INSTITUTE FOR HOMELAND SECURITY

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Examining the Role of Drones in Public Safety Agencies Across Texas:

Current Knowledge and Guidance

Institute for Homeland Security

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ABSTRACT

Over the past several years, numerous industries have begun using drones to save time and money and enhance safety. One industry where drones have become increasingly popular is in public safety. Prior research shows that public safety officials use drones for a variety of situations (e.g., combatting fires, tracking fleeing suspects), while also enhancing efficiency and mitigating personnel risk. Yet, like any technological advancement, drones present a number of challenges that officials must address, such as potential privacy violations and the monetary costs associated with managing a UAS program. While this information is important, much of the prior literature on the use of drones in public safety comes from the viewpoint of academics, journalists, and non-governmental organizations (NGOs). A missing link from this body of literature, then, is research documenting the advantages and disadvantages of managing a UAS program from the perspective of public safety officials. To address this issue, the present study conducted qualitative interviews with approximately 11 public safety agencies in Texas to address the main benefits and challenges to implementing drones in the field, as well as their agencies' training requirements and recommendations for departments looking to implement their own UAS program.

INTRODUCTION

Unmanned aircraft systems (UAS) or drones will soon be part of our everyday technology. According to the Federal Aviation Administration (FAA), there are nearly 800,000 registered drones in the United States and over 370,000 certified remote pilots (FAA, 2024). While drones are mostly flown by hobbyists, numerous industries are now employing UAS in their daily operations (Al-Dosari et al., 2021). Companies such as Amazon, UPS, and FedEx are experimenting with drones to deliver packages to customers, while the Shell gas company uses UAS to monitor pipelines for leaks, conduct maintenance, and access difficult to reach spaces (Al-Dosari et al., 2021; Carr, 2021). Additionally, industries from construction, to healthcare, to insurance, and conservation are using drones to increase efficiency and safety. In all, the use of drones across a diverse array of professions indicates that UAS are "the way of the future."

Another industry where drones have proven to be a valuable asset is in public safety, such as in law enforcement, fire departments, emergency medical services (EMS), and search and rescue teams (Breshears, 2016). According to Droneresponders (2024), a non-profit organization dedicated to enhancing knowledge and training of UAS among first responders, there are currently 255 public safety agencies in Texas that have a drone program. Research suggests that UAS offer a multitude of benefits for first responders, including personnel safety, reduced costs, faster response times, and the ability for drones to respond to high-risk (e.g., barricaded suspects) or catastrophic events (e.g., flooding, hurricanes) (Koslowski & Schulzke, 2018; West & Bowman, 2016). Yet, with any technological advancement comes limitations. While drones do receive a great degree of public approval, this support must be juxtaposed with the possible privacy and security concerns associated with UAS. Examples of such concerns include the potential that drones will be used to conduct warrantless searches and surveillance, the need for agencies to invest in data security platforms to secure any sensitive information collected by

UAS, and the possibility that drones will be exploited by criminals (Breshears, 2016; Burt, 2020; Enemark, 2021).

Against this backdrop, the purpose of this study is to examine the use of drones in public safety departments in Texas. Specifically, through qualitative interviews with 11 public safety officials, the present study seeks to understand the benefits, challenges, training requirements, and best practices for operating drones across a variety of emergency response teams. A review of prior research reveals that most studies that examine the use of drones in public safety come from the viewpoint of academics, journalists, and non-governmental organizations (NGOs). Hence, little is known about the experiences of using UAS in public safety from the perspective of first responders. The goal of this study, then, is to provide first responders with critical information about the main advantages and disadvantages with using drones across different types of public safety agencies, as well as provide decision makers with first-hand knowledge about whether to implement UAS within their own departments.

Background

The term unmanned aircraft systems (UAS) refer to a three-part component: the drone, the operator or pilot, and the system used to fly the drone. As of 2022, there were approximately 1,076 drone companies in the world. Approximately half are drone manufacturers (49.5%), while the other half consist of UAS service providers (e.g., Zipline) or software manufacturing firms (Alvarado, 2022). Like with any technology, there is a great deal of variation in the capabilities, size, flight range, altitude, speed, and costs of drones. A search on Amazon.com revealed that drone prices range anywhere from less than $20 to tens of thousands of dollars or more for high-end commercial drones. While features such as speed, altitude, battery life, and range certainly do factor into the price of drones, cost is largely determined by the brand and model of the UAS and their capabilities. Drones equipped with advanced features such as high-quality camera lenses and specialized sensors (e.g., thermal imaging, LiDAR), and those designed to be used for professional purposes are often the most expensive types of UAS (Dukowitz, 2019). Surprisingly, most of the costs associated with UAS does not come from the drones themselves, but rather, expenses associated with purchasing additional batteries and chargers, acquiring insurance, providing pilots with recurring trainings and licensing requirements, having a regularly scheduled maintenance plan, and paying for a data management system (Jukic, n.d.). In short, drones are not a one-time expense and require a yearly line-item budget to account for all the costs associated with maintaining a UAS program.

Due to the growing popularity of UAS systems, in 2012, Congress passed the FAA Modernization and Reform Act to integrate drones into the National Airspace System (NAS) (Breshears, 2016; Carr, 2021). The bill also placed the FAA in charge of regulating and providing guidance on the safe operation of UAS. According to the FAA, all drones that weigh 55 pounds

or more are required to be registered. Additionally, drones are only permitted to be flown during the daytime, below 400 feet, and within a visual-line-of-sight (Graham et al., 2021). The latter requirement means that pilots must always have eyes on the drone while in operation. However, some government agencies, especially those in public safety, do have the option to apply for a waiver with the FAA to bypass some (or all) of these restrictions. The FAA also prohibits drone pilots from flying near critical infrastructures (e.g., power plants), correctional facilities, and areas with temporary flight restrictions (e.g., major sporting events, natural disasters). Furthermore, as of September of 2023, all FAA registered drones are now required to have a Remote ID number. Remote IDs provide other parties (e.g., air traffic control) with the ability to obtain the identity and location for drones in flight.

In addition, remote pilots are required to undergo training and must be licensed by the FAA. The FAA mandates that all registered drones be flown by a pilot with Part 107 training. The requirements for receiving Part 107 certification include: be at least 16 years of age, can read, write, and communicate in English, be physically and mentally fit to safely operate the drone, and pass an aeronautical knowledge exam (Carr, 2021; Graham et al., 2021). Operators who receive their Part 107 certification must also participate in recurrent trainings with the FAA and renew their remote pilot license every two years. Still, it is important to acknowledge that while the FAA is responsible for regulating the use of drones, the agency does not have criminal enforcement authority to sanction those who violate these rules (Graham et al., 2021).

Prior Research on the use of Drones in Public Safety

As noted above, many industries are now relying on drones to perform a wide range of tasks. For the purposes of this study, specific attention will be given to the use of UAS in emergency response or public safety agencies. Current estimates show that approximately 1,400 police departments across the United States have a drone program, an increase of over 50% over the last six years (Stanley, 2023). Law enforcement agencies use UAS for a variety of purposes, such as tracking fleeing suspects, monitoring accident scenes or traffic flow, managing large crowd events (e.g., sports games, concerts), search and rescue incidents, and for SWAT operations (Heen et al., 2018; West & Bowman, 2016). Some jurisdictions are also experimenting with drones to serve as first responders (DFR). Under this model (and with FAA permission), UAS are positioned in strategic locations throughout the city and are deployed during a 911 call (Brinc, 2024; Montgomery County of Police, n.d.). Often, the drone is the first to arrive on scene and is able to provide real-time information back to responding officers, which can lead to more informed decision making and help deescalate tense situations (Axon, 2022). The Chula Vista Police Department (CVPD) in California was the first law enforcement agency in the United States to implement a DFR program. Since its inception, the CVPD has credited its DFR program with reducing its agency's 911 response time to under 2.5 minutes, less than half the national average (Axon, 2022).

UAS are also a critical tool for fire departments, EMS, and other first responders. Fire departments, for example, rely on thermal imaging cameras affixed to drones to monitor the intensity and spread of a structural fire. With thermal imaging cameras, firefighters can identify the hot spots of a fire and direct resources to extinguish it (Lawrence et al., 2023). EMS agencies

also rely on drones to deliver time-sensitive medical supplies to patients experiencing critical health events (e.g., cardiac arrest, stroke, drug overdose) (Roberts et al., 2023; Wesley, 2017). A recent study using data from Durham County, North Carolina found that stationing four drone bases across the city with Narcan would reduce the response time for overdose-related calls from 10 minutes and 46 seconds for ambulance arrival to 4 minutes and 38 seconds for the UAS (Ye et al., 2019).

Drones, therefore, provide a multitude of benefits for public safety agencies. From increasing officer and public safety, to improving response times and efficiency, it is clear that the use of UAS among first responders will only continue to grow. Yet, if history is any guide, technological advances also generate challenges that decision makers must address. Drone technology is no different. Critics of UAS argue that drones infringe on privacy rights and create security concerns. In the case of the latter, cartels are now turning to drones to smuggle drugs, weapons, and humans across the U.S.-Mexico border or to serve as a "look-out" for other illicit activities (Swales, 2019).

Additionally, just as UAS serve as a novel tool for law enforcement to fight crime, they also bring about new opportunities for offenders to victimize citizens. A study by Graham et al. (2019) using data from a nationally representative sample found that nearly one-third (31%) of respondents reported being victimized by a drone. Furthermore, according to the National Conference of State Legislatures (2023), since 2013, 44 states have implemented laws regulating the use of UAS. Unfortunately, of this legislation, only Mississippi and South Dakota have addressed privacy concerns related to the use of drones. Many of these laws, instead, focus on regulating the use of UAS among law enforcement or prohibiting their operation near high-security facilities (e.g., airports, prisons). Law enforcement officials also have limited means to deter or arrest suspects accused of using drones for criminal activities (Swales, 2019). In many cases, offenders will operate the drone from miles away from the crime scene, which significantly reduces the chances of apprehension (Graham et al., 2019). In addition, local and state police departments are prohibited from capturing drones in flight, even if they are being used to commit a crime—only the FAA has this authority (Swales, 2019). To make matters, while drones can provide a wealth of forensic evidence for police departments, this assumes that the UAS is registered with the FAA or that law enforcement officials can retrieve it if it crashes to the ground (Swales, 2019).

The most common criticism against UAS is the fear that drones will infringe on citizens' 4th Amendment Right against warrantless surveillance (Burt, 2020; Koslowski & Schulzke, 2018). The concern is that drones will serve as a new form of "big brother" and allow police departments to surveil populations without a warrant or to monitor protests and other public gatherings (Feeney, 2016; Porter, 2017). The American Civil Liberties Union (ACLU) has published several reports highlighting the need to protect individual privacy rights with UAS. They recommend that police departments only employ UAS with a warrant or during emergencies, that images and video be retained only if they contain evidence of a crime, that drone policies be set by public representatives (not police departments), and that proper oversight be given to regulate the potential misuse of UAS. Furthermore, a study conducted by Heen and

colleagues (2018) found that an overwhelming number of Americans support the use of drones in law enforcement for reactive situations (e.g., search and rescue, apprehending suspects) as opposed to proactive operations (e.g., monitoring protests, detecting traffic violations, surveilling individuals under house arrest).

Problem Statement and Current Study

Over the past decade, the use of drone technology in public safety has rapidly emerged as a critical tool for increasing efficiency and saving lives. As Carr (2021: 201) explains, "no other technologies have come close to the safety and convenience" of UAS, particularly in law enforcement. While the benefits and uses of UAS in public safety are clear, drones also present many challenges that practitioners, government leaders, and the public must confront. Chief among these is the delicate balance between security and privacy. Although the discussion above helps one understand the main benefits and challenges to implementing UAS in public safety, notably absent is researching documenting these issues from the perspective of public safety officers who employ UAS in the field. This information is critical considering that the advantages and disadvantages that first responders identify may (or may not) be the same as those defined in prior research. In addition, knowledge obtained from first responders can provide valuable information for public safety agencies looking to implement their own UAS program. To this end, the present study asks the following four research questions:

1. What are the main benefits to using drones in public safety?
2. What are the primary challenges that agencies must confront when employing drones in public safety?
3. What types of trainings do most public safety agencies require for their drone pilots?
4. What are some recommendations or best practices for those public safety agencies looking to implement their own UAS program?

DATA AND METHODS

To answer these questions, the present study conducted qualitative interviews with a sample of public safety departments with UAS programs in Texas. The initial sample was selected from the Droneresponders' Public Safety Program Directory. Specifically, agencies with a greater number of pilots and drones, payload capabilities (e.g., thermal imaging, video streaming), and a longer tenured UAS program were selected to be interviewed. Agencies were also chosen based on department type (e.g., law enforcement, fire service/EMS, search and rescue) to ensure variability in the sample. Of the initial 12 agencies that were selected, eight responded and

agreed to participate in the study. However, one agency was excluded from the sample because they no longer had a UAS program.[1] Four additional agencies were recruited via snowball sampling; that is, asking the initial seven agencies to identify other public safety departments with UAS programs to participate in the study. This process resulted in a final sample of 11 public safety agencies.

Interviews with respondents lasted between 30 minutes to one hour and were conducted via Zoom. All agencies agreed to have their interview recorded for coding purposes. To ensure confidentiality, the specific name of each agency was redacted. The recorded interviews were then transcribed and coded in Nvivo, a software program used for analyzing qualitative data. Within Nvivo, all transcripts were coded based on themes identified in the prior literature and ideas that were repeatedly cited during interviews. The results from the interviews are discussed below.

RESULTS

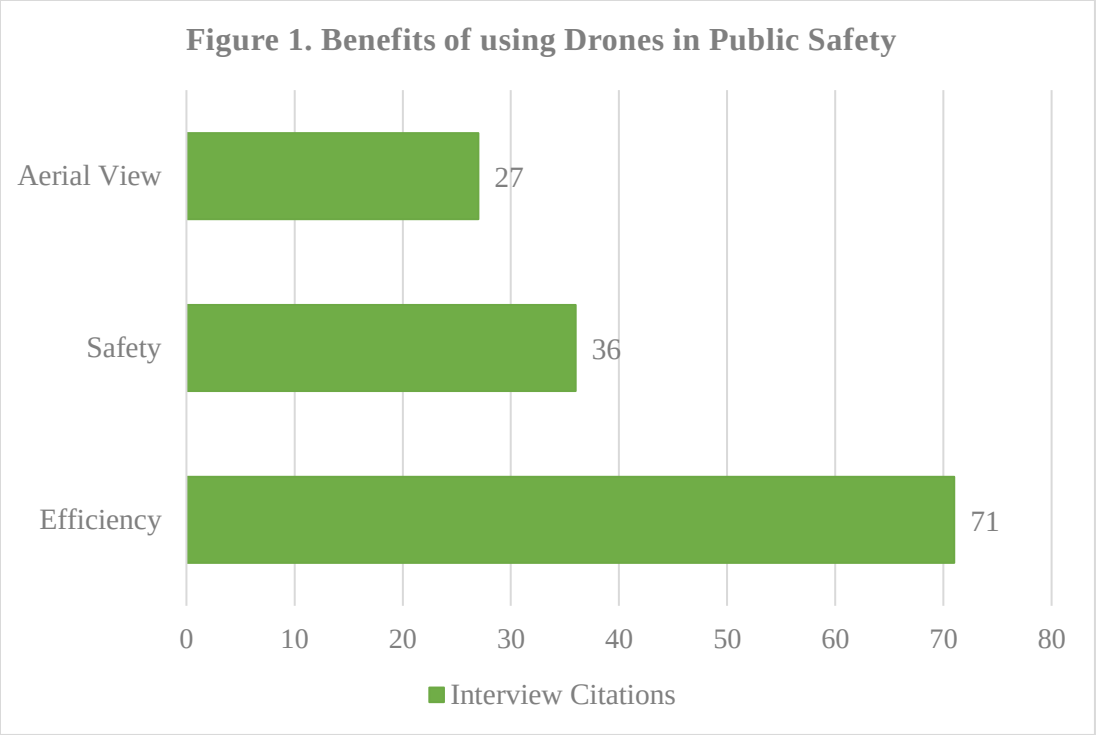
Figure 1. Characterists of UAS Programs in the Sample

Agency ID	Agency Type	# of Drones	# of Drone Pilots	Year Program Began	Part 107 Certification	UAS Training Academy
Agency #1	Fire Department	30-40	25	2014	Yes	Yes
Agency #2	Law Enforcement	11	6	2018	Yes	No
Agency #3	Search and Rescue	9	9	2016	No	No
Agency #4	Other	100	50	2018	Yes	Yes
Agency #5	Law Enforcement	19	30	2016	Yes	Yes
Agency #6	Law Enforcement	25	15	2015	Yes	Yes
Agency #7	Fire Department	3	6	2017	Yes	No
Agency #8	Fire Department	2	3	2016	Yes	No
Agency #9	Law Enforcement	326	6,365	1995	Yes	Yes
Agency #10	Other	2	7	2022	Yes	No
Agency #11	EMS	22	25-30	2020	Yes	Yes

Table 1 provides a brief description of each agency's UAS program by identifying the number of drones, remote pilots, year program began, whether officers are required to obtain Part 107 certification and whether an agency has a training academy for its unmanned aviation division. In terms of the number of drones and remote pilots, agencies ranged from having anywhere from two drones and three pilots to as many 326 UAS and over 6,000 operators. All agencies except for one began their UAS division within the last decade, and several mentioned that their drone program expanded after the protests and mass demonstrations of 2020. Furthermore, nearly all agencies require their drone operators to receive their Part 107 certification from the FAA and several have a training academy for both onboard and continuing education for their pilots.

Benefits

[1] The agency that no longer had a UAS program was a 911 emergency communications center. During initial conversations with this agency, they stated that over ten years ago, they provided drone services to various jurisdictions in the region. However, since that time, several of these agencies had since developed their own UAS program and their services were no longer needed.



The next set of results highlight the main benefits that agencies identified through their use of drones. As shown in Figure 1, efficiency, safety, and aerial view were identified as the three main advantages for using UAS in public safety. The bar chart represents the number of times these three benefits were cited across all 11 interviews. For efficiency, respondents stated that drones can be deployed quickly and are significantly cheaper to operate than other aircraft systems such as helicopters. As one respondent stated during their interview, "it's a lot cheaper, you know, man-hour wise to use the drones than it is to use the helicopters. I mean, the fuel costs alone are just astronomical right now!" Agencies also emphasized the value of using drones to locate missing persons or fleeing suspects. One agency described working a local concert festival and receiving a call about person who had been physically assaulted. After obtaining a brief description of the offender, the respondent stated that they were "able to rapidly identify where that person [suspect] was located, and they were taken into custody…who otherwise may have been able to just disappear into the crowd." Another agency whose UAS missions primarily consist of search and rescue operations described an incident where a drone pilot was called out to attempt to locate an elderly man with dementia who had wandered off from his home. Local law enforcement had been searching for hours, but within 71 seconds, the drone pilot spotted the man and was able to guide units to make the rescue.

As another attribute of efficiency, respondents stated that drone video footage provides command staff with real-time information that make for better informed decisions. Speaking to this point, an agency who oversees public safety at a large, international airport stated the following:

> "If you're on a large scene or anything and you're sitting on a radio trying to describe to whoever is an incident commander what's going on. There's a lot lost there, right? I mean, no matter who you are; you can be the best communicator in the world, but under a

> hectic situation, things are going to be lost…but if you can get a live video stream. It really clarifies a lot of things for the people in the command post."

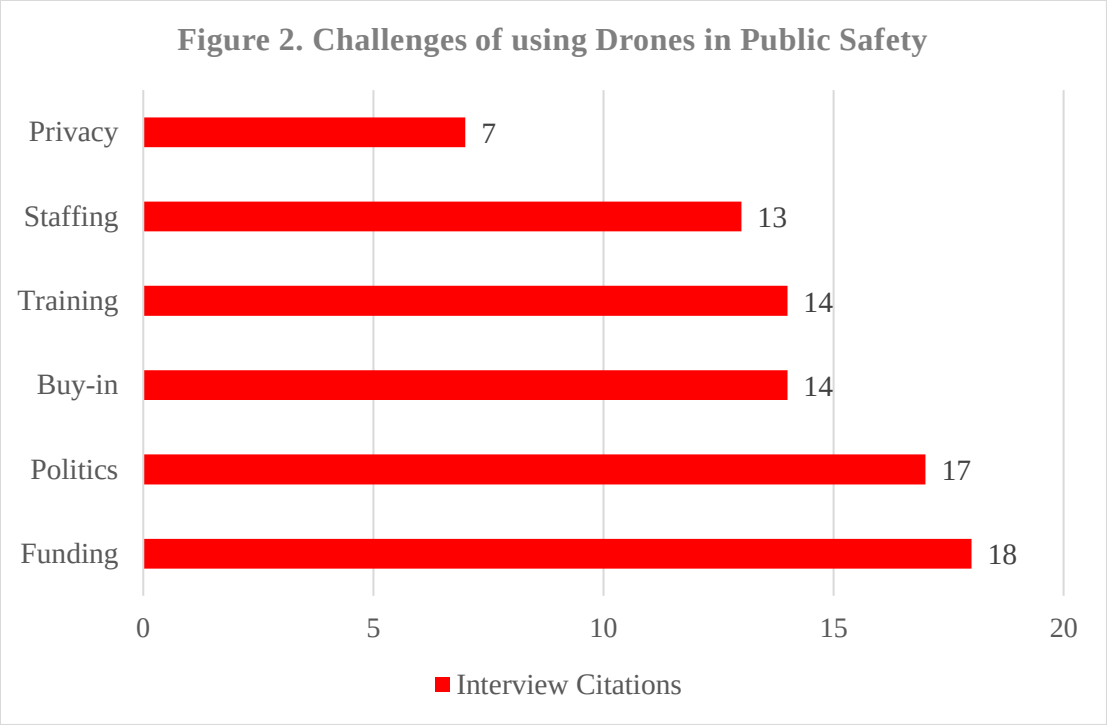
The next most common theme highlighted during the interviews was safety. Most of this discussion centered around personnel safety, especially during high-risk situations (e.g., SWAT calls, 911 calls involving a firearm). For example, one law enforcement agency stated that they routinely use drones during SWAT operations. The specific drones they employ during these incidents are specifically designed for interior use and provide officers with critical information, including whether the suspect is still alive and what part of the house he or she barricaded in. Most importantly, these types of interior drones mitigate officer risk by allowing law enforcement to monitor an area they cannot physically see. "We'd [the agency] rather have the $600 drone shot by the suspect and destroyed, then put a SWAT officer through there and take a bullet. And even if a suspect shoots that down [the drone], we've learned his intent." Drones also enhance officer safety during search and rescue missions. The director of a local volunteer search and rescue team emphasized that the biggest benefit derived from drones is "not putting my guys in danger. If I can fly a drone in without putting my guys in danger, that's what I'm gonna do."

Additionally, several fire service agencies stated that during structural fires, UAS help save lives by providing them with personnel accountability and allowing them to identify where every firefighter is positioned. "If anybody gets into trouble, we have eyes on that immediately." Finally, drones can also enhance citizen safety by deescalating tense situations. As one agency explained:

> Let's say we have reports of a person walking up and down the street agitated. We send the drone over there if we have the time to do it, and they can get eyes on this person. Okay, this person is not armed; they are agitated, you know, and maybe this is a mental health issue. So right off the bat, before they [police officers] come around the corner, they have situational awareness. They can deescalate; they can take the energy down a level and enter the situation with more information.

The third and final benefit identified during the interviews was aerial view. This theme refers to agencies having the ability to observe incidents from a "birds eye view" or a higher vantage point. With this view, several agencies highlighted the benefit of using drones to monitor large-crowd events such as outdoor concerts, sports games, or festivals. Agencies also cited this theme when discussing the mass protest events that occurred during 2020 and the need to protect soft infrastructure, especially local government buildings and police headquarters. As one respondent recalled, during the 2020 protests, various agencies worked together to protect government institutions throughout the capital city of Austin, TX. "Texas DPS [Department of Public Safety] was monitoring the capital complex, Travis County Sheriff's Office was monitoring the jail, and then between [agency name], we were kind of covering the rest of Austin."

<u>Challenges</u>



Agencies also identified several challenges with employing UAS in the field. Figure 2 shows that the most widely cited barriers among respondents were funding, politics, buy-in, training, staffing, and privacy issues. Many agencies stated that they struggle to obtain recurrent funding from local and state officials. As note above, the costs to maintain a UAS program are not cheap and often entail more than just purchasing a drone (e.g., maintenance plan, third-party software). In speaking about this issue, a respondent with an EMS agency stated that "the drone is relatively cheap, but it's all the other things that go along with that. You're gonna have to pay for video streaming; sometimes a license for video streaming can be as much as the drone itself." In many situations, agencies must rely on private funds or grants to help support their UAS program. An agency with one of the largest UAS programs in the state revealed during their interview that approximately 90% of their UAS program is privately funded, while another department spoke about applying for and receiving grant money from Firehouse Subs to purchase four thermal imaging cameras for their drones.

One of the more interesting and surprising barriers identified in the study was politics. Nearly all agencies reported using drones made by a Chinese-based company called Da Jiang Innovations (DJI). DJI drones are popular not only in public safety, but among hobbyists and professionals in other industries due to their reliability and value. Recently, there has been a movement from legislators at the state and national level to ban DJI and other Chinese-manufactured drones for fear that they are a national security threat. The concern is that drones from China may potentially have built-in spyware that can be used to collect sensitive information from critical infrastructures or other high-security facilities. Several agencies noted during their interview that they would prefer to fly U.S.-made drones, but unfortunately, the technology pales in comparison to DJI. Additionally, American-made drones often cost up to two to three times higher, which is important considering that many agencies struggle to fund their drone program and that they are

obligated to be good stewards of public funds. As one respondent stated, “we would prefer that we fly drones from [USA], heck, I would like all our drones to be made in Texas! But, we’re also using taxpay money, so we have to be as fiscally responsible with that money as possible to provide our officers with the best tool for the best price.” To mitigate this issue, most of the agencies in the sample noted that they use Dronesense—a U.S.-based software company whose data management system meets federal compliance—to operate their drones rather than the DJI-supplied software. Essentially, the important question to ask regarding this issue is not “where are these drones made,” but “how are agencies guarding and managing their data?”

Other challenges identified in the study are buy-in, training, and staffing. Several agencies noted that they initially struggled to receive acceptance from command staff and city council about the purposes and benefits of employing drones in the field. In other cases, respondents described situations where leadership personnel were resistance to change and adopting new practices. As one individual stated, “when you introduce a new technology into the mix, it really has to demonstrate that it is a necessary thing to incorporate because if we've been doing it really well for a couple of hundred years, why do we need this new thing?” Buy-in from leadership and government officials is especially critical since it affects other factors related to the success of a UAS program, namely, funding, investment in training initiatives for drone operators, and staff morale. At the same time, however, several respondents noted that resistance to UAS faded away once command staff observed the drones in action. “Once we're able to show them the uses and the effectiveness of drones. It really made it easier for people to buy-in.”

Training was another challenge identified by public safety agencies. Drone technology is constantly evolving, and several agencies stated that it can be difficult to stay on top of changes in hardware and software, as well as UAS policies at the local, state, and federal level. Moreover, all agencies stated that their drone operators are part-time pilots, which makes it even more difficult for them to keep up to date with trainings and other requirements. Related to this point, several departments mentioned that they have a difficult time staffing drone pilots for specific events or other work-related duties. In discussing this issue, one respondent stated the following: “it seems like every time that we want to do something, the pilots are off, or you know, they're somewhere else, or they're tied up with something else. So, sometimes that's pretty tough, to find a certified pilot that can get it [drone] up in the air.”

Finally, while privacy issues were identified as a notable concern with UAS in the prior literature, this barrier was rarely cited by public safety officials. From the agencies that did discuss this challenge, many stated that their agency overcame privacy concerns by being transparent with the public and local leaders and developing policies that describe the situations in which their drones will and will not be used. Additionally, all agencies stressed that they do not record video unless they have a warrant or believe the footage captured by the drone may be evidence of a crime. Respondents also stressed the importance of community engagement when discussing their UAS program. As one respondent said:

> “We want to answer your question, and sometimes you'll see people kind of walking and looking, and they're kind of, you know, pointing at it [drone flying]. And I’ll speak up and

> say, hey, come here! You want to know what we're doing? We're with [agency name redacted]. Let me tell you a little bit about our drone program!"

Another official with a state-level law enforcement department stated:

> "Anybody that wants to find out about our drone program. We have a conversation, we go to school events, we go to National Night Out, we go to church events. Somebody invites us to come out with drones, we go to it. We hosted our drone training at our tactical training center in [city in Texas]. We invited the entire [name of city] community to come out and talk to us and see the drones."

Training

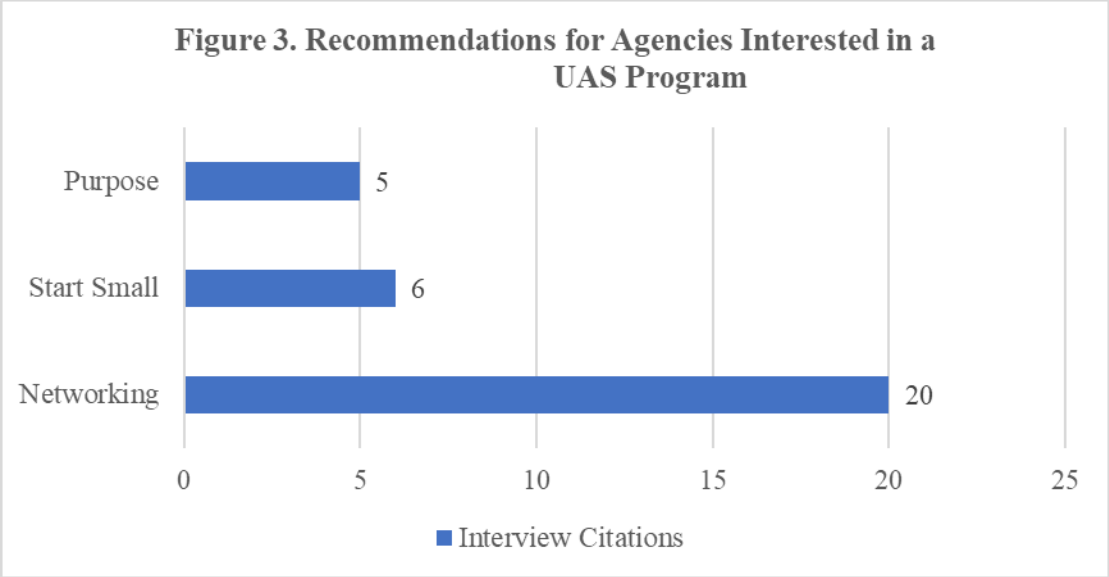
The third research question asks respondents about the types of trainings and certifications their agencies require for their remote pilots. All agencies, with the exception of the volunteer search and rescue team, require that their drone operators receive their Part 107 certification from the FAA. However, several respondents mentioned that the Part 107 license represents the bare minimum training standard and is a written-only exam. As a result, most agencies emphasized that they also require their pilots to complete a small unmanned aircraft systems (sUAS) course offered by the National Institute of Standards and Technology (NIST). The NIST course tests pilots on their operating proficiency by assessing how well the drone performs on various tasks and their ability to safely operate in the NAS. While NIST does not provide training or certification, the results from their course can be used by agencies to set their own standards for evaluating the practical skills of their pilots.

In addition, several respondents stated that their agency has its own UAS training academy. These programs typically run for one week and most of the instruction time is spent on flying drones (known as "stick time"). Some agencies also spoke about pending changes to their training procedures, which involved requiring that their pilots complete some (or all) of their classroom instruction online in an effort to maximize flight time at the academy. As one EMS agency put it, "if we're able to move all of that online and get that point across and just kind of hit the big points of the day. Each day when the training academy is going on, we'll get a lot more benefit out of that as well. And we can kind of accelerate our pilots a lot quicker to different phases of the program."

While at the academy, drone operators are trained to confront issues pertaining to deconfliction or minimizing midair collisions between drones, managing UAS malfunctions, and scenario-based trainings (e.g., tracking a fleeing suspect). Some agencies also hold additional trainings at the academy to train pilots on nighttime or interior flying and using specialized equipment such as thermal imaging cameras. A few respondents also mentioned relying on networking and attending practitioner conferences to develop or amend their training academies. One respondent noted that their agency's training academy was largely influenced by another public safety UAS program in the state. As he stated, "we're all trying to constantly piggyback off each other to learn who's changing what, why, and how." Finally, a few agencies expressed the importance of maintaining consistent training with first responders from other local agencies. Holding trainings with other departments is critical as it allows them to effectively communicate with one another

and have the confidence to know that each drone pilot has the necessary experience to work the next catastrophic incident or large-crowd event.

Recommendations



The final research question asked respondents to recommend any key pieces of advice for public safety agencies looking to implement their own UAS program. Overall, the most widely cited recommendation was for departments to network or reach out to other agencies with UAS programs. To this point, several respondents stressed that many agencies had already gone through the difficulties and tribulations that come with starting a UAS program, and so there is no reason to "reinvent the wheel." Respondents also described their experiences assisting other departments implement their own UAS program and emphasized that everyone is open to sharing. As one respondent put it:

> "You want to take off [name of agency] and our logo and put yours on it and call it a day? Cool, I have no problem with that! One of the things I stress to them is like, look, this is the culmination and hard work of amazing people from all across the state who have put in blood, sweat, and tears to do this so that you don't have to."

Another recommendation is for agencies to start small and build as you go. Do not go out and buy the biggest or most expensive UAS or run to Best Buy to purchase consumer-grade drones. Instead, agencies need to start with developing their department's UAS policies and procedures, get pilots experienced and certified, and ensure that their agency is in compliance with the FAA and local, state, and federal laws. While completing these tasks are not as fun or exciting as flying drones, they will avoid a lot of headaches in the future and ensure that the program is set up the right way. One final recommendation is for agencies to think about the intended purpose(s) of their UAS program. As one respondent stated, "not every agency needs a drone…[and] cool is not a reason to have a drone program." Thus, before making a decision about whether to implement a UAS program, agencies need to ask themselves what specific tasks or missions the drones will be used for? Addressing this question will drive a lot of

important decisions that come afterwards, such as how much funding will be needed, what type of drone and accessories will have to be purchased, and how can the intended uses and benefits of drones be used to elicit buy-in from leadership and local officials? At the end of the day, agencies need to make an argument to justify their need for a UAS program rather than feeling that by not having a drone, they'll be left behind.

CONCLUSION

This study contributes to current knowledge by illuminating the primary benefits and challenges of implementing drones in public safety, particularly from the viewpoint of practitioners. The findings from this paper demonstrate that UAS play a pivotal role in enhancing the work and security of public safety officials and are a practical tool for a variety of missions (e.g., search and rescue, SWAT operations, combat fires). At the same time, there are some challenges that public safety agencies must confront, such as difficulties with acquiring adequate funding, leadership buy-in, and politics, to name a few. Still, the agencies in this study unanimously agreed that the benefits of drones far outweigh their costs and that there are steps that departments can take to minimize these challenges.

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