unmanned aircraft became capable of carrying highly sophisticated payloads that, in the past, required much larger aircraft.

10 Bowden, M. (2013). How the predator drone changed the character of war. *Smithsonian Magazine*. Retrieved from <https://www.smithsonianmag.com/history/how-the-predator-drone-changed-the-character-of-war-3794671/>.

11 Associated Press. (2008, January 1). *Military relying more on drones, mostly in Iraq*. Retrieved from http://www.nbcnews.com/id/22463596/ns/world_news-mideast_n_africa/t/military-relying-more-drones-mostly-iraq/#.XCY81c17lyw.

Common Applications for sUAS

Over the past several years, four applications have emerged as the most common for public safety sUAS: forensic photogrammetry; search and rescue; tactical operations support; and firefighting (structural and wildland) support.

Forensic Photogrammetry

The use of sUAS by public safety agencies to photograph and document incident scenes has become one of the most popular uses for this technology. In some cases, such as natural disasters, the video/photographs alone may provide sufficient documentation of the scene. In other cases, the imagery is used for photogrammetry, a technique by which precise maps or models are developed from a series of overlapping aerial photographs.¹² This is particularly useful in forensic investigations, including transportation accident reconstruction and crime scene investigation, where investigators need to “map” the scene to document the precise locations of key pieces of evidence.

As an example, in traditional vehicular crash scene reconstruction, mapping involves the use of a surveyor’s instrument to physically measure key elements of a crash scene to determine how and why the crash occurred. This is a time-consuming process, and for crashes involving death or serious injury, a roadway can remain closed for hours while specially trained and equipped officers take the required measurements and photographs. If, however, an sUAS is utilized to map the crash scene, research has shown that the time taken to clear a crash scene and reopen the road can be reduced by 56% to 73% when compared to other measurement tools.¹³ Given that studies have shown shutting down roadways, particularly interstate highways, can be quite costly for the economy, sUAS can provide an attractive cost savings for a jurisdiction.¹⁴ In addition to the economic savings, reducing the amount of time officers and investigators are on the roadway will improve their safety and the safety of traveling citizens. It should also be noted that, compared to other potential uses, using sUAS for traffic crash reconstruction faces fewer privacy implications given that flights are normally conducted over public roadways. These factors make traffic crash reconstruction a popular law enforcement application for sUAS.

However, as the use of sUAS for photogrammetry increases, so too does court scrutiny of the accuracy of evidence produced through this method of investigation. There are several legal tests for the admissibility of scientific evidence at trial which must be considered prior to relying solely on sUAS-generated photographs for critical measurements. The use of UAS is the “least mature and thus least established among the considered measurement techniques, regarding court acceptance.”¹⁵

Search and Rescue

Unmanned aircraft can be used to conduct aerial searches without being hampered or impeded by the terrain. By using thermal imaging sensors, the ability to identify and locate victims is further enhanced. Additionally, sUAS can be used to drop food, water, medicine, or other life-saving resources to people in distress. For example, in January 2018, an unmanned aircraft was used to drop a flotation device to distressed swimmers off the coast of Australia, enabling them to swim back to shore safely.¹⁶

12 Photogrammetry. (n.d.). In *Encyclopedia Britannica online*. Retrieved from <https://www.britannica.com/science/photogrammetry>.

13 The Johns Hopkins University Applied Physics Lab. (2017). *Operational evaluation of unmanned aircraft systems for crash scene reconstruction*. Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/grants/251628.pdf>.

14 Toronto Region Board of Trade. (2013). *A green light to moving the Toronto region: Paying for public transportation expansion*. Retrieved from https://www.bot.com/portals/0/unsecure/advocacy/DiscussionPaper_AGreenLight_March18_2013.pdf.

15 The Johns Hopkins University Applied Physics Lab. (2017). *Operational evaluation of unmanned aircraft systems for crash scene reconstruction*. Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/grants/251628.pdf>.

16 Mezzofiore, G. (2018, January 18). *New lifesaving drone rescues swimmers by dropping inflatable pod*. Retrieved from <https://www.cnn.com/2018/01/18/tech/drone-rescue-swimmers-australia/index.html>.

Tactical Operations Support

Tactical situations can involve a large number of scenarios and variables. Two of the most common tactical situations for sUAS application are the service of high-risk warrants and barricaded subjects. Since these situations typically involve a static location, an sUAS can be used to enhance situational awareness of a location, providing valuable information about things like access and escape points (doors and windows), animals that could alert the suspect of approaching officers, trip hazards, suspect(s)/others moving about inside the building, and lighting (interior and exterior) conditions. With this intelligence, officers can make an approach and entry in a more efficient and safe manner. Furthermore, during the entry phase of the operation, the sUAS can be put into a position above the location to enable the incident commander to monitor the entire situation from an aerial vantage point. Should the suspect(s) attempt to escape, the sUAS can be used to track and effectuate a safer apprehension.

Firefighting Support

While not specifically a police function, joint police and fire operations are common, and they are encouraged in sUAS program development (to be discussed further in the profile of York County, VA). In many cases, the tactics used and the information gained are the same as those for police operations. For example, structural firefighting applications include:

- Enhancing command and control by giving the incident commander the most dependable, up-to-date information possible.
- Conducting rapid 360-degree assessment of buildings
- Assessing the viability of roof operations.

Similarly, wildland firefighting applications include:

- Conducting assessments of smoke sightings and ascertaining their extent and correct location
- Determining the direction of fire movement for the most effective assignment of resources
- Tracking crews more efficiently

The International Association of Fire Chiefs (IAFC) has produced an Unmanned Aerial Systems Toolkit, which identifies multiple uses for sUAS.¹⁷

As the use of unmanned aircraft continues to expand, so too will the number and types of applications for them.

¹⁷ The IAFC UAS Toolkit is available at <https://www.iafc.org/topics-and-tools/communications-technology/uas-toolkit>.

C. Obstacles to Early Adoption of sUAS Technology

From the earliest stages of the discussion about the use of unmanned aircraft for law enforcement applications, there were major obstacles to their use. These obstacles included regulatory uncertainty, societal privacy concerns, restrictive state legislation, and the economic recession of 2008.

The Regulatory Environment

In the mid-2000's when sUAS technology began to emerge beyond military applications, the FAA struggled to integrate UAS into the National Airspace System (NAS). Lacking a regulatory structure to follow, they used a series of policy documents to provide guidance while regulations were under development.

At the outset, it is important to understand the difference between *civil* and *public* aircraft, as it plays an important role in the regulation of sUAS, both historically and currently. As noted in [Appendix A: Key Definitions](#), Federal Aviation Regulations (FAR's) define an *aircraft* as a device that is used, or intended to be used, for flight in the air. Thus, an unmanned aircraft, no matter how small, qualifies as an aircraft and is subject to regulation by the FAA, the same as any other aircraft. A number of UAS users, from hobbyists to professionals, fail to recognize the fact that UAS are aircraft and must comply with federal aviation regulations. However, understanding and compliance are fundamental to the legal use of the aircraft.

The FAR's also define two types of aircraft—civil and public. Public aircraft are those owned by a government entity. Civil aircraft are simply defined as anything other than public aircraft. The regulatory difference between civil and public aircraft is significant, with public aircraft being statutorily exempt from most types of FAA regulation. For example, FAR Part 61.3 states that a person may not act as pilot in command of a *civil* aircraft unless that person has a valid pilot certificate. Pilots of *public* aircraft, however, do not have to hold an FAA-issued pilot certificate. The only federal aviation regulations applicable to public aircraft are those that are directed at “an aircraft.” These are applicable to all aircraft, both civil and public, and are, for the most part, general operating and flight rules. Note that public aircraft lose the status of a *public* aircraft if they operate for “commercial purposes” or if they perform anything other than essential government functions. For example, a public demonstration for a community group is not considered an essential government function by the FAA and is, thus, a civil operation.¹⁸

As noted above, lacking a suitable regulatory structure to address unmanned aircraft, the FAA relied on policy documents in an attempt to control what was feared to be unfettered access to airspace already occupied by traditional manned aircraft. The first document used was *FAA Order 7610.4K, Special Military Operations, specifically Section 9. Unmanned Aircraft*, issued in 2004. This document governed how the FAA handled requests by the military to fly in civil airspace. Lacking any other policy documents, the FAA applied the provisions of this order to non-military UAS operations and required all operators to obtain a Certificate of Authorization (COA) from the FAA to operate.

The first document to specifically address non-military UAS operations was issued on September 16, 2005, entitled *Unmanned Aircraft System Operations in the U.S. National Airspace System, AFS-400 UAS POLICY 05-01*. However, this document only addressed *public* aircraft operations, not *civil* applications. Civil applicants were forced to follow complicated regulations for aircraft certification.

In 2006, the FAA published a notice in the Federal Register (docket FAA-2006-25714), *Unmanned Aircraft Operations in the National Airspace System*. Of note is the statement that read, “*The current FAA policy for UAS operations is that no person may operate a UAS in the National Airspace System without specific authority. For UAS's operating as public aircraft, the authority is the COA...*”

¹⁸ For more information, see FAA Advisory Circular 00-1.1B, Public Aircraft Operations – Manned and Unmanned, September 21, 2018.

These documents went through various revisions over the years, as did the FAA's process to review and approve COAs. Despite the revisions, the early regulatory processes for obtaining FAA approval for UAS operations were quite challenging for the early adopters.

The most significant event in the process to establish a regulatory structure for sUAS occurred in April 2008 when the FAA created the Small UAS Aviation Rulemaking Committee (ARC). Among other tasks, the ARC was to recommend rulemaking necessary to integrate sUAS into the NAS and prepare a draft proposal. The committee was limited to 20 members representing various sUAS interests, with law enforcement represented by the International Association of Chiefs of Police (IACP) and the National Institute of Justice, U.S. Department of Justice.¹⁹ The committee completed its work one year later and submitted their final report to the FAA in April 2009.

The FAA began the rulemaking process in 2015 with a Notice of Proposed Rulemaking. The final rule, *Operation and Certification of Small Unmanned Aircraft Systems*, was published in the Federal Register on June 28, 2016 (effective date August 29, 2016). This rule added a new Part 107 to Title 14 Code of Federal Regulations (14 CFR), which now enables routine operation of *civil* sUAS and provides safety rules for these operations.²⁰

Note that Part 107, a historic milestone in the regulation of sUAS, applies to *civil* operations. Law enforcement agencies have the option of complying with Part 107, and operating as civil aircraft, or applying for a COA from the FAA and operating as public aircraft. The relative advantages of both will be discussed later in the report. Nonetheless, after a decade of regulation by policy, a regulatory structure is now in place.

Privacy Concerns

Almost as soon as sUAS appeared, so did the corresponding privacy concerns. Many community members were familiar with what were commonly referred to as "drones" from their use by the military in foreign theaters.²¹ In fact, there were instances where the image of a large, military drone was used as an example of what police could use to spy on citizens, often resulting in significant community concern regarding law enforcement's use of sUAS.²²

Community members are sensitive to the idea of unnecessary government intrusion into any facet of their lives. Privacy concerns are vital issues that must be dealt with effectively if law enforcement expects the public to support the use of sUAS. This issue is further addressed in **Sections E** and **F** of this report.

Restrictive State Legislation

In its 2011 document, *"Protecting Privacy From Aerial Surveillance: Recommendations for Government Use of Drone Aircraft,"* the American Civil Liberties Union (ACLU) stated, "We need a system of rules to ensure that we can enjoy the benefits of this technology without bringing us a large step closer to a 'surveillance society' in which our every move is monitored, tracked, recorded and scrutinized by the authorities."²³

19 For the full list of committee members, see: https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/SUASARC-4102008.pdf.

20 A summary of the provisions of 14 CFR Part 107 is contained in the **appendices** of this report.

21 National Institute of Justice. (2016, December). *Considerations and recommendations for implementing an unmanned aircraft systems (UAS) program*. Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/250283.pdf>

22 Betancourt, M. (2014, May). Will drones be the next police cars? *Air and Space Magazine*. Retrieved from <https://www.airspacemag.com/flight-today/will-drones-be-next-police-cars-180950136/>.

23 Stanley, J. & Crump, C. (2011, December). *Protecting privacy from aerial surveillance: Recommendations for government use of drone aircraft*. Retrieved from <https://www.aclu.org/files/assets/protectingprivacyfromaerialsurveillance.pdf>.

In response to concerns about privacy and a perceived lack of rules governing the use of sUAS, many state legislatures considered and/or adopted legislation to restrict the use of sUAS by law enforcement. These efforts began in 2013, when 9 states passed laws addressing law enforcement use of unmanned aircraft.²⁴ While many of the early bills were directed at law enforcement, most, but not all, are now written to address such things as protection of critical infrastructure, economic development of the sUAS industry, and stalking/voyeurism.

By 2017, 16 states had passed legislation that, in one form or another, impacted the ability of law enforcement to use sUAS.²⁵ Many of the bills required law enforcement to obtain a search warrant for any use of an sUAS. Of particular relevance to this analysis of early adopters is legislation passed by Florida and Virginia.

In 2013, the Florida legislature passed the “Freedom from Unwarranted Surveillance Act,” which prohibits law enforcement agencies from using drones to gather evidence or other information, unless:

1. The U.S. Secretary of Homeland Security determines that credible intelligence exists indicating a high risk of a terrorist attack by an individual or organization.
2. The law enforcement agency first obtains a search warrant authorizing the use of a drone.
3. The law enforcement agency has reasonable suspicion that swift action is necessary to prevent imminent danger to life, such as to facilitate the search for a missing person, to prevent serious damage to property, or to forestall the imminent escape of a suspect or the destruction of evidence.

Although restrictive, the Florida bill does allow some uses of sUAS without a warrant, particularly in emergencies.

Also in 2013, the Virginia legislature enacted a law that placed a moratorium on the use of unmanned aircraft by law enforcement until July 1, 2015. The use of sUAS was only authorized during a “major disaster,” Amber Alert, Senior Alert, search and rescue operation, training operation, or when “necessary to protect life, health, or property.” In 2015, the legislature amended the first bill to allow law enforcement sUAS operations pursuant to a search warrant.

With the legislative landscape constantly changing, agencies should study their state statutes for laws that could impact their sUAS program. The National Conference of State Legislatures regularly compiles a list of state UAS legislation, which may be a helpful resource.²⁶

The Economic Recession of 2008

Another significant obstacle preventing early integration of sUAS was the economic recession the country experienced from 2007–2009. This recession was the longest recession since World War II and the most significant economic downturn since the Great Depression of the 1930's.²⁷ According to the U.S. Department of the Treasury, the total loss of household wealth was \$19.2 trillion during that time.²⁸

24 National Conference of State Legislatures. (2018, September 10). Current unmanned aircraft state law landscape [Web page]. Retrieved from <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx>.

25 National Conference of State Legislatures. (2018, September 10). Current unmanned aircraft state law landscape [Web page]. Retrieved from <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx>.

26 The list of state UAS legislation is available at <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx>.

27 National Bureau of Economic Research. (2010, September 20). *Report of the Business Cycle Dating Committee*. Retrieved from <http://www.nber.org/cycles/sept2010.html>.

28 U.S. Department of the Treasury. (2012, April). *The financial crisis response in charts*. Retrieved from <https://www.treasury.gov/resource-center/data-chart-center/Pages/Financial-Crisis-Response-In-Charts.aspx>.

During this period, consumer spending dropped, unemployment rose, and financial markets were in chaos. The sudden and dramatic drop in the value of housing had a serious impact on local governments, whose primary source of revenue is property tax. With the loss of tax revenue and pressure to keep taxes low, the result was greatly reduced government budgets, and law enforcement was not spared from the impact. Essential equipment purchases, such as replacement patrol cars, were deferred, vacancies were not filled, and the layoff of police officers, a worst-case scenario, was not uncommon.

Unfortunately, the beginning of the recession was close to the same time new sUAS technology began to emerge as a tool for public safety. When recovery from the recession began in 2009, the adoption of sUAS technology also began to take hold. However, despite the recovery, many local governments are still experiencing the effects of the recession and lower property values, posing a significant obstacle for the procurement of new technology.

Impact of Obstacles

When combined, the aforementioned obstacles created an atmosphere where most agencies simply stayed away from the new sUAS technology. Only a “handful” of agencies are known to have tried to use sUAS technology from 2006 to 2014.²⁹ In 2012, the FAA released a list that showed only 13 COAs had been issued to public safety agencies, and in 2013, they only issued 21.

In the short period of time since 2013, the FAA has established a regulatory structure that enables routine (civil) operations, the FAA has streamlined the COA process, the effects of the recession have subsided, and there are proven strategies to overcome privacy concerns. The degradation of these early obstacles, combined with the introduction of affordable, easy-to-use consumer and professional systems, has had a positive impact on the pace of integration of sUAS into law enforcement operations. This is evidenced by a series of market studies by Bard College’s Center for the Study of the Drone. In their 2017 report, they identified 347 state and local public safety agencies (police/fire/other public safety) that had acquired sUAS. Local law enforcement agencies made up 217 of that total.³⁰ In 2018, the total had risen to 910 agencies, an increase of 162% over the prior year, with 599 being local law enforcement.³¹ While the total number of agencies utilizing the technology is still relatively small, the growing numbers reflect the fact that the impact of prior obstacles has been greatly reduced.

29 Gettinger, D. (2017, April). *Public safety drones*. Retrieved from <http://dronecenter.bard.edu/public-safety-drones/>.

30 Ibid.

31 Gettinger, D. (2018, May). *Public safety drones: An update*. Retrieved from <https://dronecenter.bard.edu/public-safety-drones-update/>

D. Study Group Agency and sUAS Program Profiles

This section will provide an overview of the six agencies that participated in this analysis. It will focus on how the agencies started their sUAS programs, their current operations, and their plans for the future. The section begins with the Miami-Dade Police Department and the Mesa County Sheriff's Office as these two agencies were among the very first to successfully navigate the uncharted FAA regulatory process. For reference, an explanation of the FAA Certificate of Authorization process is contained in the [appendices](#).

Miami-Dade (Florida) Police Department (MDPD)

MDPD provides police service to the unincorporated areas of Dade County, Florida. The county has a total population of 2.7 million residents and covers 2,431 square miles. The police department has 4,700 employees and has a full time Aviation Unit that supports agency operations. The UAS program was part of the Aviation Unit.

MDPD began their effort to start a UAS program in 2010 when they acquired a Honeywell MAV-3 VTOL UAS using federal grant funds (DOJ Byrne Justice Assistance Grant). The MAV, which stands for Micro Air Vehicle, was, at that time, in active military service as the RQ-16A T-Hawk. The MAV was powered by a gasoline engine, used ducted fan technology for flight, and had a very significant noise signature.

To receive FAA approval to conduct operations, MDPD first completed an application process that included legal certification that they were, in fact, a government agency—a requirement that is still in place today. The FAA eventually issued MDPD a COA for training purposes in June 2011. Per their training COA, sUAS flights were restricted to a one-nautical-mile radius from an abandoned rocket engine test site in the Everglades. Prior to granting a COA to permit actual police operations, the FAA conducted a three-day on-site inspection with MDPD. Day one involved an audit of training files and operations manual, as well as interviews with pilots and other crewmembers. Day two consisted of a full-day exercise that simulated a real call-out for UAS support and included responding to a location and following a scripted scenario. Throughout the exercise, the FAA inspectors evaluated, among other things, whether the sUAS crew maintained a sterile cockpit, perimeter security, and the visual observer's ability to maintain line of sight of the aircraft. Day three was a critique of the scenario and presentation of the audit's findings.

After some delay, the FAA granted MDPD an "operational" COA authorizing missions beyond the Everglades training site. Unfortunately, after going through this extensive process, MDPD never actually flew an operational mission. (The agency did respond to one request to support a tactical operation, but the suspect surrendered prior to launching the MAV). MDPD Sergeant Andrew Cohen, the sUAS program manager at the time, cited multiple reasons as to why the program did not achieve its goals:

1. **Aircraft Limitations** – The engine of the MAV required a gas/oil mixture, which was difficult to transport, and the system did not have a fuel gauge. Rather it used a time/fuel consumption calculation with questionable accuracy. It was also very noisy, and according to the on-site FAA inspector, it was difficult to operate.³²
2. **FAA Requirements** – COA restrictions at the time prohibited most operations in an urban environment and required a one-hour notice prior to any flights. By the time the one-hour period lapsed, the incident was usually resolved.
3. **Crew Requirements** – MDPD policy required a team of four people: pilot; visual observer; safety officer; and a mission commander (the COA required a pilot and a visual observer). Three teams, for a total of 12 people, were trained. In the event of a call out, unless a full team happened to be on-duty, the time it took to get people to the scene, set up, and deploy was problematic. Overtime costs for the call outs were also problematic.

³² Telephone interview with David Morton, FAA Unmanned Aircraft Program Office (retired), October 24, 2018.

4. **Availability of MDPD Aviation** – Perhaps the most significant factor in why the sUAS program did not achieve its goals was that MDPD Aviation was usually able to get a helicopter over an incident in less than 5 minutes, thus negating the need for a UAS.
5. **Florida Legislation** – As previously noted, the State of Florida passed legislation requiring a search warrant to use sUAS except in defined emergencies. This created another obstacle to routine use of unmanned aircraft and made it easier to use their helicopters, which had no such restrictions.

As a result of factors cited, the original MDPD sUAS program did not achieve the operational level desired despite the best efforts of the department's personnel. Today, MDPD continues to explore the use of sUAS, driven primarily by interest from the department's forensic investigators for crime scene documentation and by the Special Response Team (SRT/SWAT). The SRT is specifically seeking to fly inside of buildings to locate individuals and map the interior of a building prior to a tactical entry. This application is growing in popularity nationwide.

Mesa County (Colorado) Sheriff's Office

Mesa County is a rural county of 3,300 square miles in western Colorado that borders the state of Utah. The county is a tourist destination with 12 national/state parks and protected areas and seven trails and byways. The sheriff's office has 250 employees, serving a population of 147,000 people.

The Sheriff's Office had, in the past, used a single engine, fixed wing airplane for prisoner transport. However, that aircraft was involved in an accident that led to significant damage (but no injuries). Afterwards, the sheriff decided to end the program, which left the agency without air support of any kind.

Given the rural nature of the county and the rugged terrain, searches for missing hikers, hunters, and others are common. After one such search, a deputy approached Director Ben Miller, who was later to become the UAS program manager, and started a discussion about using sUAS to assist with searches. Miller subsequently conducted an internet search for law enforcement agencies that were using or had tried to use UAS, and he connected with the Los Angeles County Sheriff's Department. He spoke to a commander, who shared his agency's experience in trying to start a UAS program, including being told by the FAA to cease and desist. After the conversation, Miller researched the FAA COA process, eventually briefed the sheriff, and successfully sought permission to seek a COA to conduct sUAS operations.

As Miller became involved at the national level in the growing field of public safety sUAS, he met a representative from an sUAS manufacturer. That manufacturer agreed to support the sheriff's office by providing two multi-rotor systems, free of charge, in exchange for Mesa serving as a test site for the product and for the right to use Mesa in the manufacturer's marketing efforts. Miller subsequently applied for a training COA to the FAA, but it was rejected several times. However, the agency persevered and received a training COA in 2009, with flights limited to a one-mile radius over a county-owned landfill. It was there that the agency flew its first operational mission under the training COA during a search for the site of a sexual assault that occurred on landfill property.

Eighteen months after receiving their training COA, Mesa was granted a countywide operational COA on January 25, 2011. Since then, the UAS have been used for a variety of missions, with the majority being crime scene documentation and traffic crash reconstruction.

The success of the Mesa County sUAS program can, in large measure, be attributed to the strength of Director Miller's personality, his personal commitment to the program, and his empowerment by the sheriff. Miller subsequently left the agency, and for the past five years, the UAS program has been under the supervision of the commander of the Law Enforcement Division with a focus

on crime scene documentation. Given concerns about training, equipment, software, and proficiency, consideration was given to outsourcing the UAS program to a commercial service provider. However, when no qualified providers could be found, the agency purchased three new unmanned aircraft systems, and the program is again fully functional. The agency is currently considering expanding the program to support tactical operations and search and rescue operations conducted by a local volunteer group.

Michigan State Police (MSP)

Michigan State Police is a full-service law enforcement agency with police powers statewide. The agency has over 2,000 employees, including 1,400 sworn troopers, with a large aviation program that provides air support statewide. Their sUAS program is part of the Aviation Unit.

Interest in sUAS began in 2013 when then-1st Lieutenant Chris Bush was selected to be the commander of the MSP Special Operations Division, which includes the Aviation Section. He met with the outgoing commander and discussed strategic plans for each unit in the division. During this conversation, UAS were mentioned for Aviation. Lt. Bush subsequently attended an unmanned vehicle trade show and learned about the technology. He also met and developed a relationship with a representative from the FAA.

Lt. Bush successfully submitted a U.S. Homeland Security grant application in 2013 to acquire an unmanned aircraft, and MSP purchased their first unmanned aircraft in 2014. A training COA was received from the FAA in 2014, and their operational COA was received in February 2015. The process to move from the training to operational COA took seven months, and the agency's first mission was taking aerial photography of a fire scene.

Today, under the direction of Sergeant Matt Rogers, MSP has three sUAS pilots deployed across the state, each with their own aircraft. Their missions include supporting search and rescue, hazmat, tactical, and fire operations, as well as crime scene and traffic crash reconstruction, with personnel from the Special Operations Division serving as trained visual observers.³³ The agency is seeking to expand their capabilities statewide, with their long-term goal to have an sUAS in every trooper's patrol vehicle.

York County (Virginia) Fire Department and York-Poquoson Sheriff's Office

The York County Department of Fire and Life Safety provides fire/rescue services to the 68,000 residents of the County from its six fire stations. The York-Poquoson Sheriff's Office provides general law enforcement services to residents of the county's unincorporated areas and the City of Poquoson.

The effort in York County to start an sUAS program did not begin until early 2016 (after the Virginia sUAS moratorium), when the Sheriff's Office responded to a potential improvised explosive device in a neighborhood. Given the location of the device, the bomb disposal technician had to walk down the road and approach the device to examine it. During the post-incident debrief, it was discussed that an sUAS could have been used to accomplish the mission more safely. The agency began to explore the technology and eventually invited a manufacturer to demonstrate a system to them. The fire department learned of the sheriff's office's interest in sUAS technology, and after discussions between the two agencies, both decided to move forward with a joint program. Given the restrictive nature of legislation in Virginia regarding law enforcement sUAS applications, the sheriff's office viewed a partnership with the fire department as particularly advantageous, and both agencies saw the benefits of combining personnel and financial resources.

In May 2016, each agency sent one person to a UAS training program, and shortly after completing the training, the agencies submitted a COA application on June 26, 2016. Given a much-streamlined process, they received FAA approval two days later.

³³ The most common missions are in support of fire operations, crime scene photography, and traffic crash reconstruction.

Though restrictive, the Virginia legislation did not prohibit training, so initially the program activities were conducted for training purposes. Since then, operations have included supporting all aspects of fire and police operations, with fire personnel flying the aircraft for police incidents and sheriff's personnel flying to support fire incidents. In this way, the personnel needed for UAS operations are not being taken from the agency handling the actual incident, and it provides for a greater level of cross-training.

Future plans for the joint sUAS program include adding additional systems to facilitate rapid response. These systems would be assigned to personnel with take-home vehicles or access to a UAS-equipped vehicle to facilitate emergency response. Additionally, the fire chief wants automatic response of sUAS to all major fire incidents to get situational awareness as quickly as possible.

Alameda County (California) Sheriff's Office (ACSO)

The Alameda County Sheriff's Office is a full-service law enforcement agency serving a population of over 1.5 million residents. The Sheriff's Office has over 1,500 authorized positions, including 1,000 sworn personnel. Their responsibilities include general law enforcement, Coroner services, and mutual-aid coordination for the California Governor's Office of Emergency Services for Region II, the busiest mutual-aid region in the state of California.

The process to integrate sUAS into the sheriff's office began in 2013 when Sheriff Greg Ahern attended a conference and became interested in starting a UAS program. He assigned the project to then-Captain Tom Madigan (now Commander). The agency received their FAA COA in 2015, and they have since flown over 500 missions in support of a variety of public safety missions. While the process to initiate their program was straightforward, overcoming political and community opposition was extremely difficult. How Alameda County successfully dealt with that serious issue will be described in the following section.

Plans for future expansion of the sUAS program include having 30 trained and equipped pilots ready to deploy immediately from their own patrol vehicles.

Federal Bureau of Investigation (FBI)

The FBI is a national security organization with both intelligence and law enforcement responsibilities. More than 30,000 agents, analysts, and support personnel staff the agency worldwide. Their major focus is on terrorism, espionage, cyber-attacks and major criminal threats.

The agency's first sUAS operation was conducted as part of a research project in 2007 in the Operational Technology Division using a small fixed wing UAS. The UAS program stayed as a small research project until 2013, when the sUAS program was moved to the Aviation Section. UAS missions were limited to specific investigations and border/counter-intelligence operations. The program remained a fixed wing sUAS program until mid-2016 when the agency deployed a multi-rotor VTOL aircraft.

Given their nationwide jurisdiction, need for covert operations, and need to fly in a wide variety of situations, authorization from the FAA required extensive negotiations. Eventually, the agency secured FAA authorization, and their first publicly recorded COA was issued on May 31, 2011, with all information except the name of the agency redacted. Their first nationwide COA for Class-G operations was obtained in July 2015.

The FBI's integration efforts were initially hampered by frequent Congressional inquiries, Freedom of Information Act requests (that led to concerns about the potential to compromise covert operations), and other legal issues. Nevertheless, demand for the technology from functional units (evidence technicians, bomb technicians, and SWAT personnel) has led to expansion plans that will equip those units with UAS in the near future.

E. Gaining Political and Community Support

As previously discussed, citizens are extremely sensitive to the idea of unnecessary government intrusion into any facet of their lives. Despite their proven effectiveness, concerns about how sUAS will impact privacy have, to some extent, overshadowed the benefits this technology brings to law enforcement operations. Building political and community support for the program is fundamental to addressing these privacy concerns and building a successful program. This section will highlight the efforts of the six profiled agencies to gain support for their programs and, in doing so, provide examples for other agencies to follow. The section concludes with additional resources agencies can consult for further guidance on building community support and trust for a UAS program.

Alameda County Sheriff's Office

As part of the decision-making process about whether to start an sUAS program, Sheriff Greg Ahern met with a citizen advisory committee to discuss the concept. The program received their support. The sheriff also conducted a survey at a community event where he was speaking and similarly got a favorable response. The sheriff had decided to seek federal grant funding for the program, and the application required the approval of the Board of Supervisors, the county governing body. On the day the grant application was presented for discussion, approximately 200 privacy rights advocates attended to speak against the UAS program. Only one person spoke in favor.

Subsequent to that meeting, there were protest rallies where a model of a large military Predator drone was displayed as if that was the type of aircraft the sheriff intended to use. An "Alameda County Against Drones Coalition" formed.

Following these events, the sheriff's UAS program manager, Commander Tom Madigan, led an effort to work with the community to provide information about the program and address their concerns. As he said, "Transparency was the goal throughout the whole process." The following were some of the activities he undertook to do so:

- Conducted multiple community meetings throughout the area to show the community what the aircraft looked like, using a sample supplied by a manufacturer.
- Invited the ACLU, Public Defender, and District Attorney to help craft policies and procedures for sUAS operations.
- Engaged the sheriff's Public Information Office, developed a media plan, and had a lot of media interaction. One event they conducted was a news conference where they displayed all of the robotic devices used by the agency, not just the sUAS.
- Performed a flight demonstration for the Board of Supervisors.
- Hosted a presentation for the California Senate Privacy and Constitutional Protection Committee on the use of UAS technology to address privacy concerns. The committee was urged not to pass overly broad legislation to restrict law enforcement use of UAS, which has not been done in California.

In the end, however, the grant application was withdrawn from consideration due to concerns from the Board of Supervisors. Alameda County's legal counsel advised the Board of Supervisors that they could stop the grant, but could not prevent the sheriff from using his approved operating budget to make the purchase as long as the equipment would be used lawfully and within the sheriff's authority as codified by the California Government Code.³⁴ Eventually, the sheriff did, in fact, use his operating budget to acquire two sUAS.

After the sheriff's decision, the City of Berkeley passed a one-year moratorium on law enforcement use of unmanned aircraft

³⁴ Note that this is not always the case. While independently elected, many sheriffs are still required to follow their jurisdiction's purchasing regulations. Those regulations frequently have spending limits, beyond which the governing body must approve.

within the city.³⁵ Since then, however, ACSO has been called numerous times to support Berkeley first responders for public safety incidents. The first was a church fire where the Berkeley Fire Department requested the sheriff's office to use their thermal imaging camera to detect hot spots to prevent the fire from spreading to adjacent property. Another incident involved a call of a man with a gun in a park, where Berkeley police asked for UAS support to locate the armed suspect.

Since their program's inception, the sheriff's office has flown over 500 missions involving thousands of flights without a single complaint or concern from the community.

Despite early political opposition, the ongoing efforts of the sheriff's office to be transparent have overcome the initial controversy and contributed to their successful UAS program.

Mesa County Sheriff's Office

Mesa County has three commissioners on the Board of County Commissioners, their governing body. Prior to announcing the sUAS program, the sheriff leveraged relationships he already had with the commissioners and held one-on-one conversations with them to ensure they were knowledgeable about the program. The sheriff did not receive any negative feedback.

While there was no ACLU, or equivalent, in Mesa County, sharing information about the program was made a priority, and a public information plan was developed. The plan outlined a very deliberate process to get out in front and "own" the story and included doing public demonstrations wherever possible, including at shopping malls, fairs, and scout meetings.

According to Ben Miller, Mesa County's sUAS program director at the time, the agency did everything it could to mitigate what was then a growing negative perception of UAS. "We spent quite a bit of time educating the public as to the realities of what we intended to do with UAVs and keep them updated as to what we now do. We maintained a strong sense of trust with our community by creating strong policies as well as a transparent communication with the community."³⁶

Miller also advised that a key element to the agency's media plan was to "invest in [the media's] story as much as they invest in us." Accordingly, the sheriff's office invested the time to demonstrate their sUAS capabilities to the media, and the media invested in the sheriff's office by producing fact-based stories.

Given that Mesa County was one of the first law enforcement agencies in the country to receive a COA, they received significant national media attention, including CNN, ABC, National Geographic, and others. All were reportedly positive about Mesa County's program with the exception of *TIME* Magazine, which focused on the privacy concerns.

The program was not without its detractors, but the minor pushback received from a handful of community members never became consequential and was often quickly resolved due to the openness of the sheriff to personally demonstrate the technology.

Michigan State Police

As part of their program development, the Michigan State Police drafted policies and procedures for UAS operations and put them in place before the agency went public with its program. Those policies specified the missions they were authorized to perform and specifically stated surveillance was prohibited without a search warrant. The agency's sUAS program administrator at the

35 Shuttleworth, J. (2015, February 24). "No drone zone" moratorium approved in Berkeley. Retrieved from <https://www.nbcbayarea.com/news/local/No-Drone-Zone-Moratorium-Considered-in-Berkeley-293895811.html>.

36 Marks, K. (2017). Every agency can use unmanned aircraft systems (UAS). *Police Fleet Manager*. Available at http://www.hendonpub.com/police_fleet_manager/articles/2017/0102/every_agency_can_use_unmanned_aircraft_systems_ua.

time, Lt. Bush, met with the ACLU, provided a copy of their policy manual for review, and did a flight demonstration for them.

In accordance with their media plan, the agency's public information office held a large media event with approximately 30 news outlets in attendance. According to Lt. Bush, a couple of reporters were "very negative," but generally the event was positive. The media subsequently went to the ACLU, who publicly stated they supported the program.³⁷ Afterwards, there were no negative stories in the media. "Meeting with the ACLU helped more than anything," said Lt. Bush.

As for the state legislature, MSP has not received any opposition from them, but rather has collaborated successfully with them on several UAS-related issues.

York County Fire/Sheriff

As interest developed between the York County Fire Department and the York-Poquoson Sheriff's Office for an sUAS program, the fire chief approached the county administrator to gain his support for the program. The administrator was supportive, but he was unsure as to whether the community and the Board of County Supervisors would look favorably on the concept. Given the status of the Sheriff as an elected official and his good relationship with the community, the sheriff consulted with the County Board of Supervisors and discussed the program with them. After that meeting, there was no opposition from the Board.

Once political support was obtained, the agencies turned their attention to gaining the support of the community. As part of their outreach effort, the agencies identified and met with community leaders. They emphasized search and rescue applications, particularly for missing children and Alzheimer's patients, rather than law enforcement applications. The sheriff already had a good working relationship with the ACLU and the Southern Christian Leadership Conference (SCLC), and he was widely trusted by the community.

Overall, the community was very supportive, and the agencies only met minimal resistance. Only two people on social media made negative comments about the program, but the rest of the community were highly supportive.

Miami-Dade Police Department

According to the Miami-Dade Police Department's UAS program manager, Sgt. Andrew Cohen, their director met with the Board of County Commissioners and "tested the waters." The ACLU, however, voiced concern about the program due to the possibility of mass surveillance.³⁸ In an effort to gain their support, the agency provided the ACLU with a copy of the sUAS program's policies and procedures and reassured them that, given the noise signature of the MAV, covert surveillance would not even be possible.

Additionally, as part of program development, the agency spent a great deal of time with the news media and gave them full access to their program, including inviting them to the Everglades to observe training. Despite the fact that MDPD's sUAS program never achieved operational status, community opposition was not a factor in that outcome according to the police department.

37 Engelking, C. (2015, March 11). Michigan is first to get statewide approval for police drones. *Discover Magazine*. Retrieved from <http://blogs.discovermagazine.com/drone360/2015/03/11/michigan-approves-police-drone/#.XCa1d817lyx>.

38 Sutta, D. (2013, May 9). *Unmanned drones now patrolling south Florida skies*. Retrieved from <https://miami.cbslocal.com/2013/05/09/unmanned-drones-now-patrolling-south-florida-skies/>.

Federal Bureau of Investigation

Given that much of the FBI's UAS work involves covert surveillance in support of homeland security missions, no public relations efforts were undertaken to explain how they were using this technology. The FBI did, however, respond to many Congressional inquiries over the years. With the FBI now moving to more traditional uses of UAS (crime scene documentation, tactical support, etc.), the agency has begun conducting more public demonstrations and hosting regional law enforcement UAS symposiums with local public safety and critical infrastructure agencies to show the public how they are using sUAS.

Key Takeaways for Protecting Privacy

Given that the concerns about the use of sUAS by law enforcement have centered predominantly on privacy concerns, agencies interested in using the technology need to be prepared to address this issue by assuring the community that sUAS technology will only be used in a legal and ethical manner. Agencies can do this by having written policies and procedures in place to govern sUAS operations and making these available for public review. This will be discussed in greater detail in the next section of the report.

Key Takeaways for Community Engagement

All law enforcement agencies should strive to have a relationship with their community based on trust and openness. Those relationships can be leveraged when introducing somewhat controversial technology, such as sUAS.

As learned from the early adopting agencies, transparency is the key to gaining support for an sUAS program. A media plan should be developed, including a Frequently Asked Questions (FAQ) list. Agency representatives who will speak to the media and/or meet with the public must be on the same page regarding the messaging to the community.

In conjunction with the media plan, a list of specific organizations and individuals—such as civil liberties organizations and advocates, community leaders, and media outlets—should be developed and meetings set with those on the list. A single public meeting is not recommended as individual or small group meetings allow for greater exchange of information and large meetings can be difficult to facilitate. During these meetings, agency representatives should *share everything* related to the sUAS program. The goal should be to not give anyone a legitimate opportunity to claim that the agency is “hiding” something. As previously mentioned, the community should be given the opportunity to review and comment on the UAS Operations Manual, and recommendations from them should be considered for adoption.

Additionally, public demonstrations of the sUAS should be scheduled. This proved particularly effective for the early adopting agencies as it allowed the public to see the systems being considered and their capabilities, oftentimes dispelling the false assumptions that contributed to public opposition.

By laying the proper groundwork for an sUAS program and being transparent from the outset, the program will likely achieve a higher level of community acceptance. For additional guidance on how to build community engagement and trust, see the National Institute of Justice's December 2016 report, entitled *Considerations and Recommendations for Implementing an Unmanned Aircraft Systems (UAS) Program*,³⁹ and the National Police Foundation's Center for Unmanned Aircraft Systems in Public Safety.⁴⁰

39 Available at <https://www.ncjrs.gov/pdffiles1/nij/250283.pdf>

40 Available at <https://www.uaspublicsafety.org/>.

F. UAS Policies and Procedures

A critical component of any successful sUAS program is a comprehensive Operations Manual. This is a formal agency document that facilitates safe operations and establishes parameters for decision-making by the sUAS crew. It is also a tool for accountability, providing specific policies and procedures governing the appropriate and lawfully sound uses of the sUAS and related technology. This is the document that will be used to assure the community that the technology will be used properly.

All of the studied agencies have formal, written policies and procedures for their sUAS programs. Using these agencies as examples, the following are some of the topics that should be addressed in the operations manual: administrative matters; flight operations; training; safety; and maintenance. Each of these is explained in greater detail in the subsections below.

Program Organization and Administration

Defining the Mission

One of the first steps in developing an sUAS program is defining how the agency will use unmanned aircraft. The agency must *clearly define the sUAS mission*. The mission dictates every other program element, such as required training, the necessary policies and procedures, and the specific system(s) that will be needed to accomplish the desired mission(s).

It is recommended that agencies be conservative and avoid potentially controversial uses of the technology. The focus should be on basic, easily understood and accepted uses of the technology. Furthermore, by starting with basic missions, agencies can gain valuable experience upon which they can build and expand operations in the future. The most common missions identified by the study group agencies include:

- Search and rescue
- Crime scene documentation
- Traffic crash reconstruction
- Tactical support
- Disaster response for aerial documentation
- Fire scene documentation
- Hazardous materials incidents
- Explosive ordinance disposal
- Indoor tactical and fire operations

For the most part, the missions conducted by the studied agencies have not changed from those originally proposed, with the exception of indoor flights to support tactical and fire operations, which is emerging nationwide as a desired application.

It is important to keep in mind that not all incidents within a mission category will require UAS support. For example, not all traffic crashes require reconstruction, and most agencies have policies in place that specify when this process is used. Accordingly, each agency will need to establish a policy specifying when the use of sUAS technology is appropriate based on the nature of the incident, including its severity and scope. Clearly defining when an sUAS will be used is also important when assuring the community that the agency will maintain strict controls over the use of unmanned aircraft.

Protecting Privacy – Constitutional Aspects of Aerial Searches

The Fourth Amendment to the United States Constitution prohibits unreasonable searches and seizures and requires warrants to be based upon probable cause.⁴¹ While case law has yet to provide definitive guidance on law enforcement's use of *unmanned* aircraft, the courts have provided guidance on the constitutionality of law enforcement's use of manned aircraft, as well as the use of sense-enhancing technology.

In *Kyllo v. United States*, the United States Supreme Court held that all details with respect to a home are intimate details and the use of "sense-enhancing technology" to gather information about a home, in this case with a thermal imaging sensor, constitutes a search and cannot be done without a warrant.⁴²

Given that all imagery from an unmanned aircraft is captured through airborne sense-enhancing technology, law enforcement should assume that *the use of sUAS to observe a constitutionally protected area will require a search warrant*.

Incorporating case law and other best practices, the operations manual should clearly state policy that addresses the constitutional use of UAS and include the following provisions:

- Collection, use, retention, or dissemination of data shall not be used to violate the constitutional rights of any person, or in any manner that would discriminate against any person based upon their ethnicity, race, gender, national origin, religion, sexual orientation, or gender identity.
- All unmanned aircraft activities will be performed in a manner consistent with the Constitution, applicable laws, and regulations.
- The agency shall only collect data using UAS, or use UAS-collected data, to the extent that such collection or use is consistent with and relevant to a purpose authorized in the UAS operations manual.
- Airborne data collection may, under some circumstances, intrude into a person's reasonable expectation of privacy and, therefore, come under the protection of the Fourth Amendment of the U.S. Constitution.
- Absent a recognized exception to the warrant requirement, a search warrant shall be obtained, before the aircraft is deployed, in any situation where an unmanned aircraft will be used to collect evidence related to a crime, or in a manner where it may intrude upon a person's reasonable expectation of privacy.

For example, the York County operations manual contains the following statement:⁴³

"Where there are specific and articulable grounds to believe that the UA will collect evidence of criminal wrongdoing and if the sUAS will be used in a manner that may intrude upon a reasonable expectation of privacy, the agency will obtain a search warrant prior to conducting the flight, unless appropriate permissions are obtained by legal owner/occupants to which legal authority can be granted to conduct flights above property."

Michigan State Police's operations manual contains similar provisions related to warrant requirements and the protection of privacy:⁴⁴

Privacy:

Any aerial observation mission to further a criminal investigation requires search warrant approval.

UAS-recorded data will not be collected, disseminated or retained solely for the purpose of monitoring

41 For a transcription of the Fourth Amendment, see <https://www.archives.gov/founding-docs/bill-of-rights-transcript>.

42 *Kyllo v. United States*, 533 U.S. 27 (2001). For other cases related to the protection of privacy, see *Katz v. United States*, 389 US 347 (1967); *Florida v. Riley*, 488 US 445 (1989); *California v. Ciraolo*, 476 US 207 (1986); and *Dow Chemical Company v. United States*, 476 US 227 (1986).

43 This excerpt was provided to the research team by the York County Fire Department upon request.

44 This excerpt was provided to the research team by the Michigan State Police upon request.

activities protected by the U.S. Constitution, such as the First Amendment's protections of religion, speech, press, assembly, and redress of grievances (e.g., protests, demonstrations).

Collection, use, dissemination, or retention of UAS-recorded data should not be based solely on individual characteristics (e.g., race, ethnicity, national origin, sexual orientation, gender identity, religion, age, or gender), which is a violation of the law.

If the Department changes the privacy policy regarding the use of UAS, the public will be informed of those changes in order to remain transparent about the program.

Of particular note in MSP's policy is the last paragraph about maintaining the transparency of the program with the community. As previously discussed, this is critical for obtaining and maintaining community support, and agencies should consider including a similar provision in their policies.

For agencies planning to serve search warrants using UAS technology, consideration should be given to including specific language in the search warrant regarding the use of UAS. For example, Michigan State Police, after conferring with its legal counsel, includes the following statement in their search warrants:

"This search will include gathering aerial video/photography by using an unmanned aircraft, specifically a [insert UAS brand and model], Aircraft #[insert registration number], a quadcopter capable of vertical takeoff and recovery, with high definition and forward looking infrared (FLIR) cameras, operating in accordance within the Michigan State Police Certificate of Authorization (COA) approved by the FAA at or below 400 feet above ground level (AGL)."

Agencies are encouraged to confer with their own legal counsel to determine the most appropriate language to include in search warrants in their jurisdiction.

Accountability

It is important for the credibility of an sUAS program that all flights be approved by a supervisor. Furthermore, all flight time should be documented, and those records should be audited by supervisors at regular intervals. Any evidence of flight time not being documented or the alteration of flight time recorders must be investigated. All of the study group agencies document flight time and prepare activity reports detailing their sUAS activity.

Digital Media Evidence (DME)

UAS sensors capture large volumes of imagery and the metadata associated with that imagery. Digital media evidence is not new, and agencies likely already have policies in place on how to manage that data. UAS policy manuals should mandate that all UAS generated data be handled in accordance with agency policy. For reference, York County has the following requirements:

1. All DME shall be handled in accordance with existing policy.
2. Personnel shall not edit, alter, erase, duplicate, copy, share, or otherwise distribute, in any manner, sUAS DME without authorization.
3. Access to DME must be specifically authorized.
4. Files shall be securely stored in accordance with approved policies.

It is important to note that if agencies opt for cloud storage of DME, the cloud service provider must comply with the requirements of the FBI Criminal Justice Information Services (CJIS) Security Policy.⁴⁵

⁴⁵ Federal Bureau of Investigation. (2018, August 16). *Criminal justice information services (CJIS) security policy, Version 5.7*. Retrieved from <https://www.fbi.gov/services/cjis/cjis-security-policy-resource-center>.

Program Funding

An agency must account for the total cost of ownership of a UAS program, including, but not limited to, the original acquisition cost as well as ongoing operational expenses. There are generally three revenue sources for a new program: an agency's operating budget, asset forfeiture funds, and grants. York County used both asset forfeiture funds and state grant funding provided to the fire department. Mesa County used donated equipment, and the Michigan State Police used a federal grant to acquire their original systems. Meanwhile, the FBI and Alameda County both used agency operating budgets for their programs. For ongoing operating expenses, all of the studied agencies use existing operating budgets for funding, given that program costs are minimal. For example, the Michigan State Police uses its aviation unit's annual operating budget to pay for ongoing UAS costs without creating a specific budget line item for UAS operations.

Organizational Structure

Command responsibility must be identified by policy. All of the study group agencies that had prior aviation assets felt strongly that an sUAS program should be part of the aviation unit's chain of command. This is due to their aviation knowledge, which likely does not exist elsewhere in the agency. This does not prevent sUAS operations by functional units, such as tactical teams or traffic crash reconstruction technicians, but aviation should have oversight, if not command authority.

Flight Operations

Regulatory Compliance and Airspace Access

Given that sUAS are, by definition, *aircraft*, compliance with the Federal Aviation Regulations (FARs) must be mandated in the operations manual. As part of the planning process, an agency must decide whether to operate its sUAS as *public* or *civil* aircraft as there are different advantages, disadvantages, and regulatory requirements for both.

Public unmanned aircraft are those owned and operated by a government entity. The authority to operate these aircraft is provided by obtaining a Certificate of Waiver or Authorization (COA) from the FAA. Public aircraft are not required to comply with civil airworthiness or airman certification requirements to conduct operations. However, they are still subject to the airspace and air traffic rules of the FARs. All other unmanned aircraft are "civil" aircraft and must comply with 14 CFR Part 107.⁴⁶

To operate as public aircraft, the COA process will require the public safety agency to fully develop their UAS program and train their personnel prior to receiving final authorization to conduct operations. There are advantages to following the COA process, including greater airspace access and operational waivers for things such as flight over people and night operations.

Alternatively, agencies may choose to operate as civil aircraft and comply with the requirements of Part 107. For public agencies initiating an sUAS program, in particular those agencies without aviation experience, it may be advisable to choose to operate initially as a civil aircraft and comply with Part 107. Operating as a civil aircraft and complying with Part 107 provides the agency with a basic set of standards to guide the development of their program. Furthermore, it assures those responsible for program oversight and members of the community that the agency is following the same rules as civil sUAS operators.

Most of the study group agencies began their programs before Part 107 went into effect in August 2016, at a time when obtaining a COA was the only option to operate in the National Airspace System. However, since Part 107 came into effect, many of the profiled agencies have chosen to conduct some or all of their operations as civil aircraft under Part 107. For

⁴⁶ For more information, see FAA Advisory Circular 00-1.1B, Public Aircraft Operations – Manned and Unmanned, September 21, 2018. Available at: https://www.faa.gov/documentlibrary/media/advisory_circular/ac_00.1-1b.pdf

example, in Alameda County, the sheriff's office currently operates under both a COA and Part 107. They note the following advantages to the COA:

- They have the ability to operate in high-traffic, controlled airspace around busy airports (Class C, D and E). The COA allows for a streamlined and systematic approach to operate day and night in this airspace, to a greater extent than under Part 107 for civil operations.
- They are authorized to conduct operations over people in life threatening situations.
- They can launch quickly without specific FAA approvals.
- In a true emergency, they can launch immediately in any airspace approved in their COA.

For Mesa County, they allowed their initial COA to expire and now conduct all operations under Part 107 with a waiver for night operations. Given that a majority of operations are in Class G airspace (uncontrolled airspace, with access permitted under Part 107), a COA was no longer seen as necessary for their operations.

York County also conducts operations under a COA and Part 107. The advantages of their COA include waivers for airspace access, night flights, and the option to obtain Special Government Interest (SGI) emergency COAs, which can permit access into any airspace during exigent circumstances.⁴⁷ Their current Blanket Area COA comes with a night waiver, whereas they have tried unsuccessfully numerous times to obtain a Part 107 night waiver. York County also has a Jurisdictional COA that permits direct coordination with air traffic control to facilitate flights in all of York County and the controlled airspace of Norfolk Naval Base, Langley Air Force Base, Fort Eustis Army Base, Norfolk International Airport, and Newport News/Williamsburg International Airport. Their pilots hold FAA Remote Pilot airman certificates that allow them to conduct operations under Part 107, which is required to fly public demonstrations (given that these flights are not permitted under a COA since they are not considered a government function).

Likewise, Michigan State Police conduct operations under a COA and Part 107 and cite similar advantages to a COA as the other agencies (airspace access, night operations, flight over people, etc.). All MSP pilots hold an FAA Remote Pilot airman certificate that permits civil operations.

The FBI, meanwhile, currently conducts all operations under a nationwide COA. Given their expansion plans, however, Part 107 operations may be considered.

Greater airspace access is repeatedly mentioned by the study group as a benefit of operating as public aircraft under a COA. While the FAA is making advances to facilitate civil operations in controlled airspace via their Low Altitude Authorization and Notification Capability (LAANC) program, the Jurisdictional COA and Special Government Interest (emergency) COA are, at present, the best methods to gain airspace access. It is important to note, however, that Special Government Interest COAs (formerly known as Emergency COAs) are event specific and authorize emergency operations only. They cannot be used for training or other operations.

Agencies are also advised to determine if their jurisdiction contains special use airspace where flights may not be permissible under any circumstances. For example, the Washington, D.C. area is within a Flight Restricted Zone (FRZ), and all operations, including law enforcement, require special government approval from the Transportation Security Administration.⁴⁸

Summaries of the FAA COA application process and the provisions of Part 107 are contained in the **appendices** of this report.

47 SGI COAs can be approved by telephone.

48 For more information, see the TSA webpage at: <https://www.tsa.gov/for-industry/general-aviation>.

Flight Operations

Guidance must be provided to operational personnel for flight operations. As noted, sound policies facilitate safe operations and set parameters for decision making by the UAS crew. Some of the topics that must be addressed include:

1. Mission approval
2. Flight operations site selection
3. Minimum crew requirements
4. Minimum acceptable weather conditions
5. Maximum flight altitudes
6. Night flight procedures
7. Aircrew responsibilities
8. Risk assessment
9. Emergency procedures
10. After-action reporting and debriefs

Additionally, the studied agencies noted the importance of proper selection and security of the area where flight operations (takeoff and landing area) will take place and listed the following lessons learned:

1. Preflight evaluation of the operations area must ensure it is free of potential obstructions and preferably away from the incident command post.
2. Site security must be considered. Alameda County noted that they have had occasions where “hostiles” aggressively interfered and required the crew to stop and take police action.
3. Secure the area to prevent unauthorized access.
4. Maintain a “sterile cockpit.” This is where nobody is allowed to talk to the pilot, especially during takeoff and landing procedures, to avoid distractions. Headsets should be provided for the operator and the visual observer to facilitate communication and limit distractions.
5. The ability to downlink live video to a location away from the UAS operator limits distractions, as does using a third person to serve as a liaison between the UAS crew and incident command.

Training

All UAS program personnel must be properly trained to perform their role in UAS operations. This includes skills training on how to operate and maintain the specific systems and training in the policies regarding their use. All of the studied agencies have initial and recurrent training programs in place, which are described below. Note that all of the studied agencies require their pilots to hold an FAA remote pilot certificate, and none of them self-certify pilots, even though it is permissible under a COA.

Alameda County Sheriff’s Office

Alameda County conducts a five-day in-house training program. The first two days provide the aeronautical knowledge required to pass the FAA remote pilot test, and the remaining three days provide systems training (classroom and practical). After the five-day training, personnel have 90 days to receive their FAA remote pilot certificate. New crewmembers then go through a supervised progression to ensure proficiency in all positions: preflight and mission planning; visual observer; pilot in command; and finally, the mission commander (who watches the monitor for imagery being gathered and directs the operation). Once proficient with all positions and responsibilities, new crewmembers are approved for unsupervised flight operations. Recurrent

training takes place one day per month for the entire team, and the training times are staggered to permit training in both day and night conditions.

For visual observers, Alameda County has a PowerPoint-based training program, and they are currently considering including this training in the basic recruit academy so that all members of the agency can be trained as visual observers.

Mesa County Sheriff's Office

Originally, the first two pilots attended a three-day factory-training course for their system in Canada and returned as factory certified instructors. Training in Canada was conducted indoors at a soccer facility. Now, Mesa conducts a similar three-day training in a school gymnasium for new pilots. Mission specific training is conducted during missions under the supervision of experienced pilots. Given that Mesa operates under Part 107, all pilots are required to hold an FAA remote pilot certificate. Recurrent training is conducted one day per month.

York County Fire/Sheriff

York County currently has a total of 22 pilots from the fire department and sheriff's office, up from the two original pilots when the program began. The two original pilots received 16 hours of classroom training at a local community college for aeronautical knowledge, followed by three days of flight training. One day of flight training was conducted inside a university polo arena, while the remaining two days were outdoors. At present, all pilots are required to obtain an FAA remote pilot certificate. After operational training, all four UAS team leaders (two from the fire department and two from the sheriff's office) must certify new pilots as proficient before they can fly missions. In order to conduct night operations, new pilots must pass a nighttime visual acuity training program, with a written test and night flight proficiency requirement.

To ensure pilots maintain the appropriate level of proficiency, the agency's COA requires all pilots to conduct three takeoffs and landings every 90 days. The agency further requires pilots to fly a minimum of 15 minutes of day and night operations every 90 days for proficiency. To meet these requirements, the full team trains twice per month, one day and one night.

Currently, the agencies use pilots as visual observers. However, the availability of trained visual observers often hinders their ability to quickly deploy at an incident, so the agencies are examining how to utilize other department personnel to enable rapid field deployment.

Michigan State Police

MSP's COA requires the pilot to have passed the FAA private pilot aeronautical knowledge written exam, which pilots are required to accomplish on their own. MSP then provides a ten-day in-house training program, which is detailed in a written syllabus (provided in the [appendices](#) of this report). The first three days of the training program are Part 107 training, concluding with the student taking the FAA remote pilot certification exam. This is followed by a seven-day system-specific training program that ends with each pilot performing certification flights. Mission training is included in the seven-day training. After successfully completing the program, pilots are issued a system to have in their patrol car, and they are operational. Pilots must fly once a week for proficiency for the first six months on their own. From March through November, the three pilots conduct training once a month and debrief incidents that occurred during the previous month.

Visual observers receive four hours of training and practical exercises that cover topics such as airspace, weather, and visual acuity. Each visual observer is required to hold an FAA 3rd class medical certificate to ensure visual acuity. Bomb squad technicians, traffic crash reconstruction technicians, and fire investigators across the state are used as visual observers.

Federal Bureau of Investigation

All FBI fixed-wing UAS pilots are required to have an FAA private pilot certificate for manned aircraft and be assigned to the Aviation Section. This higher certification requirement is due to the complexities of operating in the national airspace system above 400 feet AGL, which is where the agency frequently operates its fixed-wing UAS. Small VTOL quadcopter pilots are required to obtain an FAA remote pilot certificate on their own through self-study.

After certification, pilots for fixed wing aircraft receive two weeks of systems training from the manufacturer, followed by internal FBI training on policies, procedures, and compliance requirements. The final phase is mission-specific training. For quadcopters, pilots receive five days of training. This includes one day of training on policies and procedures, two days flying mission-specific tactics, and one day on sensors and data processing technology before final testing on day five. To maintain proficiency, all pilots are required to conduct three takeoffs and landings per quarter.

Other Training Considerations:

As can be seen, the majority of the training conducted by the studied agencies is designed to provide pilots and other crewmembers with the skills they need to perform sUAS missions. Many of the agencies also provide training on the policies and procedures that govern the use of the sUAS technology. Four of the six agencies' UAS program managers are supervisors with extensive aviation experience, giving them the basis of knowledge to manage an aviation program. Given that the UAS industry often struggles with the concept that small unmanned aircraft are aviation assets, it is incumbent upon law enforcement agencies to provide those with supervisory and managerial responsibilities over UAS programs with the training necessary to properly manage an aviation program. This includes such things as basic aeronautical knowledge, aviation safety, and maintenance. As with all training, it should be ongoing with both initial and recurrent training.

Aviation Safety

Safety Program and Training

Professional manned aviation programs utilize a Safety Management System (SMS) for their operations. There are four components of an SMS: safety policy, safety risk management, safety assurance, and safety promotion. It is beyond the scope of this report to provide a complete discussion of what an SMS does, but some of the key elements will be described. (The FBI has developed a complete SMS program for its UAS program, and it is included as [Appendix F](#) of this report for reference.)

First, the UAS program must investigate all hazards, incidents, accidents, and acts of non-compliance with the agency COA, Part 107 regulations, or the agency's operations manual. The purpose of the investigation is to determine the root cause of the event and what risk control measures are necessary to prevent future occurrences. Next, the agency should have a formal process to analyze, assess, and control known risks. A process should be in place prior to every mission to assess flight risks and to mitigate those risks to an acceptable level. If risks cannot be mitigated to an acceptable level, the mission should not be conducted. Most of the agencies studied require a documented risk assessment prior to flight. As with most manned aviation SMS programs, the Michigan State Police have a system where approval for a flight is based on a numerical score. (An example of a flight risk assessment tool for sUAS is contained in [Appendix E](#).) Finally, all sUAS program personnel should receive training in the safety program, with all training documented.

Accidents and Near Misses

Both the FAA and the National Transportation Safety Board (NTSB) require accidents and incidents to be reported under

defined circumstances. However, even if an incident is a non-reportable event, an agency should investigate the incident as these investigations are a cornerstone of aviation safety.

Reporting requirements differ for public aircraft operations under a COA and civil aircraft operations under Part 107. Per 14 CFR Part 107.9, reporting requirements are as follows:

No later than 10 days after, report to FAA in a manner acceptable, any operation involving:

1. *Serious injury or loss of consciousness*
2. *Damage to any property – other than the UAS – unless the cost to repair or replace does not exceed \$500.*

For COA operations, the reporting process is similar to that for manned aircraft, including the definitions of an accident and an incident. An accident includes any event that results in fatal or serious injury and/or total loss or substantial damage to the unmanned aircraft. Incidents are defined as an occurrence other than an accident that results in an unsafe/abnormal operation. Both accidents and incidents must be reported within 24 hours to the FAA.

UAS mishaps tend to involve minor damage to propellers and other parts, which can be quickly repaired by snapping on new parts in the field. Given the definitions above, only one of the studied agencies reported an event that would qualify as an accident or incident. Michigan State Police detailed one accident that was reportable under their COA in 2016 (it would not have been reportable under Part 107). They were operating an sUAS at the scene of a fire, and the sUAS hit a sign resulting in approximately \$4,000 in damage to the aircraft. Investigation of the accident resulted in MSP procedural and training changes along with changes to the manufacturer's software safety features.

In the early years of their program, Mesa County was the beta test site for the manufacturer of their system. According to Director Miller, the manufacturer expected them to have issues. In fact, they did experience system issues that resulted in unplanned outcomes. When that happened, they worked with the manufacturer to resolve the issue and replace damaged parts. They never experienced a situation where there was damage to any property or other aircraft and, thus, did not report any incidents to the FAA.

As noted above, regardless of the reporting requirement, any event that results in damage to the aircraft or other property should be investigated to determine the root cause(s) and identify procedures to mitigate the risk of a similar occurrence.

Maintenance

Unlike manned aircraft, there are no standards or regulations for the design, manufacture, or continued airworthiness of sUAS. The burden is on the manufacturer and operator to ensure airworthiness. An sUAS program must have policies and procedures in place that address maintenance and include things such as: preflight airworthiness checks; personnel authorized to perform maintenance; prohibitions against unauthorized alterations to the system(s); and documentation of all maintenance performed, including the movement of an aircraft's payload/center of gravity.

During the system selection process, the ability of the manufacturer to supply maintenance procedures, training, spare parts, and firmware upgrades should be considered.

Generally, the studied agencies conduct routine system maintenance (like replacing propellers) in-house and perform test flights after firmware/software updates. For major maintenance issues, the agencies return the systems to the manufacturers or authorized service centers for repairs.

G. Selection of an Unmanned Aircraft System

Any discussion about the type of unmanned system an agency should acquire must begin with the mission that has been defined for the program. “The mission must drive the technology as opposed to the technology driving the mission.”⁴⁹ There are many different types of UAS with vastly different capabilities. The purchase decision must consider a variety of factors, but all considerations must begin with the mission.

In December 2016, the National Institute of Justice issued a report entitled, *Considerations and Recommendations for Implementing an Unmanned Aircraft Systems (UAS) Program*. That document contains a section titled *Things to Consider for Unmanned Aircraft Systems (UAS) Procurement* (pages 55-58). It begins with questions about why an agency needs UAS and offers questions to ask about the manufacturer of the system. It then provides lists of specifications for both fixed wing and VTOL system procurement.⁵⁰ This can be a very valuable guide for agencies considering the acquisition of new aircraft.

Additionally, the Airborne Public Safety Accreditation Commission released its Standards for Public Safety Small Unmanned Aircraft System (sUAS) Programs in October 2017. These were the first industry standards for public safety UAS programs, and they contain standards for UAS system requirements.⁵¹ Those standards cover topics such as General System Requirements, Evaluation of the System Manufacturer, Recommended System Requirements, Performance Testing, and Network Security Requirements.

In November 2018, the National Fire Protection Association (NFPA) released its first standard for public safety use of unmanned aircraft—*NFPA 2400: Standard for Small Unmanned Aircraft Systems Used for Public Safety Operations*—which sets standards for all aspects of sUAS operations, including system requirements.⁵² Of note, these are the first standards developed by NFPA for public safety operations in general, not just the fire service.

Given that UAS technology is still relatively new and evolving rapidly, these references can be of great assistance with the UAS selection process.

The remainder of this section will examine why the studied agencies selected their particular systems for their programs.

Michigan State Police

MSP used federal grant dollars to acquire a military grade quadcopter from an established company to start their program. More importantly, they used data from the Department of Homeland Security Robotic Aircraft for Public Safety (DHS RAPS) evaluation program as the basis for their decision. RAPS invited manufacturers of sUAS to participate in a series of real-world flight tests to determine their suitability for public safety missions. The system MSP purchased is still in use, and they have added more of the same systems to their fleet of UAS.

49 National Institute of Justice. (2016, December). *Considerations and recommendations for implementing an unmanned aircraft systems (UAS) program*. Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/250283.pdf>

50 The report is available at <https://www.ncjrs.gov/pdffiles1/nij/250283.pdf>.

51 Airborne Public Safety Accreditation Commission. (2017, October). *Standards for public safety small unmanned aircraft system (sUAS) programs*. Available at <http://www.apsaccreditation.org/standards/small-unmanned-aerial-systems/>.

52 National Fire Protection Association. (2018). *NFPA 2400: Standard for small unmanned aircraft systems (sUAS) used for public safety operations*. Available at www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=2400.

Alameda County Sheriff's Office

Alameda County Sheriff's Office (ACSO) originally purchased two quadcopter VTOL systems at a cost of \$40,000 each. Cost was equated with quality, and given that small VTOL systems were relatively new, it was difficult to compare the few systems that were available on the market at that time. The vendor established a good relationship with the agency, supported them with public displays in the community, and flew product demonstrations for the agency. According to the agency, however, the vendor also overstated the capabilities of the system. The camera on the aircraft was not stabilized, and the video was essentially unusable. After delivering the original systems to Alameda County, the manufacturer developed a new stabilized camera mount that greatly reduced the vibration problem. However, they refused to provide the new mount without additional cost. That particular system also required a large packing case, which was eventually deemed impractical for a police vehicle. The agency flew two missions with those initial systems, then stopped using them. The manufacturer is no longer in business.

The agency subsequently purchased hobbyist grade systems to train with and found them to be superior. After training with them, they opted to use them for future missions rather than their initial systems.

As their sUAS program grows, the agency continues to evaluate new technology for more effective means of enhancing public safety. For example, in November 2018, ACSO, along with 16 UAS teams from and around the State of California, created a two-dimensional map of the entire Town of Paradise. The town was completely destroyed during the *Camp Fire*, the most deadly and destructive fire in California history. The teams conducted 517 flights in two days and captured over 75,000 images. Due to the smoke/haze and airspace restrictions, they were only able to map the 17,000 acres at an altitude of 300 feet above ground. Through this experience, they identified the need to add fixed wing aircraft to their fleet, due to their longer endurance and greater airspace access.

Mesa County Sheriff's Office

Mesa County began their program using two quadcopters donated by a manufacturer that wanted to use Mesa County as a test site for their system. Problems with the system included a lack of stabilization of the camera and limited battery endurance, which permitted just seven minutes of flight time, inadequate for many missions. This created a situation within the agency where the "technology didn't meet the dream," and it disappointed many people in the agency.

The agency eventually added two donated fixed wing systems, but these aircraft only successfully completed missions about 25% of the time and their use was discontinued. The agency still uses their original two quadcopters and recently added three more aircraft.

York County Fire/Sheriff

The York County program started with two hobbyist grade systems (one purchased by each agency) as an inexpensive way to start the application process with the FAA, which required information about the specific system(s) they would operate. The agencies have been pleased with the capabilities of those initial systems, and they have since added professional grade systems from the same manufacturer given that the flight controls are the same and the training to transition to the new systems is minimal. They have similarly been pleased with the capabilities of the professional grade systems and the fact that the manufacturer offers continual upgrades. The agencies also noted the versatility of the systems in that they can be customized to include such things as searchlights, chemical sensors, and mounts to carry and release packages containing items such as first aid supplies or personal flotation devices.

Federal Bureau of Investigation

Originally, the primary mission of the FBI's UAS program was surveillance and tactical operations. To accomplish those missions, they used hand-launched fixed wing systems that were of a type in military service. They were well suited for these missions given their all-weather capabilities, ability to operate in maritime environments, and their relatively long endurance (up to three hours). With planned expansion to different mission sets, such as crime scene documentation, different VTOL systems will be required, and the agency is currently evaluating systems. Given the homeland security role of the FBI, data security is a priority. In November 2018, the Department of Justice reportedly put in place requirements to handle any UAS purchase as an information technology procurement, requiring associated vulnerability assessments of the IT infrastructure. This could have an impact on the FBI's selection criteria for small, commercial, off-the-shelf systems and potentially for all agencies with a need to protect law enforcement sensitive data.

Miami-Dade Police Department

When the MDPD started their UAS program, there were few VTOL sUAS available. The aircraft they chose was in military service, where literally hundreds of systems were in use. Furthermore, the manufacturer was a major, global aerospace company. However, had MDPD been able to put their systems into operational service, their utility would have been limited due to the loud noise signature and the impracticality of storing and transporting the required gasoline/oil mixture in vehicles.

Summary

Many agencies that were early adopters of sUAS technology had limited choices for aircraft. Hand-launched fixed wing systems were prevalent in the mid to late 2000s and were of the type used by the military. It was not until small, battery powered quadcopters became available that the use of unmanned aircraft began to grow. Unfortunately, many agencies based purchasing decisions on the price of the system and not the system's ability to complete the identified missions, perhaps to the detriment of the programs.

H. UAS Program Reporting and Data Collection

Agencies operating sUAS can be subject to a variety of federal and state reporting requirements to maintain compliance. In addition to these reporting requirements, agencies should regularly collect other data to document and evaluate their operations and ensure the success of their sUAS programs.

FAA — Part 107 Reporting Requirements

There are no reporting requirements for agencies operating sUAS as civil aircraft under 14 CFR Part 107.

FAA — COA Reporting Requirements

Agencies operating as a public aircraft under a COA must report the following to the FAA on a monthly basis (even if no flights were conducted):

1. Aircraft registration number(s)
2. UAS type and model
3. All operating locations, including latitude/longitude
4. Number of flights
5. Total aircraft operating hours
6. Any takeoff and landing damage sustained
7. Equipment malfunctions
8. Number and duration of lost link events

State-Mandated Reporting Requirements

Before operating a UAS, it is important for an agency to review state law to determine if any state restrictions or reporting requirements exist for law enforcement UAS operations. For example, Texas, Utah, and Vermont require law enforcement agencies using UAS to file an annual report with the state. For Texas, the law only applies to agencies serving a population over 150,000 people. Vermont requires agencies using UAS to create an “official record” when using UAS.⁵³

None of the profiled early adopters have any state-mandated reporting requirements.

Agency-Specific Reporting Requirements

Mesa County Sheriff’s Office

The agency records all flight data electronically. This includes the date, time, and location of all flights, as well as flight time, mission notes, and data processing time. The Sheriff does not require any specific data reporting from the program.

⁵³ National Conference of State Legislatures. (2018, September 10). Current unmanned aircraft state law landscape [Web page]. Retrieved from <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx>.

Federal Bureau of Investigation

For internal reporting requirements, each unit flying a UAS must provide 30-day activity reports, which contain data from each operation conducted within the reporting period, as well as after-action reviews for each mission conducted. Data captured for each operation in the 30-day activity report includes:

- Date of operation
- Location
- Aircraft used
- Remote pilot in command
- RPIC type (FBI agent or civilian staff)
- Controlling office
- Who the operation benefited
- Mission type
- Flight duration
- Risk assessment worksheet (RAW) value
- File number

The after-action reviews contain four elements: 1) what was planned for the operation, 2) what actually happened during the operation, 3) what worked well, and 4) what needs to be improved.

Michigan State Police

The unmanned aircraft used by MSP have fully integrated software to electronically record and manage flight data. The software tracks things such as airframe time and the operational lives of the batteries. The software also tracks duty hours in addition to flight time. For example, one mission had eleven hours of duty time but only one hour of flight time. It is the responsibility of the visual observer to record takeoff and landing time, and the pilot inputs flight time into the flight log for the aircraft.

As for periodic activity reports, the agency is not required to submit anything other than the monthly report to the FAA. The UAS program manager does, however, complete an annual activity summary, which is submitted to the agency's command staff. The agency does not release a public report.

York County Fire/Sheriff

Given that this program is a joint police/fire program, all UAS responses are reported in the National Fire Incident Reporting System (NIFRS). Additionally, at the conclusion of each mission, a detailed report with all pertinent mission information is completed and forwarded to the command staff at the fire department and sheriff's office (including the fire chief and sheriff).

⁵⁴Flight logs are maintained by a commercial flight data management software program the agencies purchased that was compatible with their systems. In addition to capturing basic flight information, the program enables the agencies to track the amount of time certain aircraft components have been used, such as propellers, motors, and batteries.

Alameda County Sheriff's Office

The agency has data on file for every mission since 2015. For each flight, a mission dispatch form is created, and activity reports are provided to the sheriff monthly. The agency does not publish periodic reports for the public, but they do have a social media account that publicizes their activities.

⁵⁴ A copy of the York County Remote Operated Vehicle Emergency Response (ROVER) Team Incident Sheet is included in [Appendix G](#).

Recommended Data Collection for UAS Operations

Across the studied agencies, it was evident that the collection of data on UAS operations is critical because it enables the agencies to effectively monitor, manage, and improve their UAS programs and fulfill all relevant federal and state reporting requirements. Incorporating the data collection practices of these agencies and other best practices, the following is a list of data that all agencies are recommended to document, at a minimum, for each UAS *mission*:⁵⁵

1. Date of mission
2. Time of deployment/call-out
3. Location(s), including the address/geographical location and GPS coordinates
4. Mission type (e.g., search and rescue, crash reconstruction, tactical response, etc.)
5. Approving supervisor
6. Agency incident/case number
7. Risk assessment (provide score, if applicable)
8. Aircrew(s)
 - Supervisor(s)
 - Pilot(s)
 - Visual Observer(s)
 - Other crewmembers
9. Aircraft used (list the registration numbers of all aircraft used during the mission)
10. Time flight operations began and ended
11. Number of flights per aircraft used
12. Total flight time per aircraft used (this will require someone on the aircrew, usually the visual observer, to document the takeoff and landing time for each flight)
13. Mission summary
14. Disposition of data collected⁵⁶
15. Equipment issues (e.g., malfunctions, lost-link events, takeoff/landing damage, etc.)
16. Operational issues
17. Other comments (e.g., lessons learned)

In addition to the data collected on each UAS mission, the agency should document the following:

- Maintenance performed on each aircraft, including such things as software updates, routine replacement of parts, changes to the payload, and the costs associated with each
- Total flight time per pilot for each aircraft (to track proficiency)
- All training conducted

With this data, agency UAS personnel should regularly debrief on UAS operations to identify lessons learned, conduct monthly supervisory audits of the program, and provide a yearly activity report to the community. Note, however, that the data points provided in this subsection are recommendations only, based on federal reporting requirements and best practices. Each agency should decide what data is most appropriate to collect for their operations and reporting requirements.⁵⁷

⁵⁵ Note that there is a difference between missions and flights. A single mission can involve multiple flights with different aircraft.

⁵⁶ What an agency does with the data collected by the UAS is a primary concern of many civil liberty advocates.

⁵⁷ For additional guidance on data collection and reporting, see the International Association of Chiefs of Police's *Model Policy for Small Unmanned Aircraft Systems* (2015).

Table 1 depicts the UAS mission data documented by each of the studied agencies, presented next to the recommended minimum data to collect. Note that simply because an agency does not document a particular piece of information in their UAS mission data, such as the risk assessment value, does not mean it was not accounted for by the agency.

Table 1: UAS Mission Data Collection by Agency and Recommended Data Collection

Data Element	FBI	MSP	York Co.	Mesa Co.	Alameda Co.	Recommended
Mission Information						
Date	X	X	X	X	X	X
Times*		X	X	X	X	X
Agency Requesting or Receiving Assistance	X	X	X		X	
Requesting POC			X		X	
Planned or Unplanned			X			
Incident Response					X	
Controlling Office	X					
Supervisor Approval	X				X	X
Mission Type	X		X	X	X	X
Incident/Case Number	X	X	X	X	X	X
Incident Summary			X	X	X	X
Aircrew						
RPIC	X	X	X	X	X	X
RPIC Type**	X					
Visual Observer	X	X	X		X	X
Other Crew	X		X		X	X
Location						
Geographic Area/Address	X	X	X	X	X	X
Latitude and Longitude	X	X	X		X	X
Indoor/Outdoor	X					
Navaid (VOR) Coordinates		X			X	
FAA Compliance***						
FAA NOTAM Filed/Info		X	X		X	
Local ATC Notified			X		X	
Special Govt Interest			X			
Waiver Approval					X	
Flight Information						
Weather Conditions		X	X		X	
Risk Assessment Value	X	X			X	X
System/Aircraft Used	X		X	X	X	X
Alternate Landing Zone			X			
Altitude Flown		X		X	X	
Total Number of Flights	X				X	X
Total Flight Time	X	X	X		X	X
Equipment Issues			X	X	X	X

* Times may include dispatch, arrival and departure times and/or time flights began and ended (mission duration)

** RPIC type for the FBI indicates whether the RPIC was an FBI employee or contractor

*** May not be applicable if agency is operating UAS under Part 107.

Most of the study group agencies use commercial software to facilitate the collection, tracking, and reporting of their UAS operations and flight data. There are a variety of commercial products available, so an agency should identify the data it needs to collect (drawing from the recommendations presented here), solicit feedback and recommendations from other agencies utilizing commercial software, and select the software that best meets the needs of the agency. Alternatively, if an agency wants to reduce costs, there are inexpensive options available. For example, an agency can complete reports for each UAS mission and enter the collected data into a free-to-use cloud-based spreadsheet with user permissions that enable authorized personnel to access the database from any location. A sample of a mission report form and a template for archiving UAS operations data are provided in [Appendix H](#) and [I](#) of this report.

The collection of the data outlined herein provides a variety of benefits for an agency and public safety as a whole. First, it enables effective management of personnel and equipment, particularly as it relates to maintenance schedules and pilot proficiency. Second, it allows the agency to easily fulfill all relevant federal and state reporting requirements. Third, it facilitates accountability and ensures transparency with the community, which can result in even greater buy-in and support for the UAS program. Fourth, detailed data enables the agency to conduct cost-benefit analyses and make better informed decisions about future equipment acquisitions for the program. Lastly, the consistent collection of detailed UAS operations data across agencies allows researchers, government entities, and other public safety agencies across the country to disseminate lessons learned, create best practices, and improve UAS operations to enhance public safety.

I. Lessons Learned from the Early Adopters

As part of this study, each of the six agencies was asked to identify lessons they learned that may prove helpful for agencies developing sUAS programs. Each agency provided a list of lessons learned, and many of these lessons learned were consistent across sites. Many of the lessons learned have been incorporated throughout the report, but an aggregated list is also provided below for ease of reference:

1. At the very beginning of the process to start an sUAS program, seek the assistance of agencies that have successfully done so.
2. Develop the program as a public safety tool, not just law enforcement. Leverage the positive public image of the fire service. Where possible, support all government entities in your jurisdiction with aerial imagery to improve the visibility and support of the program.
3. Start small, using the crawl/walk/run concept. Be conservative, and grow the program as you gain experience.
4. Be transparent throughout the program development process. Be up front with the governing body and the community.
5. Use caution to not oversell the capabilities of the technology externally or internally as it can create a sense of disappointment. Manage expectations by educating all customers on the capabilities of the system(s).
6. UAS should be part of an agency's aviation unit, if the agency has one, because of their aviation knowledge. If not operated directly by aviation personnel, they should at the very least be a part of the program development process and have oversight of flight operations, policy, and procedures. Functional units may still conduct operations, but the aviation unit should be involved. It must be remembered that UAS are "aircraft."
7. Work closely with local airport managers and air traffic control tower managers to create partnerships. Educate them about your program to build their confidence in your ability to operate safely in their airspace. In the event of a deployment outside of your jurisdiction, your local ATC and airport managers can work with authorities in the area in which you are deploying to facilitate your operations and vouch for your credibility. Additionally, these managers can be a great source of information and guidance for your agency's program.
8. Do not underestimate the need for both initial and ongoing training.
9. Integrate training with units/agencies you will be working with, such as SWAT, EOD, and the fire department. Do not wait for an actual incident. Be proactive, train first, and get to know your counterparts. These working relationships will be critical during an incident.
10. Do not acquire a system until the agency's sUAS program has been clearly defined, especially the mission, and approved for implementation. No one system can do everything. The end user needs to be the one driving the technical needs, not the manufacturer. Verify information provided by vendors, preferably with other agencies using their products or other independent parties.
11. Institutionalize the UAS program. For long-term survivability, the program needs to be based on more than one person, regardless of the strength of their personality.
12. What to do with the data and imagery captured is just as important as flying to gather that imagery. If available, get technical support from within your government. For example, one of the studied agencies brought in GIS technicians from a related government entity to process their sUAS imagery. These technicians have specialized training and greater expertise to testify in court as to how the imagery was processed and the accuracy of the results. In another agency, an IT manager conducts maintenance on the unmanned aircraft systems and helps evaluate the technology.
13. Remember to thoroughly document maintenance performed, training completed, issues encountered, and missions conducted.
14. Continue to evolve the program, and incorporate lessons learned, particularly from other agencies, into program development. Be inventive and creative. Stay abreast of technology changes.
15. Participate in user group associations, such as a state chapter of the National Council for Public Safety UAS, for information sharing.

J. The Future of UAS Technology in Public Safety

As with all technology, unmanned aircraft continue to evolve. Relatively inexpensive and lightweight multi-copters have contributed to much wider use of the technology. Furthermore, miniaturization of sensors continues to allow ever-smaller aircraft to provide the same quality of imagery that use to require large manned aircraft. This trend will likely continue.

As the public safety market finds more ways to leverage UAS technology to improve efficiency and effectiveness, manufacturers will develop the systems and the capabilities necessary to the meet demand. For example, the need to operate inside buildings is emerging for both police and fire applications. Most UAS operate semi-autonomously using Global Positioning System data to navigate. Since GPS signals are usually hindered inside of most buildings, this application will require different navigational capability and skill level for pilots. Systems are now being designed to meet this need.

The future may see high altitude, long endurance UAS with powerful sensors patrolling the skies, much the same way manned police aircraft do now.⁵⁸ This will require advances in technology, regulatory changes, and perhaps most importantly, an ongoing conversation between the community and law enforcement to address privacy implications and concerns.

58 Tucker, P. (2017). *Look for military drones to begin replacing police helicopters by 2025*. Retrieved from <https://www.defenseone.com/technology/2017/08/look-military-drones-replace-police-helicopters-2025/140588/>.

About the Authors

Chief Donald L. Shinnamon, Sr. (Ret) serves as a consultant in the unmanned aviation industry and as an Executive Fellow with the National Police Foundation. Prior to entering this industry, he had a distinguished career in public safety, serving as the Chief of Police for the City of Port Saint Lucie, Florida; Chief of Police and Chief Fire Administrator for the City of Holly Hill, Florida; and Chief of Police for the City of Gainesville, Florida. He began his public safety career with the Baltimore County, Maryland, Police Department. During his service there, he attained the rank of Colonel and held the position of Chief of Operations.

Mr. Shinnamon served as the chair of the Aviation Committee of the International Association of Chiefs of Police (IACP) for over 15 years and still serves as an active member. In that role, he authored the Guidelines for the Use of Unmanned Aircraft by Law Enforcement for the IACP to address the contentious privacy issue. A frequent lecturer and author, he is a leader in developing the first industry standards for UAS operations. He serves on the National Fire Protection Association 2400 UAS Standards Technical Committee, has chaired the Public Safety Aviation Accreditation Commission UAS Standards Development Committee, and was a member of the AUVSI Trusted Operator Program Steering Committee. In 2008, he was selected to serve on the historic first FAA rule-making committee to draft regulatory language to integrate small unmanned aircraft systems into the national airspace system, which eventually became FAR Part 107.

During his career, Chief Shinnamon was a certified police officer, firefighter and emergency manager. He holds a master's degree in business administration from the University of Baltimore and completed a fellowship at Harvard University. An experienced police aviator, he is an active commercial pilot, rated in helicopters, airplanes, and small unmanned aircraft.

Brett Cowell is a Project Associate at the National Police Foundation. He received a Master's Degree in Criminology, Law and Society from George Mason University and a Bachelor of Science Degree in Finance, with a minor in Leadership Studies, from Virginia Tech. Brett's areas of focus include police use of force, officer safety and wellness, and law enforcement technology. His recent work at the Foundation includes research on officer safety training, police use of force, and innovative crime gun intelligence centers (CGICs), as well as work on the groundbreaking LEO Near Miss officer safety initiative, the first-ever national near-miss reporting system for law enforcement.

In Brett's spare time, he is a volunteer with the Nokesville Volunteer Fire Department and Rescue Squad in Northern Virginia.

Appendix A: Key Definitions

Developing an sUAS program requires an understanding of the aviation environment in which unmanned aircraft operate. The following definitions are essential to understanding the regulatory environment for unmanned aircraft.⁵⁹

Aircraft – A device that is used, or intended to be used, for flight in the air.

Certificate of Waiver (CoW); Certificate of Authorization (CoA) – The terms “certificate of waiver” and “certificate of authorization” mean an FAA grant of approval for a specific flight operation. Types of COAs include:⁶⁰

1. Blanket Area COA for Class G airspace
2. Jurisdictional COA for other classes of airspace
3. Special Government Interest (Emergency COA)

Civil Aircraft – Aircraft other than public or model.

Control Station – An interface used by the remote pilot to control the flight path of the small UA.

Crewmember (UAS) – A person assigned to perform an operational duty during operations. A UAS crewmember includes the remote PIC, person manipulating the controls, and visual observers, but may also include other persons as appropriate or required to ensure safe operation of the UAS.

Crew Resource Management (CRM) – The effective use of all available resources including human, hardware, software, and information resources.

Data Link – A wireless communication channel between one control station and one UA. Its utility may include, but is not limited to, uplink Command and Control (C2) data, downlink telemetry, and payload data. A data link may consist of the following types:

1. Uplink – The transmittal of data from the control station to the UA.
2. Downlink – The transmittal of data from the UA to the control station.

Model Aircraft – Means a UA that is: (i) capable of sustained flight in the atmosphere; (ii) flown within VLOS of the person operating the aircraft; and (iii) flown exclusively for hobby or recreational purposes.⁶¹

National Airspace System (NAS) – The Federal Aviation Act of 1958 established the FAA and made it responsible for the control and use of navigable airspace within the United States. The FAA created the National Airspace System (NAS) to protect persons and property on the ground and to establish a safe and efficient airspace environment for civil, commercial, and military aviation.

Remote Pilot in Command (RPIC) – A person who holds a remote pilot certificate with a small Unmanned Aircraft Systems (sUAS) rating and has the final authority and responsibility for the operation and safety of an sUAS operation conducted under 14 CFR Part 107.

⁵⁹ See 14 CFR Chapter I available at <https://www.ecfr.gov/cgi-bin/text-idx?gp=&SID=85f875c1002afbf4ff3d398d7536e5b0&mc=true&tpl=/ecfrbrowse/Title14/14chapterI.tpl>. Readers are encouraged to consult the FAA and the Code of Federal Regulations for any future changes or additions to these terms. Definitions are current as of December 31, 2018.

⁶⁰ See **Appendix C** for a complete description of each type, along with a description of the COA application process.

⁶¹ See Section 336 of Public Law 112–95.

Public Aircraft – An aircraft owned and operated by a government.⁶²

Safety Risk Management (SRM) – A formalized, proactive approach to system safety. SRM is a methodology that ensures hazards are identified; risks are analyzed, assessed, and prioritized; and results are documented for decisionmakers to transfer, eliminate, accept, or mitigate risk.

Small Unmanned Aircraft – An unmanned aircraft weighing less than 55 pounds on takeoff, including everything that is on board or otherwise attached to the aircraft.

Small Unmanned Aircraft System (sUAS) – A small unmanned aircraft and its associated elements, including communication links and the components that control the small unmanned aircraft in the national airspace system.

Unmanned Aircraft (UA) – Means an aircraft that is operated without the possibility of direct human intervention from within or on the aircraft.

Unmanned Aircraft System (UAS) – A UA and its associated elements (including communication links and the components that control the UA) that are required for the remote pilot in command to operate safely and efficiently in the NAS.

Visual Line of Sight (VLOS) – Means that any flight crewmember (i.e., RPIC, the person manipulating the controls, and visual observer, if used) is capable of seeing the aircraft with vision unaided by any device other than corrective lenses, spectacles, or contact lenses in order to know the UA's location, determine the UA's attitude, altitude, and direction of flight, observe the airspace for other air traffic or hazards, and determine that the UA does not endanger the life or property of another.

Visual Observer (VO) – A person who is designated by the remote PIC to assist the RPIC and the person manipulating the flight controls of the sUAS to see and avoid other air traffic or objects aloft or on the ground.

⁶² Title 49 U.S.C. § 40102(a)(41) provides the definition of “Public Aircraft” and § 40125 provides the qualifications for public aircraft status.

Appendix B: Summary of 14 CFR PART 107 for Small Unmanned Aircraft Systems

Subpart A – General

107.1 Applicability - Applies to the registration, airman certification and operation of civil small UAS. Does not apply to hobbyists (Part 101).

107.3 Definitions - Small unmanned aircraft means an aircraft weighing less than 55 lbs.

107.7 Inspection, testing and demonstration of compliance - The pilot, owner, or person manipulating the controls of an sUAS must, upon request, make available their remote pilot certificate and other required documents and allow the FAA to inspect the system.

107.9 Accident reporting

No later than **10 days** after an operation, report to FAA, any operation involving:

1. Serious injury or loss of consciousness
2. Damage to any property – other than the UAS – unless the cost to repair or replace does not exceed \$500.

Subpart B – Operating Rules

107.11 Applicability – Applies to all civil sUAS.

107.12 Requirement for a RPIC certificate with small UAS rating – No person may manipulate flight controls unless they hold a remote pilot certificate or are a person under the direct supervision of a remote pilot who has the ability to *immediately take direct control of the flight*.

107.13 Registration – Must comply with 91.203 (a)(2) which requires the system to be registered.

107.15 Condition of safe operations – The remote pilot must check the system to determine if it is safe to operate prior to each flight and must terminate flight operations if no longer safe.

107.17 Medical condition – No person may participate in flight operations if they have a physical or mental condition that would interfere with safe flight.

107.19 RPIC – The remote pilot in command must be designated before flight, is directly responsible for the operation, and must ensure the operation does not pose undue hazard.

107.21 In-flight emergency – The pilot may deviate from any rule in an emergency.

107.23 Hazardous operation – No person may operate in a careless or reckless manner so as to endanger the life or property of another or drop an object that creates undue hazard.

107.25 Operation from a moving vehicle – Operations are prohibited from a moving aircraft but are permitted from a moving ground or water-borne vehicle if over a sparsely populated area.

107.25 Alcohol or drugs – Comply with 91.17 and 91.19 (no consumption of alcohol within 8 hours of flight operations, or

with a blood alcohol concentration of .04 or higher).

107.29 Daylight operation – Flights at night are prohibited. Operations during civil twilight (30 minutes before official sunrise and 30 minutes after official sunset) are permitted if aircraft is equipped with anti-collision lights.

107.31 VLOS – Either the pilot and the person manipulating the controls or a visual observer must be able to see the aircraft throughout the entire flight in order to:

1. Know the aircraft's location, altitude, attitude, direction of flight;
2. Observe the airspace for other aircraft/hazards; and
3. Determine the unmanned aircraft does not endanger life or property.

107.33 Visual observer (VO)

1. Not required;
2. Must maintain effective communication with the pilot;
3. Pilot must ensure VO can see UAS;
4. Pilot and VO must coordinate to scan airspace for collision hazards and maintain awareness of position.

107.35 Operation of multiple UAS – A person cannot operate more than one unmanned aircraft at a time.

107.36 Carriage of hazardous materials – May not carry hazardous materials as defined in 49 CFR 171.8.

107.37 Operation near aircraft, right of way rules – UAS must yield/give way to all aircraft/airborne vehicles and may not pass over/under/ahead of the aircraft so close as to create a collision hazard.

107.39 Operations over human beings – Prohibited unless the person is directly participating in the operation of the UAS, or the person is under a covered structure or stationary vehicle providing protection.

107.41 Operations in certain airspace – May not operate in Class B, C, or D airspace or within the lateral boundaries of Class E airspace designated for an airport without prior authorization from air traffic control (ATC).

107.43 Operation in vicinity of airports – May not interfere with operations at an airport, heliport or seaplane base.

107.45 Operation in prohibited or restricted area – May not operate in prohibited or restricted airspace.

107.47 Flight restriction in the proximity of certain areas designated by NOTAM – Must comply with flight restrictions designated by a notice to airmen (NOTAM).

107.49 Preflight familiarization, inspection, and actions for aircraft operations –

1. Prior to flight, assess the operating environment for risks to persons/property on ground and in the air, including:
 - A. Weather
 - B. Airspace/flight restrictions
 - C. Locations of persons/property on ground
 - D. Other ground hazards
2. All persons involved in operation are informed about operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards
3. Ensure that the control links are working properly
4. Ensure there is enough power available for the system to operate for the intended time

5. Ensure any object carried by the UAS is secure

107.51 Operating limitations for small unmanned aircraft –

1. The pilot must comply with the following limitations:
 - A. GROUND SPEED must not exceed 100MPH/87KTS
 - B. Altitude cannot be higher than 400' AGL, unless
 - 1) It is flown within a 400-foot radius of a structure, AND
 - 2) Does not fly higher than 400' above the structure's immediate uppermost limit.
 - C. Minimum flight visibility is 3 SM at location of control station
 - D. Minimum distance from clouds = 500' below and 2,000' horizontal

Subpart C – Remote Pilot Certification

107.53 Applicability – Prescribes requirements for issuing a remote pilot certificate.

107.57 Offenses involving alcohol or drugs

107.59 Refusal to submit to an alcohol test or to furnish test results

107.61 Eligibility

1. Age 16
2. Ability to read, speak and write the English language
3. No physical or mental condition that would interfere with safe operation
4. Demonstrate aeronautical knowledge
 - A. Pass an initial aeronautical test
 - B. If the person already holds a pilot certificate, must meet the flight review requirement and complete an initial training course

107.63 Issuance of a remote pilot certificate with a small UAS rating –

Submit application with either:

1. Evidence showing applicant passed initial aeronautical knowledge test
2. If the person holds a pilot certificate and meets flight review requirements, submit a certificate of completion from a Part 107 initial training course. Application must be submitted to an FAA Flight Standards District Office, a certified flight instructor or designated pilot examiner who verifies their identity.

107.64 Temporary certificate – Temporary certificate is good for 120 days, until permanent certificate is received or revoked.

107.65 Aeronautical knowledge recency – Within the previous 24 months, must pass an initial or recurrent aeronautical test, or if a person holds a pilot certificate and meets flight review requirements, pass an initial or recurrent training course.

107.67 Knowledge tests: General procedures and passing grades

107.69 Knowledge tests: Cheating or other unauthorized conduct

107.71 Retesting after failure

107.73 Initial and recurrent knowledge tests

107.74 Initial and recurrent training courses

107.77 Change of name or address – Must notify the FAA within 30 days.

107.79 Voluntary surrender of certificate

Subpart D – Waivers

107.200 Waiver policy and requirements – FAA may issue waiver from any regulation listed in 107.205 if proposed operation can be conducted safely.

107.205 List of regulations subject to waiver – Includes operations from moving vehicles, daylight operations, VLOS aircraft operations, operation of multiple systems, right of way, operations over people, operations in certain airspace, and sUAS operating limitations.

*See also a summary of the Part 107 rules available from the Federal Aviation Administration [here](#).

Appendix C: FAA Certificate of Authorization (COA) Application Process

1. Provide a “declaration letter” to the FAA from the **city/county/state attorney general** declaring that the public agency is recognized as a political subdivision of the government of the State per Title 49 USC 40102(a)(41)(c) and that it will operate the UAS in accordance with Title 49 USC § 40125(b) (not for commercial purposes). The agency head (chief/sheriff) cannot submit this letter. Once that letter has been reviewed by the FAA’s legal office and deemed sufficient, an online access form will be forwarded to the point of contact for the public agency to be completed and returned to the FAA.
2. The online COA application process requires that the agency provide the following information:
 - A. An executive summary that describes the overall program objective and includes a description of the flight missions to be performed.
 - B. A description of the complete UAS, including:
 - 1) The Ground Control Station;
 - 2) Data Link Communication and any FAA Technical Standard Order (TSO) components; and
 - 3) UAS registration information (aircraft must be registered to complete COA application).
 - C. An Airworthiness Release (AWR) statement from the agency head (chief/sheriff) acknowledging that the agency accepts all responsibility for ensuring that the UAS is airworthy and that it will be operated and maintained in strict compliance with the public agency’s certification criteria.
 - D. Procedures that will be implemented in the event of the loss of the command and control (C2) communications link.
 - E. Procedures that describe the actions the pilot will take if there is a loss of communications between the pilot and ATC or the pilot and visual observer (VO).
 - F. Procedures that will be used in the event of any emergency for each phase of flight, including resources for medical and fire assistance. This could include procedures contained in the manufacturer’s flight manual or other possible courses of action.
 - G. Flight Crew Qualifications:
 - 1) The public agency will need to establish their own training and certification program for their pilots, observers, and aircraft maintenance personnel. When establishing self-certification programs of this kind, the government entity conducting the public aircraft operation is responsible for ensuring that the proposed operation can be safely conducted under the terms of their COA.
 - 2) An FAA issued Remote Pilot in Command airman certificate will be accepted for pilots in lieu of self-certification.
3. Types of COAs.
 - A. Blanket Area (Class G) COA
 - 1) Upon approval, this COA will allow day and night operations during Visual Meteorological Conditions (VMC) with a small unmanned aircraft (sUAS) weighing less than 55 lbs. under the following limitations:
 - a. At or below 400’ AGL.
 - b. At least 5 NM from an airport having an operational control tower; 3 NM from an airport having a published instrument flight procedure, but no control tower; and 2 NM from any other airport or heliport.
 - c. The UA missions must be conducted with a visual observer.
 - d. Must issue a Notice to Airmen (NOTAM) for each flight conducted.
 - e. Provide monthly reporting to the FAA on missions conducted under the COA.
 - 2) The COA also allows for limited flight operations over people for life saving events.

- 3) This COA gives the agency the ability to conduct the necessary ground and flight training to bring pilots, observers, and ground crew members to a high level of UAS flight proficiency and also enables them to develop and conduct training exercises to ensure efficient, standardized coordination among other supporting/ responding emergency elements (e.g. coordination for operational missions including search and rescue, disaster control, forensic photography, fire missions, law enforcement, etc.). It is recommended that the agency conduct training at specific training locations and remain well clear of housing areas, roads, any persons, and watercraft. Once this training has been completed, the agency will be authorized to conduct UAS missions at any location within the National Airspace System under the provisions stated within the COA.
- B. Jurisdictional COA
- 1) For agencies that wish to expand their access beyond the Blanket Area COA described above, a Jurisdictional COA can be requested for day and night operations in Class B, C, and D airspace and the surface area of Class E airspace. The COA also authorizes limited flight operations over people for life saving events. Additionally, this COA can also be used to request operations with aircraft weighing more than 55 lbs. When the Jurisdictional COA is issued, the agency need only file a Notice to Airman (NOTAM) prior to flight and make notification to the appropriate Air Traffic Control Facility having jurisdictional responsibility over that airspace (if required).
 - 2) Like the Blanket Area COA, the expectation from the FAA is that, under the Jurisdictional COA, the public agency will conduct training to achieve a level of competency, and once this training has been completed, the agency will be authorized under the same COA to conduct public safety UAS missions in compliance with Title 49 USC 40125B at any location within the National Airspace System under the provisions stated within the COA.
- C. Special Government Interest COA (Emergency COA) - If the proposed operating area is not covered under the agency's approved Blanket Area or Jurisdictional COA, the public safety agency can request and receive approval from the FAA for a Special Government Interest COA that will allow for the one-time operation of the UAS at that location based on an eminent-risk-to-life type event where manned aircraft may need to be available or the risk to manned aircraft is too great.
4. The typical approval process for a Blanket Area (Class G) COA application is completed within 5 business days and 60 business days for a Jurisdictional COA application, provided there are no submittal errors, missing information, or safety or airspace issues.

***Note: This document is current as of December 31, 2018. Please refer to the FAA for the most up-to-date COA application requirements, available [here](#).**

Appendix D: Michigan State Police UAS Training Schedule

Michigan State Police UAS Operator Training Course

Aviation Hangar, Lansing MI.

Day/Time	Monday 7/10/17	Tuesday 7/11/17	Wednesday 7/12/17	Thursday 7/13/17	Friday 7/14/17
0800	Welcome	PART 107	PART 107	Aeryon Skyrainger Sgt. Rogers	Navigation Sgt. Rogers
0900	History of Aviation Unit UAS program Lt. Lawrence/Sgt. Rogers PART 107			Main components Frequency Assembly Cameras Basic operations Simulator	Foreflight Notam Airspace Ecoa VFR Sectional Review Downloading Data
1000					SOP Sgt. Rogers
1100					Aeryon Flight Modes Sgt. Rogers
1200	Lunch	Lunch	Lunch	Lunch	Lunch
1300	PART 107	PART 107	PART 107 Test Prep	Training Flights Flight #1 Setup of system Takeoff and landing	Training Flights Sgt. Rogers/Tpr. Darrow Flight #2 Grid patterns Waypoints Placards Training Area
1400			Written exam		
1500					
1600	Debrief	Debrief	Debrief	Training Area Debrief	Training Area Debrief
1700	Off-Duty	Off-Duty	Off-Duty	Off-Duty	Off-Duty

Michigan State Police UAS Operator Training Course

Aviation Hangar, Lansing MI.


Week #2

Day/Time	Monday 7/17/17	Tuesday 7/18/17	Wednesday 7/19/17	Thursday 7/20/17	Friday 7/21/17
0800	Powerpoint Sgt. Rogers	Training Flights Sgt. Rogers/Tpr. Darrow Flight #4	Training Flights Sgt. Rogers/Tpr. Darrow Flight #6	Training Flights Sgt. Rogers/Tpr. Darrow Flight #8	Powerpoint presentation Students
0900	Use Case Review Tpr. Darrow	Confined Takeoff/Landing Loss Comm Procedures Suspect Search Kill switch	Scenario #1 Crash Scene	Scenario #3 Crime Scene	
1000	RTK GPS/Addtl Equip Tpr. Darrow				Certification Flights Sgt. Rogers Tpr. Darrow
1100	Software Sgt. Rogers Maintenance Aircraft Logs				
1200	Lunch	TBD	TBD	TBD	Area to be determined
1300	Training Flights Sgt. Rogers/Tpr. Darrow Flight #3	Training Flights Sgt. Rogers/Tpr. Darrow Flight #5	Training Flights Sgt. Rogers/Tpr. Darrow Flight #7	Training Flights Sgt. Rogers/Tpr. Darrow Flight #9	Travel
1400	Photography Zoom camera FLIR camera	Advanced operations Hand landings	Scenario #2 Fire Scene	Scenario #4 Suspect/missing search	
1500					
1600	Training Area Debrief	TBD Debrief	TBD Debrief	TBD Debrief	
1700	Off-Duty	Off-Duty	Off-Duty	Off-Duty	Off-Duty

Appendix E: ACSO Mission Briefing Card with Risk Assessment

The document below is a mission briefing card developed and used by the Alameda County Sheriff's Office for all UAS operations. The card contains important considerations, references, and checklists, as well as a risk assessment worksheet on the last page. ACSO UAS crewmembers wear smaller versions of this card on lanyards for quick access and ease of reference.

ALAMEDA COUNTY



UAS
MISSION BRIEFING CARD

- 1. Mission approved and complies with policy and procedure?**
 - A. Check Weather
 - B. Risk Analysis Form completed
 - C. Check Airspace (Part 107 or COA)- TFR's, Hazards etc.
 - D. File NOTAM if flying under COA (877-487-6867)
 - E. Tower Contact if flying under COA
 - KOAK 118.3 (Tower 510-214-1701)
 - KHWD 120.2 (Tower 510-785-5260)
 - KLVK 118.1 (Tower 925-443-0666)
 - F. Class G Airspace west of Lake Merritt 124.3 Golden Gate Traffic
 - G. Air to Air
 - a. Fix Wing 122.75
 - b. Rotorcraft 123.025
- 2. Threats and Mitigations**
 - A. Type of Mission (high-risk/armed)- Security Element
 - B. Identify RPIC and Observer
 - C. Communication- Who handles
 - D. Discuss Emergency Procedures
 - E. Situational Awareness
- 3. Questions/Comments (Brief-Back mission)**
- 4. Pre-Flight Checklist (RPIC/Observer)**
 1. Fit for Flight (IMSAFE)
 2. Safety Briefing (All Crew members read back of responsibilities)
 3. Safe Landing Zone (Sterile Cockpit)- Alternate LZ identified
 4. Inspect Aircraft for damage
 5. Batteries adequately charged (RC, aircraft, IPAD)
 6. SD Card Inserted in camera and formatted
 7. Camera Gimbal inspected/moves freely (lens clean)
 8. Ensure propellers are securely mounted/motors spin freely (cross-check)
 9. Ensure compass calibration if necessary
 10. Determine clearance altitude before flight

SHERIFF'S OFFICE
UNMANNED AERIAL SYSTEMS

ALAMEDA COUNTY



MISSION BRIEFING CARD

5. Initial Power Up

1. IPAD Securely Mounted to RC and connected to aircraft
2. RC controller sticks and switches working and in position
3. Power on controller
4. Open Flight application on IPAD
5. Power on aircraft
6. RC/Aircraft Link established (control and video)
7. Ensure proper satellites acquired (Ready to Go- Green Signal)
8. Check battery levels RC and aircraft battery
9. Ensure home point has been established
10. Confirm area clear for hover/warm-up and LZ secure
11. Initiate hover and control check
12. (Inspire-Confirm landing gear raised)

6. Landing

1. Landing Zone clear
2. Aircraft turned aft to RPIC
3. Lower landing gear (Inspire)
4. Land Aircraft

Altitude	Type of Airspace	Flight Visibility	Cloud Clearance
Below 10,000 MSL	C	3 statute miles	152 → 500 below → 1,000 above → 2,000 horizontal
	D		
	E		
	B	3 statute miles	Clear of clouds
Below 1,200 AGL	G (night)	3 statute miles	152 → 500 below → 1,000 above → 2,000 horizontal
	G (day)	1 statute miles	Clear of clouds

SHERIFF'S OFFICE
UNMANNED AERIAL SYSTEMS

ALAMEDA COUNTY



MISSION BRIEFING CARD

7. Emergency Procedures (See checklist)

1. Engine Failure (note position-locate aircraft)
2. Loss Link (Point RC towards aircraft, monitor link status, if link returns continue w/ flight, if link does not return press "home button" and clear landing area)
3. Aircraft Critical Battery- Landing (clear landing area)
4. Loss of GPS (land aircraft in safe area as soon as possible)
5. Extreme Winds (return home and land in safe area-consider alternate)
6. RPIC Incapacitation/Medical Emergency (select crew member to take over as RPIC)
7. Flyaway (note location, altitude and direction, immediately notify nearest ATC, initiate search)
8. Emergency Shutoff- Only stop the motors mid-flight in emergency situations when doing so can reduce the risk of injury/damage:
 - a. P4- Pull the left stick inward and downward and press the RTH button at the same time
 - b. Inspire-1. Push the throttle down, 2. Conduct Combination Stick Command (CSC)- hold both sticks inward and downward
 - c. Mavic- hold both sticks inward and downward

8. Post Flight Debrief

- A. Concerns w/ mission
- B. Lessons learned
- C. Designate person who will complete mission reports, process any evidence, complete aircraft log and RPIC logbook
- D. Ensure aircraft is ready for next mission (charge batteries, controller, IPAD, ensure micro-sd card is reformatted)
- E. Complete maintenance logs in aircraft Binder

SHERIFF'S OFFICE
UNMANNED AERIAL SYSTEMS

ALAMEDA COUNTY



MISSION BRIEFING CARD

Mission Type

- Local = 1
- Test Flight = 2
- Tactical = 4

Environment

- Visibility
 - > 6 Nautical Miles = 0
 - 3 - 6 Nautical Miles = 2
 - 1-3 Nautical Miles = 3
- Ceiling
 - 3,000 + = 0
 - 1,100- 2,900' = 2
 - 500-1,000' = 3
- Thunderstorms
 - None = 0
 - Isolated = 2
 - Scattered = 4
- Dust Storms
 - None = 0
 - Light = 2
 - Moderate = 5
- Headwinds
 - < 10 knots = 1
 - 10 - 20 knots = 2
 - > 20 knots = 3
- Crosswinds
 - < 5 knots = 1
 - 5 - 10 knots = 3
 - > 10 knots = 5
- Gusts
 - < 5 knots = 1
 - 5 - 10 knots = 3
 - > 10 knots = 5

Crew Assessment

- Planning Time
 - In Depth = 1
 - Adequate = 2
 - Minimal = 3
- Operator Mission Type Experience
 - > 5 flights = 1
 - < 5 flights = 3
- Operator DJI Flight Experience
 - > 25 flights = 1
 - < 25 flights = 3
- Crew Duty Day
 - 8 hours = 1
 - 8 - 12 hours = 2
 - 12 - 16 hours = 4
- Length of rest period
 - 8 hours = 1
 - 4 - 8 hours = 3
- Operator Familiarity with Area
 - Extensive = 1
 - Average = 2
 - None = 3
- Operator Flights in Area
 - > 10 = 1
 - 6-10 = 2
 - < 0-5 = 3

Risk Assessment and Action

- < 25 Points** LOW RISK. No additional Action required
- 25 - 30 Points** MEDIUM RISK. Design, document, and implement risk mitigation measures.
- > 30 Points** HIGH RISK. Design extensive risk mitigation measures. Mission approval SHALL be obtained from UAS Captain.

SHERIFF'S OFFICE
UNMANNED AERIAL SYSTEMS

Appendix F: FBI UAS Safety Management System (SMS)

UAS Safety Management⁶³

A Safety Management System (SMS) is a proactive, integrated approach to safety management. It is a formal, top-down, organization-wide approach to managing risk and assuring the effective use of aviation assets as it balances operations with effective risk mitigation. It includes systematic procedures, practices, and policies for the management of safety risk. The four components of an SMS program include: Safety Policy; Safety Risk Management; Safety Assurance; and Safety Promotion. More information on the FBI SMS program is contained in the FBI Aviation Policy Guide (APG).

All employees from Executive Management to front-line UAS personnel are responsible to adhere to the APG. This section of the SOP has been developed to provide UAS operators with fundamental guidance on how to implement sound UAS safety management in accordance with the APG. To ensure aviation safety receives the proper level of attention, any employee is authorized to bring any concern of the safety of aviation to the next level in his or her chain-of-command or directly to the Program Manager of Aviation Safety at the SAS.

Safety Policy

Aviation Personnel Safety Responsibilities

All personnel are responsible for working safely and maintaining a safe work environment. Aviation Program personnel are required to conduct themselves in a manner that is consistent with the safety rules and policies in this Policy Guide and SAS manuals. All aviation personnel should receive Safety Orientation Training (see the APG – Promotion Section). Responsibilities of all aviation personnel include:

- Be familiar with the contents of the SMS as described in this document.
- Attend all required aviation meetings and conferences (including safety meetings and AvCo, Maintenance and Safety Conferences).
- Be familiar with SAS safety policies and manuals.
- Be familiar with the local SOP.
- Participate in flight and ground training as required.
- Submit ASTAR reports when hazards are identified in the work environment or unsafe practices or conditions are observed.
- Complete initial safety management training on UAS operations as described below.
- Complete semi-annual training on UAS Mission Risk Profiles (MRPs) as described below.
- Maintain training currency as described in this SOP.
- Take positive steps to avoid unsafe work conditions.
- Correct unsafe work conditions promptly.
- Report all accidents, injuries, incidents, or hazardous conditions to your Supervisor, local Aviation Safety Coordinator and/or the PM of Aviation Safety.
- Identify areas of potential hazards within the local flight operation and communicate those hazards to the appropriate person. Participate in proactive risk management.

⁶³ Note, many of the resources referenced throughout the FBI's UAS Safety Management System are internal resources that are not publicly accessible.

Aviation Safety Coordinator

The field office Aviation Safety Coordinator is primarily responsible for ensuring field aviation personnel remain compliant with policies and procedures outlined in this SOP. In some field offices, a SAS approved UAS safety coordinator might also be designated. Duties of the aviation safety coordinator are defined in the APG.

Field Office Management

The field office SAC is ultimately responsible for the safe operation of UAS flight operations within their field office and should be kept informed of safety concerns and needed resources. The field office Supervisor is responsible for UAS operations and must ensure all aviation personnel comply with policies relating to the operation, maintenance, safety, and training of UAS aircraft. Supervisors must take action on any outstanding issues and pending safety initiatives as appropriate. The Supervisors attend quarterly safety meetings when practical.

Field Office management has a critical role in managing medium- and high-risk missions using the UAS Risk Assessment Worksheet. Local management has the responsibility to consider and implement risk mitigation measures as necessary, or to cancel the mission if the perceived risk outweighs the potential benefits of the mission continuing. Supervisors must ensure UAS operations follow the following basic safety principles:

1. Always operate in the safest manner possible
2. Never take unnecessary risks
3. Recognize that safe does not mean risk free
4. Hold everyone accountable and responsible for the identification and management of risk

Emergency Response Plan (ERP)

Aviation personnel notified of an accident shall follow ERP procedures in the appropriate aircraft accident checklist available on the Aviation Support Unit (ASU) intranet web page. The aircraft accident checklist outlines what should be done when an aircraft accident or incident occurs. The field office Aviation Safety Coordinator is the point of contact for all aircraft accidents or incidents in the field office.

The ERP must be activated in the event of death or serious injury to any person, significant damage to property, or significant damage to the aircraft as determined by the field office and/or SAS. For events exceeding \$500 for repair or replacement of any property, the field office and/or SAS may initiate an internal safety investigation.

Duty Time and Rest Requirements

Maximum Duty Day:

A crew member duty day is defined as the time between the crew member's arrival at his or her first duty station (e.g., hangar, field location or office) and the crew member's departure from the duty station. Maximum Duty Day for UAS operations is 14 hours.

Crew Member Rest Period:

The rest period for an individual flight crew member is defined as the time between the end of one duty day and the beginning of the next duty day. The minimum rest period for any individual UAS operator is 8 hours.

Waiver Policy:

Any waivers or deviations to this SOP must consider all known hazards and mitigation strategies in order to reduce mission risks to the lowest acceptable level.

Factors to be considered when granting waivers: Time of flight, time of landing, time driving home, prior crew rest taken, RAW value, weather, hours awake, last RDO taken, personal stressors, unfamiliar area, crew experience level, recent operations tempo, etc.

Risk mitigation strategies when granting waivers: Shorten mission time, change mission start and/or end time, change crew, VMC only flight, day time only flight, change location of launch or recovery, force protection for operator, etc.

The CIRG/SAS Program Managers are the first point of contact for duty day and crew rest waivers.

Safety Risk Management

Hazard Identification and Analysis

Mission Risk Profiles (MRPs) are developed to identify and analyze UAS operational hazards. These profiles provide operational hazards, consequences, risk levels and risk mitigation controls to provide a clear understanding of the risk associated with each type of UAS mission. Additional details on how to develop MRPs is contained in the APG – Strategic Risk Management. Some standard UAS MRPs are available on the ASU webpage.

Risk Assessment and Mitigation

All UAS flight operations must use the approved FBI's Risk Assessment Worksheet (RAW) prior to every flight. Completed RAWs must be retained by the field office for 3 years. The approved UAS RAW can be located on the ASU webpage. Prior to departure, the RAW ensures flight crews evaluate their mission for potential hazards, conditions, and/or factors that might affect flight safety and mission completion (e.g., adverse weather, crew experience, terrain and environmental factors, crew rest, and waivers granted). A quantitative value is assigned to each hazard category based on the severity of the hazard. The sum of all categories is then added to provide an overall risk rating (low, medium or high) associated with the mission. The crew must also consider any hazards or factors not identified on the RAW. Any additional hazards must be documented and mitigated when practical. All risk factors on the RAW must be discussed by all involved in the UAS flight operation. Crews requiring assistance to evaluate and score uncategorized hazards on the RAW can refer to their local Aviation Safety Coordinator or the CIRG/SAS PM of Aviation Safety. Additional details can be found in the APG – Tactical Risk Management.

Missions scored as low risk may be completed with PIC concurrence. If risk is scored at medium or high, then local management must be contacted as directed on the RAW. Medium- or high-risk missions must have risk mitigation measures considered by the crew and/or supervisor. Mitigation should also be implemented by the crew or supervisor for low-risk missions as determined appropriate. Any mitigation used must be documented on the RAW. Four fundamental principles of Risk Assessment must be considered when evaluating risk and applying mitigation. These principles are:

1. *Accept no unnecessary risk:* An unnecessary risk is a task that does not provide the desired return in terms of benefit or opportunity. Everything involves risk. The most logical choices for accomplishing a task are those that meet all mission requirements with the risk as low as reasonably practical.
2. *Make risk decisions at the appropriate level:* Risk decisions should be made by the person indicated on the RAW, or other individuals deemed appropriate.
3. *Accept risk when benefits outweigh the costs:* All identified benefits should be compared against all identified costs.
4. *Integrate risk management into planning at all levels:* Risks are easier to assess and mitigate in the planning stages. The later changes are made in the process of planning and executing a task, the more complex risk mitigation will become.

Safety Assurance

Hazard Reporting Policy

The FBI Aviation Program strives to maintain a culture of open reporting of all safety hazards. The FBI will not initiate disciplinary action or blame against any personnel who, in good faith, due to unintentional conduct, discloses a hazard or safety incident. It is expected that all aviation personnel will constantly search for and report potential hazards. (Additional information regarding hazard reporting is contained in the APG - Safety Assurance).

The Aviation Safety Tracking and Reporting (ASTAR) form is the primary tool used to collect information and provide detailed preventive and corrective actions to SAS management and the SMS. An ASTAR can be submitted online through BAO or a paper form mailed to CIRG/SAS/ASU (see ASU's web page for blank ASTAR forms). No punitive or administrative actions shall be taken against an individual who reports an aviation safety oversight or mistake provided there is no gross negligence; gross disregard for operational rules, procedures, and regulations; or reckless operations as initially determined by the Aviation Safety Council. Additional detail on the Hazard Reporting program can found in the APG – Safety Assurance.

Continuous Improvement Process

The Continuous Improvement Form allows aviation personnel to formally suggest ideas for potential improvements to UAS policies, procedures or processes. The form is available on the ASU web page. Additional details are available in the APG – SMS Continuous Improvement.

After-Action Reports

Information gained and “lessons learned” from local missions, training, or recent TDY deployments that might be valuable to other UAS operations should be documented using an After-Action Report (AAR). All AARs should be submitted to the CIRG/SAS UAS PM for field-wide dissemination. The AAR form can be found on the ASU webpage.

Safety Promotion

Risk Mitigation Training

Semi-annually, all UAS personnel must review UAS MRPs to ensure operators are familiar with risk mitigation measures to be used on UAS operations. This training/review must be documented in the local aviation training file. This training/review may be coordinated through the CIRG/SAS UAS PM/MAPA.

Initial Safety Orientation Training

All newly assigned UAS personnel (field office aviation supervisors and operators) must receive Initial Safety Orientation Training before assuming UAS duties. This initial training must be completed by the field office Aviation Safety Coordinator, SAS authorized UAS instructors who have received formal SMS training, or other instructors as approved by the CIRG/SAS PM of Aviation Safety. This training must be documented in the local aviation training file. Safety Orientation Training includes instruction in the following:

1. Components of the SMS

2. Review of the UAS SOP and APG regarding safety management
3. Each employee's responsibility
4. The hazard reporting system
5. Responsibilities under the Accident Response Plan

Safety Information

Open communication concerning hazards and the methods used to control them create safe work environments and help to complete UAS mission objectives. The field office Aviation Safety Coordinator is responsible to manage aviation safety communications within their field office as described in the APG – Safety Communication and Awareness. Available safety information discussed in the APG includes:

1. Quarterly Safety Meeting and Safety Training (Regional and National Stand-downs⁶⁴)
2. Safety reading file
3. Safety library
4. Safety bulletin board
5. Aviation Safety Information / Communications from SAS
6. Hazardous material list
7. Lessons Learned / After Action Reports (AARs)
8. ASTARs
9. Continuous Improvement Forms

UAS operators are encouraged to seek these resources, participate in quarterly safety meetings, and provide pertinent UAS safety material to the Aviation Safety Coordinator or UAS safety designee for dissemination. UAS operators are encouraged to submit ASTARs, AARs, and Continuous Improvement Forms to the CIRG/SAS UAS PM for field-wide dissemination.

⁶⁴ These stand-downs refer to designated dates/times where flight operations are suspended to conduct safety training.

Appendix G: York County UAS Mission Report Form

York County VA. R.O.V.E.R. Team Incident Sheet

Event Name: _____ Remote PIC: _____ Start/End Time: _____ / _____

Date: _____ Weather: _____ FLS# _____

Arrival Time: _____ YPSO# (if issued) _____

Incident Type: Callout or Scheduled Event -- LE Search Fire -- York Co. Mutual Aid VDEM

Person Requesting Team: _____ Agency: _____

Contact #: _____ Date/Time: _____ / _____

Location of Staging Area/ Brief Time: _____

Location of Event (Address, Landmarks): _____

(Lat/Long-DMS,) Latitude: _____ Longitude: _____

_____ Degrees and _____ miles from _____

_____ Degrees and _____ miles from _____

Alternate Landing zone(s) location: _____

Tower Notified: _____ Contact: _____ Initials _____ Date/Time: _____ / _____

NOTAM Filed: No Yes Contact: _____ Initials _____ Date/Time: _____ / _____

NOTAM Number: _____ Start Time _____ End Time _____ Radius _____ Miles SCF to _____ ft.

SGI Waiver Requested: No Yes Contact _____ Initials _____ Date/Time: _____ / _____

Team Members Requested: All Page / Requested: _____

Members Present (times): _____

Equipment: Trailer Driver: _____ Air 1 Pilot: _____ Air 2 Pilot: _____ Air 3 Pilot: _____

Issues with Equipment: _____

Summary Brief: _____

Tower Notified: _____ Contact _____ Initials _____ Date/Time: _____ / _____

Departure Time: _____

Appendix H: Sample UAS Mission Report Form

UAS Mission Report Form		
Date:	Time of Deployment:	
Location(s):		
Mission Type:	Approving Supervisor:	
Incident/Case #:	Risk Assessment Score:	
Time Flight Operations Began:	Time Flight Operations Ended:	
UAS Crewmembers		
Supervisor(s):	Pilot(s):	
Visual Observer(s):	Other:	
Aircraft Used		
Registration Number:	Number of Flights:	Total Flight Time:
Registration Number:	Number of Flights:	Total Flight Time:
Registration Number:	Number of Flights:	Total Flight Time:
Registration Number:	Number of Flights:	Total Flight Time:

Mission Debrief

Mission Summary:

Equipment Issues:

Operational Issues:

Other Comments:

Appendix J: Compilation of UAS Resources

Below is a compilation of resources that may be helpful in developing and managing a UAS program, many of which have been referenced throughout this report. Click on the text to navigate to the desired resource. This list is not intended to be comprehensive.

- [Airborne Public Safety Association](#) – provides a variety of resources, including sample UAS operations manuals
- [Airborne Public Safety Accreditation Commission – Standards for Small Unmanned Aerial Systems](#)
- COPS Office Report: [Community Policing & Unmanned Aircraft Systems \(UAS\): Guidelines to Enhance Community Trust](#)
- [International Association of Chiefs of Police – Unmanned Aircraft Model Policy](#)
- [International Association of Fire Chiefs \(IAFC\) – Unmanned Aerial Systems Toolkit](#)
- [Know Before You Fly](#) – provides user-friendly guidance on operating civil and public unmanned aircraft
- [National Conference of State Legislatures – Current Unmanned Aircraft State Law Landscape](#)
- [National Council on Public Safety UAS](#) – offers a compilation of UAS resources, including guidance on operating under Part 107 and Certificates of Authorization (COA)
- [National Police Foundation’s Center for Unmanned Aircraft Systems in Public Safety](#) – includes guidelines, recommendations, and resources for community engagement, policy development, and program implementation
- [National Fire Protection Association – Standard for Small Unmanned Aircraft Systems \(sUAS\) Used for Public Safety Operations](#)
- [National Police Foundation’s sUAS and Public Safety infographic](#)
- NIJ Report: [Considerations and Recommendations for Implementing an Unmanned Aircraft Systems \(UAS\) Program](#)



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