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INTEGRATING UNMANNED AIRCRAFT SYSTEMS INTO MODERN POLICING IN AN URBAN ENVIRONMENT

by

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INTEGRATING UNMANNED AIRCRAFT SYSTEMS INTO MODERN POLICING IN AN URBAN ENVIRONMENT

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ABSTRACT

This thesis examines the possibilities and advantages of incorporating the use of unmanned aircraft systems (UAS) into operational use by local public safety agencies. The use of UAS has become a vital tool for the military but still has not become a tool used by domestic police forces. This thesis explores the options of using this type of technology, such as an economical alternative or enhancement to existing aviation programs and better situational awareness for tactical operations. In addition, to reviewing issues and concerns related to privacy considerations; this thesis addresses program implementation, creation of best practices policy and procedures, benefits to community safety, and flight regulations and restrictions under the oversight of the Federal Aviation Administration (FAA).

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LIST OF ACRONYMS AND ABBREVIATIONS

ACLU	American Civil Liberties Union
ATC	Air Traffic Control
AUVS	Association for Unmanned Vehicle Systems International
CAA	Civil Aeronautics Administration
CAA	Civil Aviation Authority–United Kingdom
CAB	Civil Aeronautics Board
CARs	Canadian Aviation Regulations
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosives
CCTV	Closed Circuit Television
CFR	Code of Federal Regulation
COA	Certification of Authorization
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
DSA	Detect, Sense & Avoid
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FLIR	Forward Looking Infrared Radar
GAO	Government Accountability Office
GCS	Ground Control Station
GDT	Ground Data Terminal
GPS	Global Positioning System
ICARS	Integrated Collision Analysis and Reconstruction Service
IES	Intelligence Sharing Environment
IFR	Instrument Flight Rule
ILP	Intelligence-Led Policing
IMINT	Imagery Intelligence
IP	Instructor Pilot
IP	Internet Protocol
ISR	Intelligence, Surveillance and Reconnaissance
MASPS	Minimum Aviation System Performance Standards
NAS	National Airspace System
NYPD	New York Police Department
OCU	Operation Control Unit
PIC	Pilot in Command

R&D	Research and Development
RC	Radio Controlled
RCH	Remote Controlled Helicopter
RCMP	Royal Canadian Mounted Police
ROA	Remotely Operated Aircraft
RPV	Remotely Piloted Vehicle
SAA	Sense and Avoid
SFOC	Special Flight Operation Certificate—Canada
SOP	Standard Operating Procedures
SWAT	Special Weapons and Tactics
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aircraft Vehicle
UGV	Unmanned Ground Vehicle
UK	United Kingdom
U.S.	United States
VFR	Visual Flight Rules
VTOL	Vertical Take-Off Landing

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I. INTRODUCTION

This thesis examines the possibilities and advantages of incorporating the use of unmanned aircraft systems (UAS) into operational use by local public safety agencies. The use of UAS has become a vital tool for the military but still has not become a tool used by domestic police forces. This thesis explores the options of using this type of technology, such as an economical alternative or enhancement to existing aviation programs and better situational awareness for tactical operations. In addition, to reviewing issues and concerns related to privacy considerations; this thesis addresses program implementation, creation of best practices policy and procedures, benefits to community safety, and flight regulations and restrictions under the oversight of the Federal Aviation Administration (FAA).[1]

Public safety entities throughout the United States along with commercial enterprises are realizing the benefits of utilizing UAS within the urbanized airspace governed by the FAA. These benefits are to develop enhanced surveillance systems to deal with complex problems of homeland security, crime and social disorder. Unlike European nations that have already embraced this technology, the United States remains reluctant to create meaningful and practical policies that will enable this technology to be used in situations to aid in the advancement of public safety.[2] Two areas of concerns safety and privacy have limited the use of UAS in the United States.[3] The United Kingdom (UK) Civil Aviation Authority, in cooperation with the European Commission, has addressed the use of UAS over urbanized areas with comprehensive policies and procedures.

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[1] *Section 91.155 14 CFR Part 91—General Operating and Flight Rules—FAA*, n.d.

[2] "Association for Unmanned Vehicle Systems International," (n.d.), http://www.auvsi.org/Home/.

[3] W. J. Hennigan, "Civilian Use of Tiny Drones May Soon Fly in U.S.," *Seattle Times*, November 28, 2011, http://seattletimes.nwsource.com/html/nationworld/2016882681_drones29.html.

Endless possibilities exist for the use of UAS surveillance and intelligence gathering throughout the public safety arena in the United States.[4] This use is also applicable in possible commercial applications as this technology enters into civilian airspace. Public safety is an inherently dangerous occupation.[5] In regards to law enforcement, at no time are officers more vulnerable than when approaching an unknown individual, whether during a traffic stop, criminal investigation, domestic violence call, or possible mentally disturbed or impaired person. Often, the best protection officers have is access to information about the person with whom they are dealing, the address to which they are dispatched, the vehicle and the driver they have stopped, and other information regarding activities in their jurisdictions. This information provides public safety officers with situational awareness that could significantly increase safety for not only the officer but the general public as well.

Public safety officials need tools to provide accurate, timely, and complete information in the field. In addition, law enforcement agencies need access to a broad variety of technologies to build comprehensive situational awareness.

Unlike any other event in recent history, the terrorist attacks of 9/11 demonstrated the critical importance of information sharing, intelligence analysis, and situational awareness for justice, public safety, and homeland security.[6] In the wake of these devastating attacks, several assessments revealed the splintered nature of intelligence gathering and analysis, and the barriers to information sharing among agencies at all levels of government.[7]

The ability to have real-time situational awareness at a low cost and low risk to life has not previously been available to the civilian market. This market is

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[4] "Association for Unmanned Vehicle Systems International."

[5] CNN Wire Staff, "America's Most Dangerous Jobs—Police Officer," *CNN Money*, August 26, 2011, http://money.cnn.com/galleries/2011/pf/jobs/1108/gallery.dangerous_jobs/11.html.

[6] *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*, Authorized ed. (New York, New York: W.W. Norton & Company, Inc., n.d.).

[7] Ibid.

emerging for application in six distinctive areas: law enforcement, firefighting, energy sector, agriculture forestry and fisheries, earth observation and remote sensing, and communications and broadcasting.[8] To make this possible, UAS need full approval and integration into civilian airspace under the guidelines of the FAA.

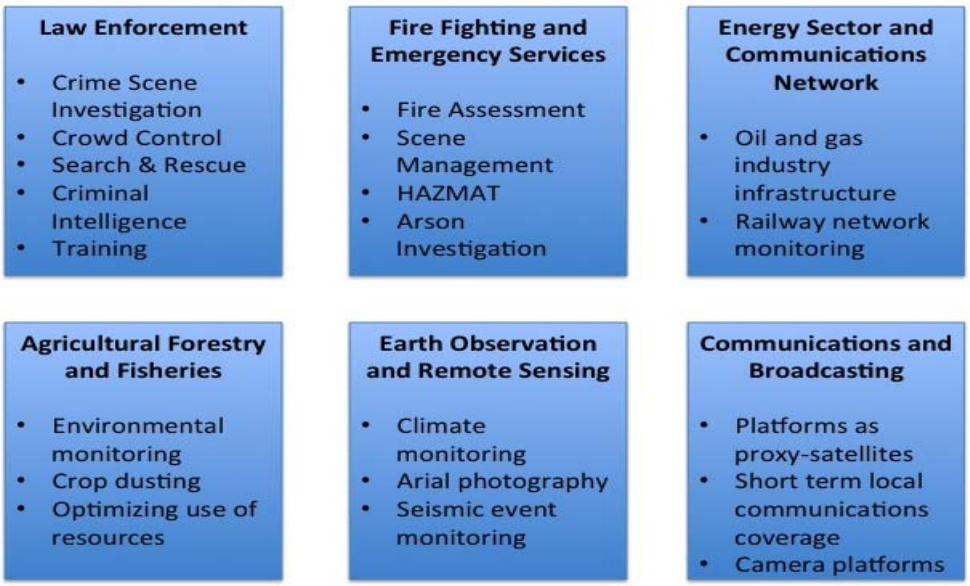

Figure 1.1. Potential applications for civil and commercial UAS[9]

A. RESEARCH QUESTION

Can battlefield proven military UAS in a post-war environment be integrated into urbanized law enforcement best policing practices without compromising the constitutional right of citizens and increasing safety for the general public? The unmanned aircraft system technology for this research is already exists; the operational theory will use this current technology to increase public safety while improving community-policing efforts. Can this technology be

[8] European Commission, *Study Analysing the Current Activities in the Field of UAV*, Enterprise and Industry Directorate-General, 2007, 7.

[9] Ibid., 48.

put into place to provide a practical and economical framework for implementing an intelligence application for the analysis and dissemination of real-time data? With careful consideration, what systems and processes can be implemented to ensure that the perception of government intrusion and the reduction of personal rights are addressed?

B. IMPORTANCE

More and more law enforcement agencies are assuming the role of not only local law enforcement but also that of local and first contact for homeland security incidents.[10] With this increased responsibility, local agencies need to have the necessary resources and tools available to safeguard their communities. The acquisition and use of an UAS is such a tool that increases situational awareness and provides real-time video and intelligence to public safety officials. The use of small UAS technologies has revolutionized warfare in Iraq, Afghanistan, and Pakistan. The use of UAS has unlimited potential to change and significantly impact modern policing practices within the United States.

Certain knowledge gaps need further research to make possible UAS applications used by the military for civilian purposes. The ability to adapt these applications into the urban law enforcement will have sound policy and safe considerations. The size of UAS range from less then a pound to over 18,000 pounds; this research concerns applications most suited to local law enforcement and limit the weight of UAS and the maximum altitude to those classified as micro, mini and tactical. These UAS consist of an unmanned aircraft, an aircraft control station (fixed or portable) and command and control links. When defining small UAS, radio controlled (RC) within the line of sight of the operator are to be considered. These UAS are portable and weigh no more then 2–85 pounds and are capable of a cargo capacity equal to or more than its own overall weight.

[10] Janet Napolitano, “Policy Directive # 252-11: Office for State and Local Law Enforcement,” Department of Homeland Security, June 9, 2009, 4, www.dhs.gov/.../plcy_directive_252-11_office_for_state_and_local_...

Aerial reconnaissance or imagery intelligence (IMINT) is not a new concept. However, this new technology of using UAS has the potential to be a tactical windfall as it relates to law enforcement operations.[11] When used in the right scenario and within the intelligence process as a means of collecting information for analysis, the potential is unlimited. Law enforcement and counterterrorism operations continue to place an increased amount of effort on surveillance in open public spaces. The implementation and use of closed-circuit television (CCTV) has proven to be an excellent asset to public safety by being able to cover large areas of public space surveillance with minimal personnel effort. This increased CCTV surveillance has raised the wrath of civil right organizations, in particular the American Civil Liberties Union (ACLU), that question whether U.S. citizens are trading too many of their personal freedoms for heightened security.[12]

The recording, video streaming and photographic capabilities of cameras that can be mounted on UAS are limitless. With this technology, it is certain that legal review and case precedence will come into question regarding search and seizure, especially the plain sight doctrine and violations of constitutional privacy rights under the Fourth Amendment. Many of the germane case decisions for in-flight searches and plain sight observations examined with the use of manned aircraft and various technologies, such as FLIR and thermal imaging, were operated by persons onboard the aircraft during routine or surveillance flights of both private and public spaces, which occurred in addition to the public's obvious speculation of mistrust for government and the potential for abuse of power.

The safe usage of UAS in civil airspace is a top priority of the FAA.[13] It is critical that aircraft do not endanger other users of the National Airspace System

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[11] Doug Wyllie, "Police UAVs: Nearly Limitless Potential," *PoliceOne.com*, May 17, 2012, http://www.policeone.com/police-products/investigation/video-surveillance/articles/5558533-Police-UAVs-Nearly-limitless-potential/.

[12] Simon Garfinkel, *Database Nation: The Death of Privacy in the 21st Century* (Sebastopol, CA: O'Reilly & Associates, 2000).

[13] Federal Aviation Administration, "2009–2013 FAA Flight Plan," 2009, 11, www.faa.org.

(NAS) or compromise the safety of persons or property on the ground. The FAA, under federal statues, enforces all flight rules and regulations about the operation of any UAS by a public agency, whether it is a federal, state or local law enforcement operation.

C. OBJECTIVE AND HYPOTHESES

The objective of this thesis is to provide a practical and economical framework for implementing an intelligence application and policies, and procedures for deployment and usage of UAS for use in local law enforcement operations over an urbanized area. Careful consideration will be given to ensure that the perception of government intrusion and the reduction of personal rights are considered. In addition, flight safety, equipment needs and definitions regarding the value of the information that can be collected and interpreted, and that can be utilized in many arenas, such as criminal investigations, intelligence gathering and the collection and preservation of evidence, will also be kept in mind.

The technology for this research is already in existence. The process is to take this current technology and utilize it in a format consistent with policing best practices without compromising the constitutional rights of citizens.

D. LITERATURE REVIEW

Several categories of literature discuss the use, technology, operations, acquisition, and future developments of different forms of UAS. This literature can be located in military service publications and service school libraries describing research papers and professional periodicals that relate to many facets of UAS operations. Additional UAS information is available on professional association and corporate websites related to the development and future implementation of their own UAS for private or commercial use. Numerous websites and journals for private organizations related to UAS technologies in development also exist. Conversely, when exclusively looking for literature on

how UAS can and should be integrated into the NAS, the availability is narrowed to a few organizations. This narrow field includes published documents from the Government Accounting Office (GAO), and research studies conducted by Department of Defense (DoD) and the FAA concerning UAS integration in NAS airspace. In addition, information has been presented to Congress that discusses the desire for UAS integration and implementation into domestic airspace. The FAA Title 14 Code of Regulations (CFR)[14] is the governing regulation for all aircraft flying in and around the NAS and is referenced often throughout this thesis.

The purpose of the literature review was to research source materials to assist in the analysis of practical applications for the use of UAS in an urbanized law enforcement setting. Although a large amount of material is available regarding UAS for military applications, only a scant amount is relevant for a law enforcement application. The assessment for UAS integration into daily operations concerns many areas.[15] These areas include but are not limited to flight safety, the perception of governmental intrusion and the reduction of personal rights, availability of aerial technology at an economical cost, and the value of information that can be obtained using UAS.

1. Methods and Sources

To address the primary and secondary research questions posed earlier in this thesis properly, a comparison of literature published primarily by the FAA, governmental reports and federal and state court decisions was conducted. The research material was amassed from numerous sources, analyzed and then merged to form a safe and useable set of recommendations. Since limited sources of literature addressed the topic of UAS integration into NAS and the use of UAS in a civilian law enforcement environment, various sources were used

[14] Federal Aviation Administration, "Title 14 Aeronautics and Space, Title 14, Chapters I-VI," 2005, http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title14/14tab_02.tpl.

[15] Federal Aviation Administration, “Fact Sheet—Unmanned Aircraft Systems (UAS),” (December 1, 2010).

together to theorize draft operations for UAS usage within the United States. The strong desire by public safety agencies to utilize UAS technologies and the FAA's requirement for integration to ensure safety were then combined with all the other sources to arrive at a proposed solution amenable to both public safety agencies and FAA. From this proposed solution, a foundation is established that initiates and creates policies and procedures for a best policing practice to bring UAS into the NAS.

This research is advantageous because it combines the viewpoints of multiple entities trying to achieve the same goal. Information collected from these multiple sources is combined to provide the best recommendations available for future UAS operations. The FAA has updated its regulations and procedures in an attempt to accommodate UAS operations and is actively working on other solutions to accommodate first responders.

The disadvantage with this method is the speed in which information becomes outdated. The qualitative approach taken in this thesis, as well as other research studies on this topic, can become quickly updated with the speed at which technology is advancing. This method also attempts to limit the focus to those entities with similar interests that want to gain NAS access. A difference of opinion and the fairly new nature of UAS leads to a discussion about what constitutes safety of flight and the need to add and define added positions that speak specifically to UAS operations and the intelligence information they may gather.

The comparison of this literature on this topic cannot take into account the multitude of different UAS designs currently being produced. Therefore, the scope of this thesis is limited to UAS in the micro and mini classifications. By using these UAS classifications, most recommendations accommodate the majority of the local public safety agencies’ needs.

The research methodology associates the current literature available to determine if the FAA and local law enforcement are working together to integrate UAS into the NAS.

2. Federal Aviation Administration

The FAA writes, reviews, updates, and oversees Title 14 CFR. These regulations govern every aspect of how air vehicles, both manned and unmanned, gain access to the NAS. The FAA's current process for UAS access is based on a review and approval process, which then grants a Certificate of Waiver Authorization (COA) for a specific period of time. As of the publication date of this thesis, the FAA has received applications from 61 agencies, police departments and public universities to fly drones, according to a released document by the FAA in April 2012.[16] While the FAA has shortened the time it takes to consider requests to fly and operate UAS, from 24 months to 12 months, the process is lengthy.[17]

Starting on March 29, 2012, the FAA has been authorized to "allow government public safety agency to operate an unmanned aircraft weighing 4.4 pounds or less" under certain restrictions.[18] The bill further specifies that these UAS must be flown within line of sight of the operator, less than 400 feet above the ground, during daylight conditions, inside Glass G (uncontrolled) airspace and more than five miles from any airport or other location with aviation activities.[19]

The FAA is responsible for producing, publishing, updating, and enforcing all regulations and policies that govern the flight of all vehicles within the United

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[16] Alan Levin, "Drones Up to 25 Pounds Allowed for U.S. Safety Agencies," *Bloomberg*, May 14, 2012, Web ed., 2.

[17] Federal Aviation Administration, "FAA Makes Progress with UAS Integration," *Federal Aviation Administration*, May 2012, 1, http://www.faa.gov/news/updates/?newsId=68004&omniRss=news_updatesAoc&cid=101_N_U.

[18] Ibid.

[19] Ibid., 2.

States.[20] Its mission is, "to provide the safest, most efficient aerospace system in the world."[21] Moreover, its vision is "to reach the next level of safety, efficiency, environmental responsibility and global leadership."[22] Consequently, by law, it is given the authority to produce and enforce CFR Title 14, *Aeronautics and Space*. Title 14 specifically addresses or references most aspects of aviation in the NAS. The document itself is updated on a yearly basis. Since the beginning of UAS, the regulations have progressed to acclimate certain phases of unmanned operations. The CFRs do not cover every possible aspect of aviation; consequently, if a procedure is not explicitly addressed, then it is not approved. Per the regulations, the FAA should be contacted for interpretation or further guidance if the current regulations are unclear or do not exist. Since UAS are not specifically addressed in many sections of 14 CFR, their use is not allowed in situations in which they could be safely deployed if authorized. This component has continued to slow the progress of UAS operations.

With minimal information or regulations concerning UAS within the CFR, the FAA published a memorandum in September 2005 to address UAS operations specifically.[23] This memorandum determines whether to allow UAS flights in the NAS, and is primarily a list of criteria UAS requestors must meet before the FAA will grant a COA.

3. Flight Safety

The National Strategy for Homeland Security is comprised of 12 major initiatives. One of the initiatives is to plan for military support to civilian

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[20] Federal Aviation Administration, *Title 14 Aeronautics and Space*, *Title 14, Chapters I-VI*.

[21] Federal Aviation Administration, "FAA Mission," Government, *Federal Aviation Administration*, May 18, 2009, http://www.faa.gov/about/mission/.

[22] Federal Aviation Administration, "FAA Vision," Government, *Federal Aviation Administration*, July 18, 2012, http://www.faa.gov/about/mission/.

[23] Federal Aviation Administration, "Flight Standards Service AFS-400 Policy 05-01: Unmanned Aircraft Systems Operations in the US National Airspace—Interim Operational Approval Guidance," September 16, 2005, www.faa.org.

authorities.[24] The importance of military support to civilian authorities as they respond to threats or acts of terrorism is recognized in Presidential decision directives and legislation.[25] Military support to civil authorities pursuant to a terrorist threat or attack may take the form of providing technical support and assistance to law enforcement, assisting in the restoration of law and order, moving specialized equipment, and helping with consequence management.[26]

With the proliferation of UAS, it will be essential to open currently controlled airspace to mixed-use. The FAA has stated that for UAS to fly regularly in controlled airspace, those UAS must meet the same FAA airworthiness standards as manned aircraft.[27]

The FAA relies upon the eyesight of a human pilot as the primary method to ensure safety, either in the form of a midair collision or flying in conditions that are not safe for air travel.[28] The use of UAS does not allow for either of these safety components. To share airspace with manned aircraft, UAS will have to have a form of alternate detect, sense and avoid (DSA) capabilities attributed to the onboard pilot. The potential introduction of UAS into the NAS consists of a new type of aircraft system with an undetermined level of risk and regulatory framework.[29] All aviation systems in the NAS have a sense and avoid (SSA) requirement (14 CFR 91.113).[30] Operation of a UAS in NAS has a fundamental disconnect with the U.S. Civil Aeronautics Board's (CAB) regulations pertaining

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[24] George W. Bush, *National Strategy for Homeland Security* (Washington, DC: Office of Homeland Security, 2002).

[25] Ibid.

[26] Ibid., 44.

[27] Federal Aviation Administration, "Fact Sheet—Unmanned Aircraft Systems (UAS)," Federal Aviation Administration, December 1, 2010.

[28] *Section 91.155 14 CFR Part 91—General Operating and Flight Rules—FAA*.

[29] Ann M. Simmons, "Lancaster OKs Aerial Surveillance of City," *Los Angeles Times*, November 11, 2011, http://www.latimes.com/news/local/la-me-lancaster-planes-20111111,0,2659448.story.

[30] "Title 14—Aeronautics and Space—Code of Federal Regulations §91.113 Right-of-way Rules: Except Water Operations," July 1989, http://law.justia.com/cfr/title14/14-2.0.1.3.10.2.4.7.html.

to Visual Flight Rules (VFR). VFR's are a set of regulations that allow a pilot to operate an aircraft in weather conditions generally clear enough to permit the pilot to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minimums, as specified in the rules of the relevant aviation authority.[31] When flying an aircraft in NAS, the pilot is responsible for DSA. With the absence of the on-board pilot in UAS, the aircraft must have a technology solution and/or an external human observer to fulfill the DSA functions.[32]

4. Privacy Considerations

The Electronic Commission Privacy Act of 1986 requires a search warrant to monitor "conversations" in a public area.[33] This opinion was based on the need for an enhanced microphone and that the conversation could not be heard with the "*naked ear*" or without magnification. The key legal decision for public place monitoring and unreasonable search and seizure can be found in the 1967 Supreme Court case, *Katz v. United States*.[34] The Supreme Court established a two-part test to determine when a search warrant is required. According to the Court, a warrant is required when 1) a person expects privacy in the area search, and 2) society believes that expectation is reasonable. If either of these two criteria is not met, a warrant is not required to search the object of interest.[35]

Due to this court decision, the use of video technology to monitor open public areas would not be in violation of the Fourth Amendment. Conversely, the recording, video streaming and photographic capabilities of cameras that can be mounted on UAS are limitless. With this technology, it is certain that legal review

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[31] *Section 91.155 14 CFR Part 91—General Operating and Flight Rules—FAA*.

[32] RTCA, *Guidance Material and Considerations for Unmanned Aircraft Systems*, 2007.

[33] Patrick Marshall, "Privacy Under Attack," *Congressional Quarterly* 11, no. 23 (June 15, 2001): 513.

[34] United States Supreme Court, *Katz V. United States*, 389 U.S. 347, 1967.

[35] Donald L. Shinnamon, Sr., "Public Acceptance: Privacy Concerns for Small Unmanned Aircraft in Law Enforcement," *Air Beat*, July 2011, 29.

and case precedence will come into question regarding search and seizure, especially the "*plain sight doctrine*" and violations of constitutional privacy rights under the Fourth Amendment. Many of the germane case decisions for in-flight searches and *plain sight* observations examined with the use of manned aircraft and various technologies, such as forward looking infrared radar (FLIR) and thermal imaging, were operated by persons onboard the aircraft during routine or surveillance flights of both private and public spaces. In *Kyllo v. United States*,[36] the police flew a manned helicopter (with the direct desire to observe Kyllo's property for suspected criminal activity) utilizing a FLIR device capable of thermal imaging detection to determine if Kyllo was using powerful light to cultivate marijuana.[37] The court opinioned that a search warrant was necessary since the police used a device or technology not available for "general public use" in addition to flying over private property that was not open to public access and could not have been seen without being on the property. The same argument could be made concerning the use of mini or small UAS as no flight will be random and all viewing is done with the use of technology. This perception will also be a significant factor as the use of manned aircraft has the "naked eye" doctrine, which again will not be a prevailing argument with the use of UAS.

For the purposes of surveillance, either by human eye or by photographic device, California courts have been unwilling to grant protection for an individual who knowingly exposes himself to the public view.[38] A California court held in a separate case that the videotaping of an individual in public view and on a public street does not constitute an unreasonable search or invasion of privacy.[39] This court decision further states that video cameras with zooming capabilities do not constitute an unreasonable search since the cameras do not physically intrude

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[36] U.S. Court of Appeals—Ninth Circuit, *Kyllo V. United States*, 2001.

[37] Marcus Nieto, Kimberly Johnston-Dodds, and Charlene Wear Simmons, "Public and Private Applications of Video Surveillance and Biometric Technologies," *California Research Bureau* CRB 02-006 (2002): 39.

[38] *People vs. Triggs*, 26 Cal. App. 3nd 381. (1972)

[39] *Aisensio vs. American Broadcasting Co., Inc*., 220 Cal. App. 3rd 146 (2nd Dist. 1990).

into a person's domain of privacy and if any intrusion does occur, it would be so minimal as not to violate the person. Nieto's research suggests that individuals who have knowledge of the presence of surveillance cameras have no concern for their existence. He claims most people approve of the use of cameras, and that an improved perception of safety does exist.[40]

The New York Police Department (NYPD) has developed a robust and sophisticated CCTV surveillance system. Part of the system includes the Public Security Privacy Guidelines,[41] which is a means of operation for the program. The guidelines are not statutory in design but are more of an operational procedure, which includes that the stipulated footage must not be stored beyond 30 days if it is not being used as part of an official investigation.[42] Currently, no body of law, either federal or state, specifically controls digital documents; just as no set of rules called "Internet Law" exists. Undeniably, a digital document is, in fact, a set of code-based document descriptors that materially exist as magnetic impulses on a hard drive that, when viewed with the right document authoring software, can qualify as legal evidence. Similarly, they do not qualify as evidence in the courtroom, unless a surviving paper copy or a digital copy in "living" media format can be authenticated.[43]

The advancement and acceptance of surveillance equipment, such as CCTV and other tools incorporated by public safety agencies, will undoubtedly

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[40] Marcus Nieto, "Public Video Surveillance: Is It An Effective Crime Prevention Tool?," *California Research Bureau*, no. CRB-97–005 (June 1997), http://www.library.ca.gov/crb/97/05/.

[41] Staff, "NYPD—Press Release—New York City Police Department Releases Draft of Public Security Privacy Guidelines," *NYPD—New York's Finest*, (n.d.), http://www.nyc.gov/html/nypd/html/pr/pr_2009_005.shtml.

[42] Larry Greenemeier, "The Apple of Its Eye: Security and Surveillance Pervades Post-9/11 New York City." [Video]. *Scientific American*, September 9, 2011, http://www.scientificamerican.com/article.cfm?id=post-911-nyc-video-surveillance.

[43] Arthur Gingrande, "Digital Documents and the Best Evidence Rule," Information, *Document*, 2011, http://documentmedia.com/ME2/dirmod.asp?sid=&nm=Content+Library&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=1B8ACD1C6CA248AE8A9C2807E8267DE2.

change the future of law enforcement.[44] One of the basic fundamental changes will be the removal of the patrol officer's physical presence while patrolling an area. This change is already occurring with the use of surveillance systems in public areas but does not include the extensive use of surveillance equipment utilized by private sectors. Figure 1.2 shows an overview of CCTV equipment and system design.

[44] Grant Fredricks, "CCTV: A Law Enforcement Tool," Professional, *The Police Chief—The Professional Voice of Law Enforcement*, August 8, 2004, http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display_arch&article_id=359&issue_id=82004.

Figure 1.2. Overview of CCTV equipment and system design[45]

Ethical concerns surround the use of UAS in municipal applications. Continuous debate regarding the ethics of using remotely piloted vehicles in

[45] Admin, "Easy Guide to CCTV Systems Installation and Maintenance," Professional, *GeekyEdge.com*, June 19, 2012, http://www.geekyedge.com/easy-guide-to-cctv-systems-installation-and-maintenance/.

combat operations has also ensued.[46] For example, they (UAS) have been blamed for significant civilian losses of life on the ground in combat zones. The removal of soldiers from the field and not seeing in person the cause and effect of their actions has many opponents suggesting that technology is diverting the moral compass of war "from the human consequences of their actions."[47] Public safety leaders and policymakers need to consider the two opposing opinions when considering the usage of UAS for surveillance and information gathering purposes. Both sides can argue effectively about the ethical needs or perceived liberty infringements when using this technology in an urbanized community. As use of this technology becomes a reality for public safety, and eventually commercial applications, watchdog groups, such as Big Brother Watch, will question whether this technology is in fact a community benefit. Hayes states, "drones and other robotic tools will add to the risk of a PlayStation mentality"[48] as he feels this is an extension of a generation more geared to computer applications then dealing with the public in person.[49] Hayes will further argue (as relates to the European Union) the corporate security and profiteers place law enforcement demands ahead of civil liberty concerns.[50] Hayes is not alone in his thought process as Whitehead has similar concerns with the ethical use of UAS in an urbanized environment. He argues that UAS have no conscience or reasoning, and can view everyone as a suspect, "everyone gets monitored, photographed, tracked and targeted."[51] Similarly, Nevins opines that while UAS are seen by law enforcement as "just another tool in the toolbox" and technology

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[46] Alexandra Schwappach, "The Ethics of Unmanned Vehicle Warfare," *SpaceWar—Your World at War*, December 8, 2011, http://www.spacewar.com/reports/The_ethics_of_unmanned_vehicle_warfare_999.html.

[47] David Cronin, "Defense Cuts People but Spends on Gadgets," *New Europe* 909 (October 31, 2010).

[48] Ben Hayes, *Arming Big Brother: The EU's Security Research Programme*, Summary of the Report (Transnational Institute, April 2006), http://www.tng.org/es/archieves/act/4451.

[49] Ibid.

[50] Ibid.

[51] John W. Whitehead, *Drones Over America: Tyranny at Home* (Charlottesville, VA: The Rutherford Institute, June 28, 2010), http://www.rutherford.org/articles_db/commenttary.asp?record_id=661.

neutral, “there is every reason to be concerned about how law enforcement and homeland security organizations will take advantage of their new tools.”[52] Whitehead agrees, asserting that technology functions without discrimination and that “the logical aim of technologically equipped police who operate as technicians must be control, containment and eventually restrictions of freedom.”[53] Nevins agrees, saying, “the normalization a previously unacceptable levels of policing and … Official abuse” has “disturbing implications for civil and human rights.” Nevins also reports fears of “mission creep” in police use of UAS.[54] These ethical concerns become entangled with safety concerns as UAS have the potential to carry weapons, including nonlethal weapons, as well as an assortment of chemical irritants.

5. Significance for Thesis

Extensive literature on UAS exists that spans multiple sources and formats, such as books, government reports, Congressional hearings, federal regulations, and federal and state court decisions.

The Office of the Secretary of Defense has issued the following guidance on the domestic use of UAS effective September 28, 2006. The Department requires rapid progress on DoD technology issues, as well as the resolution of new regulatory restrictions recently issued by the FAA on DoD’s unmanned aircraft use. UAS use is encouraged in support of appropriate domestic mission sets, including homeland defense and defense support of civil authorities.[55] It is inevitable that UAS will be used by local law enforcement and other public safety entities.

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[52] Joseph Nevins, “Robocop: Drones at Home,” *Boston Review*, January/February 2011. http://bostonreview.net/BR36.1/nevins.php.

[53] Whitehead, *Drones Over America: Tyranny at Home*.

[54] Nevins, “Robocop: Drones at Home.”

[55] Gordon England, *Interim Guidance for the Domestic Use of Unmanned Aircraft Systems*, Office of the Secretary of Defense, September 28, 2006.

Narrowing literature review and program implementation processes to information specific to this thesis topic is imperative. The significant information that remains for a detailed review and analysis comes from government reports specific to NAS integration, UAS operations, privacy considerations, program integration, operational protocols including policy and procedure development, and on the UAS devices.

Several distinct weaknesses and limitations were identified in this study. The first is the limited access being given to testing facilities and agencies attempting to utilize UAS in a law enforcement application. This thesis attempts to fill that gap by focusing on small UAS that will have minimal impact on flight patterns and flight processes established by the FAA. A second weakness is the assumed invasion of individual privacy with the implementation of UAS as an information gathering devices during police operations. It will be shown that the majority of uses will be over open spaces available to public access or involved in a criminal investigation or tactical operation that will require the use of a search warrant or have sufficient probable cause to continue to investigate criminal activity. Thirdly, this thesis discusses safety issues concerns that appropriate training, policies and procedures can address. The differing mission objectives between domestic law enforcement and military use will quickly bridge the gap of misrepresented safety concerns. Law enforcement will be more concerned with a fly and retrieve format as opposed to the military use of utilizing UAS as a tool to complete mission objectives.

E. THESIS OVERVIEW

This thesis is comprised of five chapters and an appendix. Chapter I provides the introduction, literature review and the methods and sources for this thesis. Chapter II offers a comparative analysis of several regulatory agencies dealing with integrating UAS into civilian airspace in a safe manner. Chapter III defines UAS size and functionality, discusses UAS history and potential uses in public safety, the correlation between community policing and advanced use of

technology, and the value of intelligence information for both tactical and strategic uses. Chapter IV provides information regarding the evolution of technology and implementation efforts using strategic planning to include a discussion on budgeting, integration methods and dealing with potential misuse of information. Chapter V concludes the thesis and provides recommendations for integrating unmanned aircraft systems into a modern policing urban environment. Also included is an appendix with an example of a best policing practices policy and procedure for UAS use for local law enforcement.

The next chapter provides a comparative analysis of NAS authorities in the United States, United Kingdom and Canada as each deals with issues of integrating UAS into controlled civilian airspace. Each nation is currently having the same struggles with local public safety agencies desirous to put this technology into an operational context to increase community safety. However, the difficultly lies with making this integration in a manner that provides maximum safety for aircrafts in flight, and civilians and property on the ground.

II. COMPARATIVE ANALYSIS OF AIRSPACE REGULATORY AGENCIES

> That Wilbur Wright is in possession of a power, which controls the fate of nations, is beyond dispute.
>
> Major B. F. S. Baden-Powell, President of the Aeronautical Society of Great Britain, 1909

In the aviation context, airspace can be defined as any part of the earth's atmosphere that can be used by an aircraft. Airspace is a three-dimensional space, or volume, in which aircraft (including rockets, balloons, gliders, and unmanned aircrafts) can operate.[56]

The use of airspace is controlled by international rules and procedures in much the same way that laws of the sea control shipping. In practice, the rules and operating procedures are complex, particularly in the vicinity of major airports. This chapter provides an analysis that compares and contrasts the different and similar approaches being taken by the United States, United Kingdom and Canada as it relates to the potential use of UAS in their controlled airspace. These analyses emphasize the need for further discussion on the importance of testing UAS within an urbanized area. The regulations reviewed and analyzed are applicable to all classifications of UAS. Later in this thesis, the size of the proposed UAS will be limited for proper application for local public safety agencies.

A. FEDERAL AVIATION ADMINISTRATION

The Federal Aviation Administration is charged with the safe handling of UAS in civil airspace.[57] The ability to use UAS must fall within the legal confines of the FAA as it relates to the ability to fly over urban areas with minimal

[56] "Civil Aviation Safety Authority—Airspace," *Australian Government*, 2012, http://casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90449.

[57] Federal Aviation Administration, *Title 14 Aeronautics and Space*, *Title 14, Chapters I-VI*.

limitations. Two acceptable means of operating UAS in the NAS outside of "restricted" air space exist, a Special Airworthiness Certificate—Experimental Category or a COA.[58] The COA process is available to public entities, such as governmental agencies (including local law enforcement) that want to fly UAS in civil airspace. The COA authorizes an operator to use defined airspace and includes special provisions unique to each operation. COAs require coordination with an appropriate air traffic control (ATC) facility and may require UAS to have a transponder to operate in certain types of airspace. Many aviation experts think that UAS do not provide the type of safety record to allow them to fly within the boundaries of civil airspace. The U.S. military operations have reported an accident rate involving UAS many times higher than that of manned aircraft. In addition, some reports have shown an accident rate seven times higher than that of general aviation and 353 times higher than commercial aviation.[59] However, it appears that data regarding UAS accidents may not be as reliable as "critics" might suggest.[60] The FAA has indicated problems in obtaining adequate data on UAS operations to assess safety as related to "small" UAS usage. Therefore, the data is not representative of UAS operations. The information on "small" UAS operations are pulled from DoD sources and is based on UAS operations in Iraq and Afghanistan, where the UAS devices are typically flown in harsh, high stress environments. Information on the "small" devices is even harder to quantify as UAS are regarded as an operational "piece of equipment" in which the lack of recovery or purposeful abandonment of the unit cannot truly be attributed to a cause or effect on UAS. Thus, it is impossible to classify UAS as shot down, or crashed, because of a systems or communications failure. Even with these variances in military safety data, on March 4 2012, the Montgomery County (TX)

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[58] Federal Aviation Administration, "Fact Sheet—Unmanned Aircraft Systems (UAS)."

[59] Sharon Weinberger, "Border Patrol Drones Plagued by High Accident Rate, Pilot Shortage," *AOLNews.com*, July 16, 2010, http://www.aolnews.com/2010/07/16/border-drones-plagued-by-mishaps-pilot-shortage/.

[60] Ibid.

Sheriff's Department,[61] which is the first domestic police agency approved by the FAA for domestic UAS usage, had a UAS malfunction. The UAS (produced by Vanguard Defense) was being tested on a police photo mission. The UAS was 18 feet above ground when it had a communications error and crashed into the department's armored vehicle. The FAA is developing new policies, procedures and approval processes to address the increase in both the civil and civilian operators. By 2013, the FAA expects to have formulated new rules that would allow police across the country to fly lightweight, unarmed UAS up to 400 feet above the ground routinely—high enough for them to be largely invisible eyes in the sky.

B. UNITED KINGDOM PERSPECTIVE

The United Kingdom (UK) is leading the innovative use of UAS in civilian applications. The UK has similar regulations to that of the FAA, but the Civil Aviation Authority (CAA), which is the UK equivalent of the FAA, has reduced the restrictions of UAS that fall under the "light" classification. UK policy for the certification and operation of unmanned aircraft vehicle (UAV) systems, both military and civil, was first published in CAP722 [1] in May 2002. Under this policy, the principles established for civil manned aircraft are extended to civil UAV, including the need for systems to be certificated to a code of airworthiness and organizations involved in the design, manufacture, maintenance or operation of a civil UAV system to be approved for this purpose.[62]

Traditionally in the UK model, aircraft enthusiasts have only used unmanned aircraft for recreational purposes. However, they are increasingly being used for professional applications, such as surveillance and data gathering. Such aircraft are likely to be operated in a way that may pose a

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[61] Stephen Dean, "Drone Crashes into SWAT Team Tank During Police Test Near Houston," *Houston Page One | Examiner.com*, March 4, 2012, http://www.examiner.com/page-one-in-houston/drone-crashes-into-swat-team-tank-during-police-test-near-houston#ixzz1oNnffEGm.

[62] D. R. Haddon and C. J. Whittaker, "UK-CAA Policy for Light UAV Systems," Design & Production Standards Division, Civil Aviation Authority, UK, May 28, 2004, 1.

greater risk to the general public. Unlike manned aircraft or model aircraft used for recreational purposes, no established operating guidelines exist. Thus, operators may not be aware of the potential dangers, or indeed, the responsibility they have towards not endangering the public. Furthermore, much larger unmanned aircraft are now being developed. These aircraft are required by national and European law to be designed and manufactured to an approved standard, and very often require a great deal more space in which to operate. Therefore, it is often necessary to take additional steps to ensure that the aircraft can be safely integrated with other airspace users—both in the air and on the ground. In January 2010, the CAA introduced new regulations that require operators of small-unmanned aircraft used for aerial work purposes and those equipped for data acquisition and/or surveillance to obtain permission from the CAA before commencing a flight within a congested area or in proximity to people or property.[63]

All aircraft, including unmanned aircraft, must be operated in a manner that does not create a hazard to people or property. Even very small aircraft can be a hazard when operated in close proximity to people or property and could potentially inflict critical damage to other airspace users. CCA Articles 166 and 167 of the ANO 2009 explain the specific circumstances in which operating permission must be obtained from the CAA. Authorization is not required for aircraft of 40 pounds or less being flown within direct unaided line of sight and away from people, property and congested areas (the Air Navigation Order defines a congested area as being 'any area of a city, town or settlement that is substantially used for residential, industrial, commercial or recreational purposes'). Most other operations, including flights in congested areas and those conducted for commercial purposes, will require prior permission from the CAA.[64]

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[63] CAA, "The UK Civil Aviation Authority," *Civil Aviation Authority*, March 19, 2012, http://www.caa.co.uk/homepage.aspx.

[64] Ibid.

To ensure that sufficient safety measures have been put in place, operators required to apply for permission from the CAA will be asked to demonstrate that they have considered the safety implications and taken the steps necessary to ensure that the aircraft will not endanger anybody. The requirement for avoiding collisions between aircraft, or between aircraft and objects, applies equally to manned and unmanned aviation. Therefore, appropriate steps must be taken to cater to the absence of a pilot within the aircraft. For UAS flights, the methods used to prevent collisions depend on whether the aircraft is being within or beyond the 'Line of Sight' of its pilot. Visual line of sight is termed as being the maximum distance that the flight crew is able to maintain separation and collision avoidance, under the prevailing atmospheric conditions, with the unaided eye (other than corrective lenses). For flights within line of sight, the pilot is required to employ the see-and-avoid principle through continued observation of the aircraft, and the airspace around it, with respect to other aircraft and objects. Within the UK, visual line of sight operations are normally accepted out to a maximum distance of 500 meters horizontally, and 121 meters vertically, from the pilot. For operations beyond line of sight, it is not possible for the pilot to directly see the unmanned aircraft and avoid other aircraft or objects. Therefore, alternative arrangements to prevent collisions must be taken. In these cases, the aircraft must either be fitted with a sense-and-avoid system or, in the absence of such a system, it must be operated within segregated airspace (a block of airspace specifically allocated for an unmanned aircraft's flight; collision risks are eliminated by either preventing or strictly controlling entry to this airspace by other aircraft).[65]

Currently, no RPA pilot licenses are recognized in aviation law. However, it is essential that pilots of any aircraft have at least a basic understanding of the applicable regulations, in particular the Rules of the Air Regulations. Therefore,

[65] CAA, “The UK Civil Aviation Authority.”

the CAA will require a potential RPA operator to demonstrate that the pilot is appropriately qualified before any operating permission is issued.[66]

With regard to policing, some of the police departments in Europe (where data is most available) have been using UAS since approximately 2006. At least five police forces in the UK (Essex, Merseyside, Staffordshire, Derbyshire, and the British Transport police) have purchased or used mini UAS. Each department has commented about the surveillance potentials of these devices. UAS have been used by UK police to monitor festival goers by "keeping tabs on people thought to be acting suspiciously in car parks and to gather intelligence on individuals in the crowd,"[67] protests at right-wing festivals, as well as the Olympic handover ceremony at Buckingham Palace.[68] The Merseyside police force in Liverpool has used two UAS to police "public order" and "present antisocial behavior." Police in Liverpool have flown UAS over groups of young people loitering in the parks, as well as used it for covert surveillance.[69] Merseyside police are credited with the first UK arrest using UAS. A car thief was tracked down through undergrowth by the UAS's thermal imaging camera.[70]

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[66] CAA, "The UK Civil Aviation Authority."

[67] James Randerson, "Eye in the Sky: Police Use Drone to Spy on V Festival," *The Guardian*, August 21, 2007, http://www.guardian.co.uk/uk/2007/aug/21/ukcrime.musicnews.

[68] Ibid.

[69] Ibid.

[70] Travis Dunlap, "Comments: We've Got Our Eyes on You: When Surveillance by Unmanned Aircraft Systems Constitutes a Fourth Amendment Search."

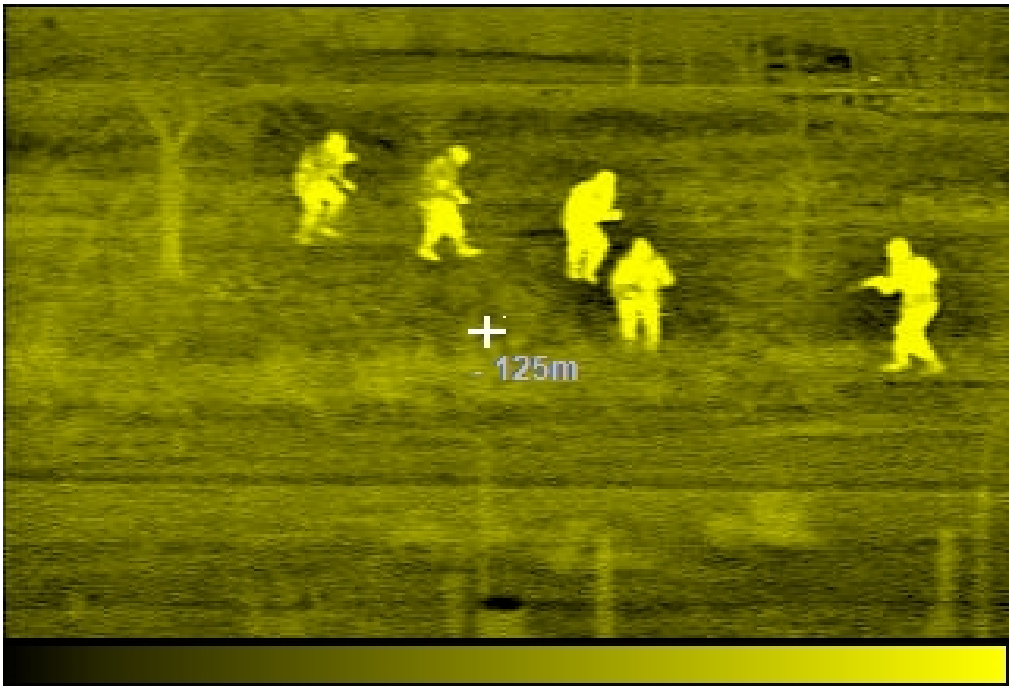

Figure 2.2. Image of airborne FLIR technology systems[71]

C. "LIGHT" UAS OPERATIONAL EXEMPTIONS

Under the UK-CAA Light UAV Systems policy, certain exemptions exist that allow for the use of UAS possessing a total (fuel excluded) weight under 40 pounds. UAS fitting these criteria are excluded from the vast majority of regulations that apply to other UAS aircraft to allow autonomy to operate a small aircraft provided the operator does not act in a reckless or negligent manner to endanger any person or property. For UAS with a mass between 14–20 pounds, some additional operational limitations are enacted to safeguard adequate security.

- Clear of control airspace, unless with ATC permission
- Clear of any aero dome traffic zone, unless with ATC permission
- At least 400 feet above the point of launch, except with permission as above

[71] FLIR Systems, "FLIR Thermal Imaging Infrared Rifle and Weapon Sight," *Imaging1.com*, August 11, 2012, http://www.imaging1.com/thermal/specterIR.html.

- Within 500 yards of the operator at all times
- Not within 150 yards of any congested area of a city, town or settlement
- At least 50 yards clear of persons, vessels, vehicles or structures that can be reduced to 30 yards for takeoff or landing. Other UAS operators and any assistants or officials may be within this distance, as may vessels, vehicles or structures under their control.
- A serviceable "fail-safe" mechanism shall be incorporated to terminate the flight following loss of signal or detection of an interfering signal
- Ensure that any load carried on the UAS is secured; flights must comply with any conditions, such as bylaws
- CAA permission is required for any commercial flights[72]

Restricting the height of UAS to 400 feet reduces possible encounters with other aircraft. Flight within 500 yards of the operator at all times is imposed to ensure correct handling of UAS and also ensure that the operator can perform the "see and avoid" function necessary for the avoidance of aerial collisions.

D. CANADIAN PERSPECTIVE

Canada has taken a very aggressive role in being a leader in the advancement for UAS technologies transitioning from a military role to both local government and commercial usage. Canada has more than 220 UAS-related firms. At least 38 post-secondary researchers, research centers, or technical training institutions also support the UAS sector. In fact, a Transport Canada work group was tasked with reviewing the feasibility of UAS in both these markets with minimal government interference. The prevailing Transport Canada opinion is that unmanned air vehicles are not constrained by human limitations and requirements, as they make it possible to gather information in dangerous

[72] Civil Aviation Authority, "CAP 722—Unmanned Aircraft System Operations in UK Airspace—Guidance," Directorate of Airspace Policy, April 6, 2010.

environments without risk to flight crews and they can be much more cost effective than manned aircraft operations.[73]

The report is quoted as stating, “Canadian industry is currently capable of becoming a world leader in unmanned aircraft system technology and services. The Working Group is unanimous in the opinion that the rapid development by Transport Canada of regulations and standards is critical to exploit this technological advantage for domestic and export opportunities.”[74] Canada has publicly identified several working groups to develop policies and procedures for use of UAS in diverse environments and high risk roles, including but not limited to, atmospheric research, scientific research, oceanographic research, geophysical research, mineral exploration, imaging spectrometry, telecommunications relay platforms, police surveillance, border patrol and reconnaissance, survey and inspection of remote power lines and pipelines, traffic and accident surveillance, emergency and disaster monitoring, cartography and mapping, search and rescue, agricultural spraying, aerial photography, promotion and advertising, weather reconnaissance, flight research, and firefighting monitoring and management.[75]

Transport Canada defines UAS as a power driven aircraft, other than a model aircraft operated without a flight crew on board. A model aircraft is defined as an aircraft, which has a total weight that does not exceed 77.5 pounds, that is mechanically driven or launched into flight for “recreational purposes” and that is not designed to carry persons or other living creatures. Although some micro unmanned air vehicles may weigh less than 35 kg, research institutions and other organizations operate them for non-recreational purposes.

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[73] “Unmanned Aerial Vehicle—UAV—Transport Canada,” *Transport Canada—Government of Canada*, (n.d.), http://www.tc.gc.ca/eng/civilaviation/standards/general-recavi-uav-2265.htm.

[74] Transport Canada—Staff, “UAV Working Group—Transport Canada,” *Government of Canada*, February 29, 2012, http://www.tc.gc.ca/eng/civilaviation/standards/general-recavi-uavworkinggroup-2266.htm#1.

[75] Ibid.

Similar to the ideologies shared in the United States and United Kingdom, Canada's first and foremost priority when dealing with UAS is flight safety within the airspace they control. Aircraft flight regulations in Canada are found under the Canadian Aviation Regulations also known as CARs. CARs mandate that unmanned aircraft shall not be operated without a Special Flight Operation Certificate (SFOC). The certificate allows the operator to fly in a designated area as approved by an application process. The application process to obtain the SFOC is very similar to that of the FAA. Unlike the regulations of the FAA, Canadian Aviation Regulations have fewer regulations concerning the testing of unmanned aircraft in a public safety forum. Currently, the Royal Canadian Mounted Police (RCMP) now uses 14 UAS nationwide. In addition, several smaller police forces within Canada are also testing and operating unmanned aircraft. Canadian federal regulators have approved 300 special flight operation certificates for governmental and commercial use during the past five years. The special flight certificates related to the operation of small or mini UAS are not without certain restrictions. The most telling restriction is that when not in an operational setting, the unmanned aircraft is not to be flown within a “built-up area in city or town” or “noise sensitive area”–such as churches, hospitals, parks, schools, for the purposes of routine flights.[76] Even with these limitations, the RCMP finds that the use of unmanned aircraft is extremely effective and efficient in assisting with the investigation of criminal activity. The RCMP has had an initiative to ensure the general public that UAS are used for the purposes of assisting criminal investigations and not as intelligent gathering instruments. The RCMP makes every effort to ensure the gathering evidence versus conducting widespread surveillances is an important distinction within the unmanned aircraft program. Transport Canada with the Privacy Commissioner of Canada is ensuring that no Privacy Act violations will occur during testing.[77]

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[76] “Unmanned Aerial Vehicle—UAV—Transport Canada.”

[77] Ibid.

The Office of the Privacy Commissioner, responsible for reviewing privacy impact assessments, has not received any complaints regarding the RCMP's use of UAS due largely to the RCMP's strong policy statement not to collect personal information as defined by the Privacy Act. However, if the situation arises in which the RCMP needs the UAS to be used in an operational setting where personal information is collected, it will need to complete a privacy impact assessment. The Office of the Privacy Commissioner reviews each completed privacy impact to ensure that governmental authorities have not colluded to expose or make public the gathered information.

In British Columbia, the RCMP is prohibited from flying UAS over crowds, near buildings or higher than 150 feet. Only licensed officers from the RCMP are allowed to operate the UAS, and the UAS must remain within the officer's line of vision. The RCMP's Integrated Collision Analysis and Reconstruction Service (ICARS) is testing UAS to take aerial photographs of major collision scenes in the Lower Mainland. UAS provide for a much more effective understanding of the collision scene with aerial photographs far more superior to photos taken by someone at the ground level. These images assist in the analysis when reconstructing the accident scene and can be used in courts as best evidence.

E. EUROPEAN APPLICATIONS

The European market has already shown a high interest for the use of UAS in the civilian market. These six distinctive areas include but are not limited to the following.

- Law enforcement
- Firefighting
- Energy sector
- Agriculture forestry and fisheries
- Earth observation and remote sensing
- Communications and broadcasting[78]

[78] European Commission, *Study Analysing the Current Activities in the Field of UAV*, 7.

It is not expected that all these areas will emerge simultaneously but with continued exposure and use in the civilian airspace, more interest and applications will be moved forward. Government users are expected to take a lead in innovation based on ease of procurement of military technologies to be used by public safety sector entities. The European attitude towards UAS usage proclaims the main advantages for civilian purposes as being similar to those applicable in the military context: persistence, cost-effectiveness, and the ability to function in an environment hazardous to human occupants.[79] The European Commission has also noted that legislative and regulatory factors are making the emergence of the market significantly delayed. As such, developments and experiments are ad hoc and uncoordinated.[80]

The report conducted by the European Commission demonstrates that European nations are interested in participating in the on-demand aircraft systems technology.[81] Part of this commitment would be to form a commission to be a single point of information for the exchange between the institutional, academic and industrial participants of advancing unmanned aircraft technologies. Adequate funding for specific projects would be needed to accelerate the creation of special interest groups to assist in modifying regulatory restrictions to fly these devices within the controlled airspace of European nations. The European commission also found safety to be the number one issue in the deterrence of moving forward with regular flights of unmanned vehicle systems. The commission's report primary focus is on specifications including involvement in rule definition processes of developing an effective and a plausible collision avoidance solution.[82]

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[79] European Commission, *Study Analysing the Current Activities in the Field of UAV*, 8.

[80] Ibid.

[81] Ibid., 82.

[82] Ibid., 87.

F. SUMMARY

After reviewing the information, it is well documented that the potential exists to use military proven UAS in civilian public safety operations. The technology is already in existence. Hence, no development of technology is needed, but the creation of sound operational practices and policies are necessary to implement this technology in a manner considered best police practices and to ensure trust from the community.

Three areas of importance need to be fully addressed and understood to make the use of UAS a possibility by law enforcement in urban areas (in addition to sound best practices policies and procedures). First, the information that can be collected by using UAS needs to be significant enough to result in a new way to increase efficiency, save money, and enhance public safety. Good intelligence relies on the collection of timely and accurate information.

Secondly, the ability to use UAS must fall within the legal confines of the FAA as it relates to the ability to fly over urban areas with minimal limitations. Two acceptable means of operating UAS in the NAS outside of "restricted" air space are a Special Airworthiness Certificate—Experimental Category or a COA.[83] The COA process is available to public entities, such as governmental agencies (including local law enforcement) that want to fly UAS in civil airspace. The COA authorizes an operator to use defined airspace and includes special provisions unique to each operation. COAs require coordination with an appropriate ATC facility and may require UAS to have a transponder to operate in certain types of airspace. The FAA is developing new policies, procedures and approval processes to address the increase in both the civil and civilian operators. By 2013, the FAA expects to have formulated new rules that would allow police across the country to fly lightweight, unarmed UAS routinely up to 400 feet above the ground—high enough for them to be largely invisible eyes in the sky.

[83] European Commission, *Study Analysing the Current Activities in the Field of UAV*, 87.

Thirdly, the information collected by use of UAS must be obtained legally and not conflict with the Fourth Amendment. The technology will allow law enforcement to record the activities of the public below with high-resolution, infrared and thermal-imaging cameras. Much of the legal framework to fly UAS has been established by cases that have examined the use of manned aircraft and various technologies to conduct surveillance of both public spaces and private homes. These cases will need further review and interpretation as most deal with the "random" manned flight missions over an area with the open to public view doctrine with items seen with the "naked eye" at a flight altitude of 400 feet or above. Obviously, neither the randomness nor naked eye methodology will be appropriate with the use of UAS. However, with a warrant or in situations with exigent circumstances, the use of UAS will be both legal and appropriate. During events in open public areas, UAS will be under the same purview as CCTV cameras both in a fixed or portable position. The use of CCTV during incidents of public protest that have lead to criminal activity has been found by the courts to be both operationally sound and acceptable for submission as evidence for the criminal filing of law violations.[84]

The next chapter discusses the history of UAS, what size UAS will best suit policing efforts in an urbanized environment and how this technology compliments nationally accepted community policing efforts and ideologies.

[84] Fredricks, "CCTV: A Law Enforcement Tool."

III. SMALL UNMANNED AIRCRAFT SYSTEMS AND COMMUNITY POLICING

The use of aviation equipment as an operational tool has a long and distinguished role within law enforcement and the public safety sector.[85] The use of helicopters and fixed winged manned aircraft has been a vital law enforcement tool since the early 1960s.[86] Even with all the benefits attributed to traditional law enforcement aviation activities, many municipal law enforcement agencies have either drastically reduced aviation coverage or abandoned their programs altogether due to the expense related to these programs. This reduction in aviation support deters the agencies' ability to provide both the community and officers with the tools necessary to provide excellent services. This decrease is also contrary to the community policing philosophy of using all means necessary to reduce and deter conditions that lead to crime and social disorder.[87] The use of small UAS has the potential to augment and assist law enforcement agencies in fulfilling the role of public safety in operational situations in which traditional aviation support is needed.

A. WHAT IS A SMALL UAS

For purposes of this thesis, the term UAS will include all vehicles flown/operated in the air with no person onboard able to control the aircraft; all controls will be completed with line of sight ground operations. This definition is consistent with military application in the range of both micro and mini UAS. This definition provides simplicity as more complex definitions of unmanned vehicle

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[85] Kenneth Solosky, "A Primer on Police Aviation," Professional, *PoliceOne.com*, September 27, 2008, http://www.policeone.com/police-technology/articles/1737278-A-primer-on-police-aviation/.

[86] Kenneth Solosky, "Fixed Wing Aircraft in Law Enforcement," *LawOfficer.com*, January 3, 2009, http://www.lawofficer.com/article/patrol/fixed-wing-aircraft-law-enforc.

[87] COPS Office, "Community Policing for Mayors: A Municipal Service Model for Policing and Beyond," *US Department of Justice; COPS Office*, August 28, 2006, 5, http://www.cops.usdoj.gov/ric/ResourceDetail.aspx?RID=32.

systems exist, such as that of DoD, which uses the following definition for unmanned vehicle systems, "a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously will be piloted remotely, can be expendable recoverable, and can carry a lethal or nonlethal payload. Ballistic or semi-ballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles."'[88]

Figure 3.1 is an illustration of the compact nature of mini and micro sized UAS. The officer is able to deploy UAS from the top of a patrol car's trunk lid.

Figure 3.1. Mesa County Sheriff with Draganflyer X6[89]

Over the past two decades, the collection of information and its use in the analysis of criminal patterns has made considerable advancements within police organizations. The data collected and the complexity of the collection method

[88] Kenzo Nonami, "Prospect and Recent Research and Development for Civil Use Autonomous Unmanned Aircraft as UAV and MAV," *Journal of Systems Design and Dynamics* 1, no. 2 (2007): 126.

[89] Draganfly Innovations Inc., "Draganflyer X6 Six Rotor UAV Helicopter Aerial Video Platform," *Draganfly Innovations, Inc.*, August 11, 2012, http://www.draganfly.com/uav-helicopter/draganflyer-x6/.

along with analysis and sophisticated software applications continues to advance at a rapid pace. Most law-enforcement agencies routinely use intelligence information to provide real-time crime analysis on a daily basis. The sophistication of this information in both the use and collection processes would not have been possible just 20 years ago. Advancements in technology will continue to provide tools critical in the efforts to protect the public, identify and apprehend criminals and terrorists, and investigate crime and conditions that cause social disorder. Technology advancements have afforded even the smallest law enforcement agencies the ability to facilitate and enhance information collection and management, data analysis, and produce intelligence information for dissemination to front-line officers.

In this fast growing enterprise, additional terminology has been used that includes a Remotely Piloted Vehicle (RPV), a Remotely Operated Aircraft (ROA), a Remote Controlled Helicopter (RC-Helicopter) and an unmanned vehicle. From a military perspective, all unmanned aircraft fall into five specific categories that include micro, mini, tactical, mid-altitude, and high altitude. Figure 3.2 illustrates the spectrum of current under manned aircraft systems within the military type definition.

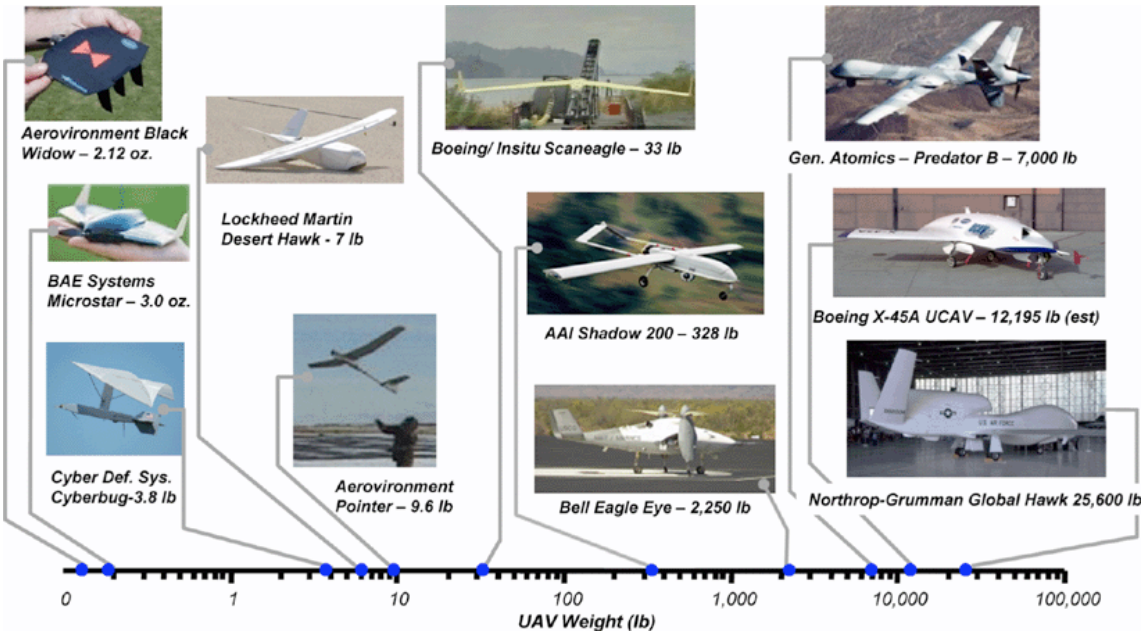

Figure 3.2. Spectrum of current UAS military types. National Airspace System: Progress and ongoing challenges for the air traffic organization U.S. Government Accountability Office, GAO-05-485T, 14-04-2005[90]

The RC- and model helicopters and rotary powered UAS are clearly defined by the Association for Unmanned Vehicle Systems (AUVS) International as mini, close and medium range UAS depending on their size, endurance, range and flying altitude.[91] When defining small UAS, they are to be considered RC that are within the line of sight of the operator. These UAS are portable, weigh no more than 2–85 pounds, and are capable of a cargo capacity equal to or more than its own overall weight. The limited range of small UAS requires that these vehicles be delivered to the vicinity of the desired operating location.

The hypothesis of this thesis deals specifically with helicopter models and other UAS rotary powered systems. This is not to say that the fixed wing application would not have some utilitarian value in a public safety setting. The

[90] Tim Padgett, "Using Drones in the Drug War," *TIME.com*, June 8, 2009, http://www.time.com/time/nation/article/0,8599,1903305,00.html.

[91] "Association for Unmanned Vehicle Systems International.

fixed wing application (see Figure 3.3) would provide for maximum efficiency in an open space or rural setting.[92] Since this thesis deals with incorporating UAS systems into an urbanized law enforcement setting, the rotary powered or helicopter styled applications will prove to be more beneficial for operational scenarios. In the correct situations, small rotary UAS could prove to be particularly adept at providing reconnaissance in urban settings where flights between buildings, other fixed structures, and hovering capabilities would provide operational intelligence.

Figure 3.3. Fixed wing application AeroVironment Raven[93]

[92] Gary Mortimer, "Mesa County Police Purchase Falcon Fixed Wing sUAS," *sUAS News*, January 16, 2012, http://www.suasnews.com/2012/01/11259/mesa-county-police-purchase-fixed-wing-suas/.

[93] "Unmanned Aircraft Systems (UAS)—AeroVironment, Inc. (AV)," *AeroVironment*, August 5, 2012, http://www.avinc.com/uas/.

B. UAS HISTORY AND POTENTIAL IN PUBLIC SAFETY

Rotary UAS promise to be able to gather actionable information, particularly in support of intelligence surveillance and reconnaissance before, during, and after events of interest. Other crisis situations could account for incidents of eminent danger, such as unlawful crowd containment or riotous activities, confrontations between assemblies threatening violence and public safety personnel, and natural or man-made disasters in progress. The psychological impact of UAS should not be underestimated as the mere presence of UAS might serve as notice to the rioting masses that they are being monitored constantly. Images taken by UAS will assist law enforcement personnel's efforts to prosecute criminal violators. UAS could be used to provide pinpoint delivery of crowd control agents, such as tear gas, and thereby, reduce the chaos that sometimes ensues over a wide area when those measures are employed.

The applications for an unmanned aerial vehicle for public safety, specifically law enforcement, have unlimited potential.[94] UAV have the ability to perform concentrated patrols, equipped with cameras monitored and flown by officers on the ground. Searches for missing persons or suspects could be conducted using heat-seeking devices (such as a FLIR system) just as helicopters flown by human pilots use them today (see example in Figure 3.4).

[94] Wyllie, "Police UAVs: Nearly Limitless Potential."

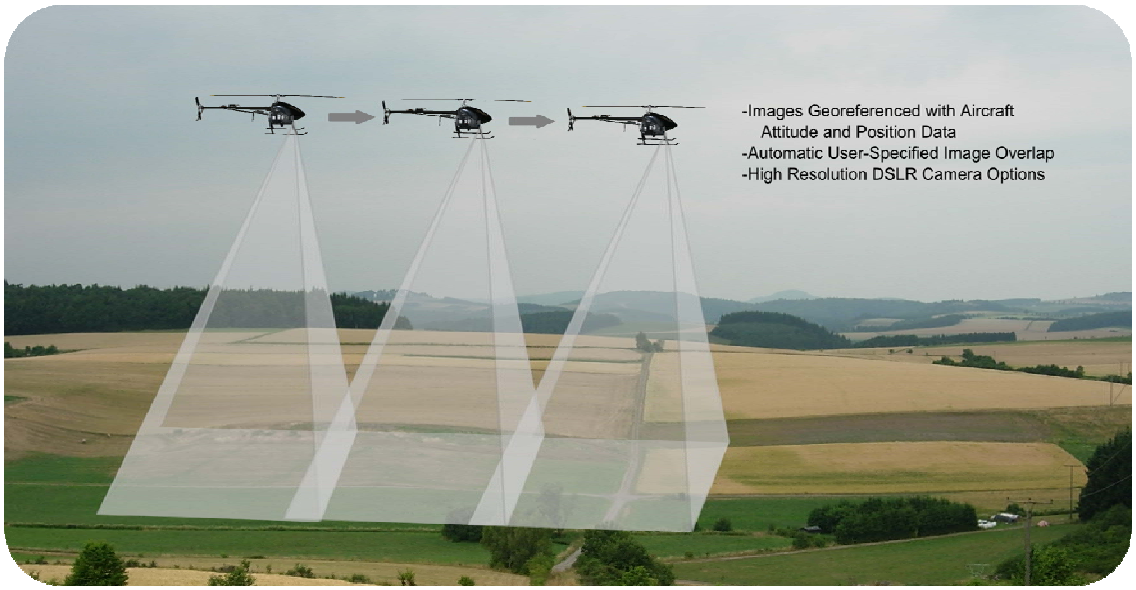

Figure 3.4. Example of downward sensing abilities for attached camera and FLIR systems[95]

During a hostage or rescue situation, UAS have the ability to hover near windows and provide real-time intelligence and situational awareness information to Special Weapons and Tactics (SWAT) operators and command post personnel. In a potential Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) incident, an UAS could be deployed into “hot zones,” and when properly outfitted with sensing equipment, take air samples without risking the safety of pilots. UAS have the ability of negotiating their way into operational areas, such as a SWAT high-risk low-frequency situation, and maintain a covert presents for ongoing reconnaissance, which greatly increases the odds in favor of law enforcement forces. During an active shooter type situation, unmanned vehicle systems could prove useful in a supporting role by providing intelligence and reconnaissance, intercepting and/or jamming adversary communications, and giving location proximity to rescue missions that may be deployed upon evacuation of the aggressors.

[95] “Viking Aerospace,” *Viking AeroSpace*, August 5, 2012, http://vikingaero.com/.

UAS technology has become advantageous, especially when compared to traditional law enforcement aviation techniques utilized by manned helicopters.[96] Current generation UAS can be transported in small vehicles (such as a patrol car) and launched from an area with dimensions no larger than 10' x 10' for a rotary platform, but still maintain the cargo capacity to be equipped with cameras and sensors that can provide usable operational intelligence. This technology holds considerable promise for public safety organizations due to its small size, cost effectiveness, a tool for investigative purposes, and supporting operational functions.[97]

UAS have three distinct operational capacities over manned aircraft in certain public safety applications.

- They are less expensive to operate
- Are not affected by the fatigue of human pilots
- Do not put human pilots at risk

To decrease pilot tiredness, numerous personnel can be trained to operate UAS to provide the opportunity for proper rest periods without compromising or reducing the flight time for a flight operation. This advanced technology is an appealing complement to existing aviation apparatuses, such as helicopters and fixed winged manned aircraft or a cost-effective substitute for departments unable to fund an aviation unit.

The research and development (R&D) of UAS have primarily been motivated for military applications driven by the desire for full capabilities in surveillance, reconnaissance and the penetration of hostile terrain without risking human life. These developments were to alleviate human pilots from the "dull, dangerous and dirty" flight missions.[98]

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[96] Padgett, "Using Drones in the Drug War—TIME."

[97] Benjamin J. Miller, "Not Just in a Galaxy Far Away," *Air Beat—The Official Journal of the Airborne Law Enforcement Association*, July 2011, 40.

[98] Dean Irvine, "Doing Military's Dangerous, Dull and Dirty Work," *CNN*, February 16, 2012, http://edition.cnn.com/2012/02/15/business/singapore-airshow-drones/index.html.

Notwithstanding recent growth and endorsement in the UAV/UAS market, UAVs have a reasonably long history. The first unmanned aircraft was a torpedo developed in 1915 for the United States Navy, which was designed to fly to a specific location and drive into its target.[99] In the Second World War, UAVs/UASs were used as radio controlled targets and reconnaissance missions.[100] From the 1960s to the 1980s, the United States and Israeli military forces commenced meaningful research into UAVs. In the 1990s, the Defense Advanced Research Projects Agency (DARPA) and NASA begin research into future uses of UAS, and a number of well-known UAVs, such as the Helios, Proteus, Altus Pathfinder and Predator (which was first used by the United States in the Gulf War), which resulted from this effort.[101] Wilson asserts that drones (UAS) were so effective in the Gulf War that "Iraq troops begin to associate the sound of the little aircraft's two-cycle engine with an imminent devastating bombardment", which he says led to "the first instance of human soldiers surrendering to a robot."[102] Growth in this area has recently increased exponentially, particularly because of developments in lightweight construction materials, microelectronics, signal processing equipment and GPS navigation. Over 50 nations presently use UAS for military reconnaissance, intelligence gathering and targeting, and as of 2003, at least three-dozen nations had active UAV development or application programs.[103]

Due to the substantial growth in this industry, the capabilities and uses of UAS vary considerably, particularly in relation to newly emergent civil applications. Likewise, these innovative civil applications are a substantial source of growth for the industry, and have been motivated by particular groups of

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[99] Travis Dunlap, "Comments: We've Got Our Eyes on You: When Surveillance by Unmanned Aircraft Systems Constitutes a Fourth Amendment Search," *South Texas Law Review* 51, no. 1 (Fall 2009): 173–204.

[100] The Economist, "Unmanned Aircraft: The Fly's a Spy," November 1, 2007, http://www.economist.com/node/10059596.

[101] Nonami, "Prospect and Recent Research and Development for Civil Use Autonomous Unmanned Aircraft as UAV and MAV," 120–128.

[102] J. R., Wilson, "UAVs: A Worldwide Roundup," *Areospace America* (June 2003).

[103] Ibid.

stakeholders, although primarily industry. While some groups, such as law enforcement, industry and public authorities, certainly do benefit from relatively inexpensive deployments of UAS, their use brings forth some ethical and privacy concerns and requires a range of regulatory mechanisms to address these concerns. Currently, regulations heavily restrict the civil use of UAS, and although some participants are researching ways to remove these obstacles, a small number of other sponsors are recommending privacy protections to protect citizens from UAS surveillance.

C. COMMUNITY POLICING

How does the use of UAS fit into the ideology of contemporary community policing? After the attacks of 9/11, then-President George W. Bush created the first concerted effort to incorporate homeland security into localized policing. As part of the document of the National Strategy for Homeland Security, the working definition of homeland security was defined as "a concerted national effort to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recovery from attacks that do occur."[104] Critical to this definition is the phrase "concerted national effort," which is based on the principles of shared responsibilities and partnerships at the federal, state, and local levels. This definition is also to include the private sector and the American people.[105] Traditional public safety efforts even with the efforts in community policing have focused primarily on preventing and solving crimes within the community, which includes a concerted effort to reduce conditions that cause crime and/or social disorder. Law enforcement is now faced with the challenges of dealing with new and unknown territories, that of terroristic threats. Law enforcement has learned that the community policing style has proven to be very adaptable in not only technique but also in the acceptances of new

[104] Bush, *National Strategy for Homeland Security*, 2.

[105] Ibid.

technologies. This adaptability will play a pivotal role in the advancement in the implementation of UAS usage in operational situations.

Technology innovations, such as UAS, will allow local law enforcement agencies to compete for limited funding and resources while looking to adapt current technologies and remain steadfast in their commitment to the community and the reduction of crime and social disorder. With the absence of terrorist activity on domestic soil, the community perceives the threat of terrorism as either diminished or nonexistent.[106] This perception makes it increasingly difficult in these times of limited resources to have public agencies continue to do business as usual, which includes the expensive proposition of maintaining aviation bureaus without reviewing additional resources to provide similar capabilities and reduce cost. This type of technology advancement falls into the definition of community policing.

Even though no singular definition of community policing exists, it is generally accepted that three essential elements need to be present for effective community policing efforts.

- The creation and reliance on effective partnerships between the police, the community, and the private sector to share in the resources of each other
- The application of problem-solving strategies and techniques
- The transformation of police organizational culture and structure to support the philosophy and shifts in America's changing environment

Community policing is designed around the core concepts of community engagement and problem solving to address crime, social disorder (and the conditions that cause both crime and social disorder), and other public safety concerns affecting the quality of life within a community.

[106] John Mueller, "Is There Still a Terrorist Threat?: The Myth of the Omnipresent Enemy," News, *Foreign Affairs: Published by the Council on Foreign Relations*, October 2006, http://www.foreignaffairs.com/articles/61911/john-mueller/is-there-still-a-terrorist-threat-the-myth-of-the-omnipresent-en.

Public safety leaders must understand technology is progressing and be able to determine the difference between beneficial and cumbersome technology projects.[107] Making unresearched assumptions and moving forward with unproven or risky technology does not constitute best practice leadership. "Criminal justice is an integral concern of all human beings and societies around the world. Quantum leaps in technology, growing out of basic science research, or transforming societies around the world and consequently, crimes, the crime scene, criminals, and the criminal justice system. Police practitioners will agree that random patrols do little in combating crime and social disorder. The ability to monitor large geographical areas by the use of technology not only accomplishes this goal but also brings perceived intrusions of civil liberties, in that spirit the definition of community policing as defined by Robert R. Friedman best illustrates how community policing community perception and incorporation of technology to better serve the community.

> A policy and strategy aimed at achieving more effective and efficient crime control, reduced fear of crime, improved quality of life, improved police services and the police legitimacy, to a proactive reliance on community resources that seeks to change crime causing conditions. This assumes a need for greater accountability of police, greater public shared decision-making, and greater concern for civil rights and liberties.[108]

As we approach the next century, emerging changes will demand more accountability and offer new challenges."[109] Few policing professionals would disagree with these observations, especially in light of the many challenges and changes that have occurred since 1999.[110]

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[107] Roslyn Muraskin and Albert R. Roberts, *Visions for Change: Crime and Justice in the Twenty-first Century*, 2nd ed. (Upper Saddle River, NJ: Prentice Hall, 1999), 3.

[108] Robert R. Friedman, *Community Policing: Comparative Perspectives and Prospects* (New York, New York: St. Martin's Press, 1994), 4.

[109] Muraskin and Roberts, *Visions for Change: Crime and Justice in the Twenty-first Century*, 3.

[110] James A. Conser, Gordon G. Frissora, and Joseph A. Schafer, *Policing 2020: The Patrol Function in the Future—One Vision* (Quantico, Virginia: FBI Futures Working Group, March 2007), 177.

- Devastating terrorist attacks, increased awareness of terrorism, and the globalization of fear
- The reorganization of law enforcement/homeland security functions of the executive branch at the federal level
- Diversion of tremendous resources to the war on terrorism and the military operations in Afghanistan and Iraq
- The continued growth of high-tech crime and computer enhanced criminal activities
- Integration of adaptive simulation training that can be tailored to an individual department's environment
- Significant advances in and application of technological innovations to policing
- A troubling societal division on many policy issues[111]

The new standard of best practices for law enforcement will need to consider fully how not only law-enforcement officials but also the general public-at-large will embrace and accept these uses of technology. These best practice considerations will also need to include not only the safe operation but also the ethical considerations regarding technology advancements and what mechanisms will be associated with public safety and civil liberties.

D. VALUE OF INFORMATION

Since the attacks of September 11, 2001, much public attention has been focused on intelligence at the federal level; but considerable steps have been taken to expand the use of intelligence as a resource and a tool for state, local, and tribal law enforcement agencies.

The world is becoming a *data sphere*, or a place in which information about people, their environment, and their actions is the primary driver.[112] Information is the most powerful force multiplier in the world today. Obtaining usable and reliable information is the leading challenge confronting public safety

[111] Conser, Frissora, and Schafer, *Policing 2020: The Patrol Function in the Future—One Vision*, 177.

[112] Garfinkel, *Database Nation: The Death of Privacy in the 21st Century*, 75.

agencies today and in the future. It is hard to imagine the potential power that could be generated when everything and everyone has a digital component and those components are linked through a network with user search ability (almost at fruition with the evolution of smart phones). This power would consist of technologies with a centralized relational database that can catalog, collate, and retrieve data in an efficient manner. “A network centric organization cannot be achieved simply by the application of new technology to current law enforcement structures and methodologies. To occur, network centric policing will need new organizational structures based upon human social networks that are facilitated by information technology, a streamlined and unified structure that comes from the greatly increased ability to exchange information in real time”.[113]

The increasing capabilities of technology will influence law enforcement's ability to accumulate intelligence information. Consideration must be given on how existing and emerging technologies, such as UAS, can facilitate and enhance information collection and management, data analysis, and intelligence production and dissemination. Developments in both software and Internet-based communications have made it possible for even small and medium-sized agencies throughout the United States to develop and utilize an intelligence function. This capability contributes to the overall homeland security by having this information developed and used at the local level. The use of crime data and mapping software has become a fundamental and dynamic component of modern policing, will only increase with the advancements of technology, and thus, allow agencies to serve their communities better. Law enforcement agencies not having an effective intelligence capability will soon become obstructions in the ability of homeland security and law enforcement to share information effectively and comprehensively to provide for stronger homeland security.

[113] Thomas J. Cowper and Joseph A. Schafer, *Policing 2020: Information Age Technology and Network Centric Policing* (Quantico, Virginia: FBI Futures Working Group, March 2007), 95.

The National Criminal Intelligence Sharing Plan outlines when and how information and intelligence are to be used by all levels of law enforcement agencies.[114] This use of information for the purposes of criminal investigations is termed Intelligence-Led Policing (ILP).

> The benefits of the enhanced use of law enforcement intelligence are not limited to the detection and prevention of terrorist incidents. Police agencies first used intelligent systems to support the investigation of organized crime. Indeed, although the main purpose of implementing ILP may be to ensure homeland security, for many agencies the greater benefit may be the enhancement of successful criminal investigations.[115]

The key to ILP is to answer the need for targeted resource allocation to combat crime, terrorism and other public safety issues through improved situational awareness. The information that can be collected by using UAS needs to be significant and bring new techniques to increase efficiency, save money, enhance public safety and even have the possibility to save lives. Information that UAS can collect will fall into two broad purposes that law enforcement agencies can utilize as raw intelligence.

- **Prevention (Tactical Intelligence):** Includes gaining or developing information related to threats of terrorism or crime and using this information to apprehend offenders, hardened targets, and/or employee strategies that will eliminate or mitigate the threat.
- **Planning and Resource Allocations (Strategic intelligence):** Includes generating information to decision makers about the changing nature threats, the characteristics and methodologies of threats, and emerging threat idiosyncrasies for the purpose of developing response strategies and reallocating resources, as necessary, to accomplish effective prevention.[116]

All information collected by UAS must be able to process, store, retrieve, and reformulate this raw intelligence into actionable intelligence.

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[114] *National Criminal Intelligence Sharing Plan* (Washington, DC: Office of Justice Programs, 2004).

[115] David L. Carter and Joseph A. Schafer, *Policing 2020: The Future of Law Enforcement Intelligence*, March 2007, 230.

[116] Ibid., 235.

It must be recognized that each agency not having an effective intelligence capacity represents a weak link in the ability of American law enforcement to share information effectively and comprehensively that will provide for stronger homeland security.[117]

New innovations in technology and information gathering are transforming policing. Emerging technologies are playing an increasingly crucial role in the daily work of frontline police officers that equips them with enforcement and investigative tools that have the potential to make them better informed and more efficient. Law enforcement use of computer technology has expanded substantially over the past two decades.[118] Given the increasing power and diminishing cost of technology, the extensive growth in mobile communication infrastructures, and the expansion of innovative applications available, computer use continues to increase in law enforcement agencies throughout the United States.[119] The implementation and operational readiness of UAS will be the next expansion of law enforcement technologies to enhance community safety.

This chapter illustrated how UAS technologies and community policing combined have the potential to not only enhance operational missions but also provide citizens with a safer community. The next chapter provides information regarding the evolution of technology and implementation efforts using strategic planning, and also includes a discussion of budgeting, integration methods and how to deal with the potential misuse of information.

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[117] Carter and Schafer, *Policing 2020: The Future of Law Enforcement Intelligence*, 226.

[118] Ibid., 72.

[119] Ibid.

IV. IMPLEMENTATION CONSIDERATIONS

To implement any technology related project, public safety agencies need to consider fully the impact of the project as it relates to both the agency and the public served. Often when projects are first considered, many aspects are overlooked and haphazardly implemented without this consideration. Areas that must be fully developed include having a strategic plan for the project implementation, understanding budgeting and cost considerations, having sound policy and procedures, and comprehending the impact of what the project will produce; in this case, the result will be usable intelligence gathered by the use of UAS. This chapter addresses these issues for implementation consideration.

It is anticipated that the FAA will reduce the restrictions on flights for the operation of UAS over urbanized areas. This reduction will include the ability to fly in darkness and over populated areas. Thus, UAS technology will be available for full implementation into public safety operational procedures. Since no fully developed program exists and policies and procedures are missing, the following are basic operational considerations for deployment and operation of UAS in an urbanized area. It is important to remember that these procedures are "guidelines." No rules or procedures can be established that embrace all situations; some issues must be left to the discretion of the individual employee. Individual styles of policing should encourage officers and employees to initiate problem-solving strategies and address community concerns. Employees must "balance" this high level of responsibility with the expectation that they adhere to the department's written policies and procedures.

During the process of developing operational procedures, the use of scenarios can be a helpful tool in the development process. Clarifying each section of the procedure is critical, as each component of the procedure must support the agencies' values and mission. Completing the scenario helps to identify the duties and functions that must be completed with each task. The day-

to-day operations of law enforcement agencies are so similar throughout the United States that it is not necessary to reinvent the wheel. Policies from other departments are an excellent resource for expediting the development process. Copies of manuals may be acquired from neighboring departments that have completed state certification or national accreditation. In addition, manuals can be obtained or requested from Internet sites, such as IACP Net. In many cases, these policies can be downloaded in an electronic format, which simplifies the editorial process. The tendency is for departments to copy manuals from other communities verbatim. This process is completely acceptable if the manual represents the department's philosophy and procedures, and is consistent with legal guidelines. However, this is usually not the case and considerable editing is usually required.

Policies from other departments are an excellent resource for expediting the development process.[120] The Appendix provides an example policy and procedure for law enforcement executives to consider when introducing UAS into an operational situation.

A. STRATEGIC PLANNING

What will be the most problematical issue concerning integration of UAS into public safety operations? Strategic, or formalized, planning is an important process for any organization regardless of its ultimate goals. The benefits of this kind of planning include more effective strategies for current and future operations, clear and concise priorities for the expenditure of scarce resources, a high probability of improving decision making based on learned information from the process, management of change, a clear picture of possible consequences, and an overall increase performance of the organization. In the end, strategic planning provides a framework for understanding and addressing complex issues in a particular organizational or programmatic context.

[120] W. Dwayne Orrick, *Best Practice Guide: Developing a Police Department Policy and Procedure Manual*, BJA Technical Assistance Program, IACP Best Practice Guides (Washington, DC: Bureau of Justice Assistance, 2006), 4.

Information technology, more specifically, the use of unmanned aircraft systems is constantly evolving. One of the difficulties is that it does so quite rapidly, which makes it very hard to control. The issue of rapidly changing technology and surveillance technology is highly problematic and continues to be more complex as it evolves into mainstream law enforcement practices. Technology by its very nature is in constant flux. New developments are steadily replacing or enhancing previous innovations. The whole reason information technologies and surveillance applications exist is to make continual improvements in the way manage and disseminate intelligence information is ingested. Change and constant design improvements drive technology and the timeline is very short. The window for opportunity on new and innovative processes is extremely short. Fundamental breakthroughs in UAS technologies are occurring at an astonishing rate. The nature of these technologies will have serious ramifications for public safety agencies in strategic planning and operational components. The primary dilemma is how does an organization plan for consistently changing and often unknown future of technology advances?

Public safety usage of UAS may soon be more widespread, as the FAA released temporary rules that make it easier for public safety agencies to obtain approval to use systems weighing less than 25 pounds for testing in emergency situations.[121] The Department of Homeland Security (DHS) also announced a program to help law enforcement agencies integrate the technology by the year 2014 principally as a less expensive and safer alternative to helicopters for reconnaissance missions. However, with this in mind, the problematic issue of IT planning for public-sector entities remains consistent. This issue is particularly important because it impacts not just managers and end users, but also systems integrators. Levels of individual expertise range widely in this new industry. Currently, the lack of a fully developed UAS program makes it very difficult for planning purposes, as no developed protocols are in use. In other words, it is very difficult to plan effectively for this technological implementation. As might be

[121] Federal Aviation Administration, “FAA Makes Progress with UAS Integration.”

expected, the lack of formalized strategic plan for UAS operations makes a planning process more problematic. The key is to create a formalized plan including policy and procedure for operational usage. The lack of a plan or the use of a purely informational plan provides little or no concrete directives for the acquisition or implementation of surveillance technologies within an organization. Concerning the nature of IT and the problems that users and managers face regarding them, it stands to reason that the lack of a plan merely aggravates an already difficult situation.

B. BUDGETING

Fiscal budgeting issues are particularly problematic to the planning process from a numbers standpoint. To begin, information gathering and surveillance technologies generate a variety of expenses. From the outset, their purchase can prove to be quite expensive, often out of the range for smaller municipalities that necessitates acquiring technology already over an extended time-line, which in turn, can create a host of compatibility, upgradability, and standardization issues. In addition, expenses accumulate due to the very nature of what could be a very steep learning curve. Insufficient budgetary planning can become a catastrophic error for any technology project and implementation. Common budgetary issue mistakes include improper licensing cost estimates, failure to plan for support or upgrade costs, improper estimates for data management, and realistic training costs. All these issues should be properly considered during the request for proposal process. The use of technology in daily public safety work is no longer a frill or option, but rather an integral part of the services provided to the community. Therefore, short-term or one-time funding of technology related resources would not suffice. While some resources may initially be obtained through grants or other one-time funds, ongoing maintenance and upgrades need to be woven into the budget for the future. This planning is imperative for core operations.

When law enforcement executives consider the use of UAS, the cost of a traditional aviation unit with all related assets needs to be examined. This traditional model is an extremely expensive proposition for small and mid-sized public safety agencies, especially if this aviation consideration is a start-up venture. A full-size helicopter can require an investment of $1.2 million for just the base aircraft, and mission ready equipment and up-fitting can add an additional $1 million.[122] These costs do not include other associated costs, such as storage and/or hangar fees, ongoing maintenance, and both flight crew and maintenance crew training and salaries.[123]

As these costs relate to UAS operations, most models in the micro/mini classification are battery powered, and utilize rechargeable batteries that would relieve any costs associated with fuel. Training costs are reduced for both flight and maintenance crews, and there is no cost for hangars or aircraft storage. Once the initial purchase of the UAS has been completed, very few on-going costs are associated with the operation.[124] Figure 4.1 provides an illustration of a fully integrated UAS rotary system. This particular model is the Aeryon SCOUT developed by Aeryon Labs, Inc. This illustration also shows the compact nature of the device.

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[122] Doug Wyllie, "Police UAV Pilot: A Career Path Less Traveled By," Professional, *PoliceOne.com*, May 17, 2012, http://www.policeone.com/airborne-maritime/articles/5558534-Police-UAV-pilot-A-career-path-less-traveled-by/.

[123] Ibid.

[124] Ibid.

Figure 4.3. Fully integrated UAS system. Aeryon SCOUT by Aeryon Labs, Inc.[125]

Public safety agencies should expect to pay about $200K for a reliable fully outfitted unmanned aircraft system. This cost normally includes operator training and one to two years of maintenance on the device. In contrast, the on-going cost of a helicopter can range from $1,500—$3,000 per flight hour, depending on the make/model of the aircraft, operating environment, and other variables.[126]

[125] Aeryon Labs Inc., "Aerial Vehicle Systems—SCOUT," *Aeryon Labs Inc*, August 8, 2012, http://www.aeryon.com/products/avs.html.

[126] Wyllie, "Police UAV Pilot: A Career Path Less Traveled By."

C. INTEGRATION

The implementation of remote-controlled vehicles for public safety operations is not a novel approach. Tools, such as robots, or so-called unmanned ground vehicles (UGV), have been utilized throughout law enforcement operations for many years, and especially by bomb squads for bomb removal and detonation. These devices have manipulative arms, cameras and sensors, and have proven to be a useful tool in tactical situations. Thus, the transition to utilizing UAS could possibly be seamless in like settings. UAS will also have the same capabilities with cameras and sensors but have the capabilities of gathering intelligence information from an aerial perspective.[127] UAS have the potential to increase officer safety and efficiency, and thus, become a force multiplier in providing more "eyes and ears" within the community to enhance the perception of public safety.

> The typical patrol officer of 2020 might be equipped with a multipurpose UGV and a small UAV carried in or on the patrol car for use in a wide range of circumstances. A quick with the camera, sensors and even less lethal weapons, the officer might employee either the UGA or UAV or both at traffic stops to better observe the interior of vehicles. Handling domestic disturbances might become safer by allowing officers at the scene to track and monitor multiple suspects with close proximity, warning them of any dangerous movements or actions of participants they may be unaware of. In cases where large numbers of people have gathered the UAV might identify and then warned the officers if one or more of the participants was approaching from behind or fleeing the area. The UGV might then position itself to help prevent that person from attacking were fleeing.[128]

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[127] Cyrus Farivar, "What's Next; A Flying Crime Fighter (Some Assembly Required)," *New York Times*, January 13, 2005, Internet ed., sec. Technology.

[128] Cowper and Schafer, *Policing 2020: Information Age Technology and Network Centric Policing*, 85.

The most obvious benefit to the rotary winged style UAS is the ability to hover. This vertical capability enables the UAS to hover and stare, as well as linger over a target.[129] A fixed-winged UAS would need to orbit around a target location to achieve this same operational tactic.

Vertical Take-Off Landing (VTOL) (rotary styled) UAS have the associated benefit of being able to fly to a target area and land on an elevated surface like a rooftop, where the rotor system can then be powered off.[130] The camera attached to UAS can still continue to gather information while conserving the flight operation battery life. This "perch and stare" capacity is most useful in a prolonged or stagnate tactical operation.[131]

Privacy and civil rights groups are making strong assumptions and predications that the use of UAS will violate search and seizure rights.[132] They suggest that law enforcement agencies are going to have the ability to float surveillances above private homes to watch inhabitants sleep or eat. The concept of CCTV citywide surveillance is already in process. The surveillance keeps an eye on public areas; the worn system was developed to handle situations in which the plain sight of the eye can look in private spaces. No new development with unmanned aircraft systems is occurring in the terms of the gathering a collection of evidence for the purposes of criminal prosecution. Already well-established laws address obtaining and using evidence through aircraft and sensors on aircraft case decisions.

D. MANAGERIAL CONTROLS

Acceptable controls remain the most important tie between the community's trust in their government and successful implementation of UAS surveillance systems for the public's territory. People want to trust that the

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[129] Wyllie, "Police UAV Pilot: A Career Path Less Traveled By."

[130] Ibid.

[131] Ibid.

[132] Whitehead, *Drones Over America: Tyranny at Home*.

government agents will act in a manner that protects their civil rights. If events occur in which the trustworthy person violated the social contact between government and its citizens, technologies will be rejected. Management controls must be established to protect the citizens. The following elements can provide the organization procedures for controlling the behavior of employees and prevent mistakes that result in organizational embarrassment.

- **Appropriate supervision**—strong supervision should always be present whenever surveillance camera operations are activated
- **Individual administrator**—a management employee should be designated as the person responsible for UAS operations and be held personally accountable for the actions of the surveillance system employees
- **Limited access**—the video control room should be off limits to unauthorized personnel
- **Privacy separation**—the video control room must be physically separated from all other functions to ensure privacy and protect the integrity of the operation
- **Control log**—a log should be maintained at the video control center indicating the employees and supervisors working, documenting any unusual incidents, recording reasons for manual overrides of cameras, noting requests for information or copies of images, listing of all persons gaining access to the video center
- **Confidentiality agreement**—all operators should be required to sign an agreement acknowledging an understanding of the operational policies, image release standards, and behavior requirements
- **Custody chain**—recorded images must be handled in such a manner as to prevent challenges to their authenticity, procedures should be initiated to maintain security of the DVD, hard drive or other storage format, and the number of persons handling the recorded images should be kept to a strict minimum
- **Electronic protection**—recording formats should have watermarking, encryption or some other technological method of verifying video authenticity

- **Written policy**—as with all other important programs instituted within an organization, the guidelines must be known to the employees to reduce liability and provide direction[133]

E. INTELLIGENCE—NOBLE CAUSE CORRUPTION

One last issue that law enforcement administrators need to consider fully is the handling of intelligence information. The possibility always exists that officers will use information in a manner that will violate department policy, or even worse, the law. The idea of noble corruption is when officers misuse intelligence for the short-term goal of making a case, when the more severe consequence is the loss of public trust due to the violation of ethical standards entrusted to law enforcement.

Law enforcement officers pledge to protect and serve, and that oath involves stringently obeying the constitutional procedures described within the Bill of Rights. Nevertheless, the possibility does exist that officers can rationalize privacy violations in an effort to achieve "the desired ends."[134] Law enforcement administrators and trainers need to speak to the intelligence scenario wherein *noble cause corruption* may occur to inform their personnel assigned to intelligence units better.[135]

Noble cause corruption in policing occurs when officers bypass the profession's compulsory constitutional constraints. The Fourth Amendment protects citizens from "unreasonable" governmental intrusions into their private lives to prevent subjective and mischievous police activities. Noble cause corruption is a felony, not a misdemeanor, because it is an abuse of police powers, "it is the corruption of police power when officers do bad things because

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[133] Thomas J. Nestel, III, "Using Surveillance Camera Systems to Monitor Public Domains: Can Abuse Be Prevented?" (master's thesis, Naval Postgraduate School, 2006), 64–65.

[134] Thomas J. Martinelli, "Dodging the Pitfalls of Noble Cause Corruption and the Intelligence Unit," *The Police Chief* LXXVI no. 10 (October 2009): 1.

[135] Ibid.

they believe that the outcomes will be good."[136] It is not a "bending" of the constitutional rules, as some may try to suggest, but rather a breaking of those rules in an effort to obtain the upper hand on society's terrorist and criminal elements.[137]

The ACLU stresses national implementation for the intelligence-sharing environment that offers all populations the ability to retreat from unreasonable governmental intrusions.[138] Without such guidelines, secrecy and abuses are bound to occur.[139]

An example of noble cause corruption involved the Los Angeles County Terrorism Early Warning Center.[140] Two military analysts with access to highly sensitive intelligence data pled guilty to a myriad of charges in a military tribunal, with the most severe charge being "mishandling classified material and stealing government property."[141] These perpetrators of intelligence leaks involved both active duty military and law enforcement personnel. The military analysts confessed that they shared classified materials with local law enforcement personnel to conduct covert surveillance of suspected terrorist cells in their own police jurisdictions.

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[136] John P. Crank and Michael A. Caldero, *Police Ethics: The Corruption of the Noble Cause* (Cincinnati, OH: Anderson Publishing Company, 2009).

[137] Martinelli, "Dodging the Pitfalls of Noble Cause Corruption and the Intelligence Unit," 1.

[138] Caroline Frederickson, *Protecting National Security and Civil Liberties: Strategies for Terrorism Information Sharing* (Washington, DC, 2009).

[139] Martinelli, "Dodging the Pitfalls of Noble Cause Corruption and the Intelligence Unit," 4.

[140] Ibid., 5.

[141] Rick Rodgers, "Former Marine Outlines Secret Dossiers: Muslims, Arabs Not Targeted, FBI Says," *The San Diego Union—Tribune*, Metro ed., November 17, 2008, http://www.uniontrib.com/uniontrib/20081117/news 1m17maziarz.html.

> Addressing noble cause corruption issues in the intelligence field is no different than addressing corruption issues in any other law enforcement specialty. The challenge is always balancing an officer's individual passion for fighting crime and protecting citizens, with the constitutional controls and restraints necessary to protect the target citizen's privacy rights.[142]

The professional law-enforcement officer must balance a passion for crime fighting with respect for the constitutionally imposed restraints. It is in the job description and the oath of office.[143]

F. SUMMARY

Within the planning and implementation process, an understanding and acceptance must exist that UAS do have vulnerabilities. Like all computer devices, UAS are subject to unauthorized intrusions; thus, the possibility arises that they can be "hijacked" without proper security controls in place. A research team from the University of Texas at Austin preformed a test on June 25, 2012 using a small UAS helicopter manufactured by Adaptive Flights. During this test, the research team was able to "hijack" the UAS by a practice known as "spoofing."[144] The hijacking process is completed by sending a false signal to the UAS's GPS receiver that allows the "spoofing" party to take control of the UAS and redirect the flight pattern.[145] The UAS tested for this experiment did not have encrypted radio signals, which is a standard protocol in military applications. This lack of encryption left these UAS open to radio signal interception. Professor Todd Humphrey who led the experiment warns government officials that this vulnerability must be addressed before UAS are allowed to have broad access to U.S. airspace.[146]

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[142] Martinelli, "Dodging the Pitfalls of Noble Cause Corruption and the Intelligence Unit," 4.

[143] Ibid.

[144] Kevin Smith, "Concerns Arise That Civilian Drones Can Be Hijacked," *LA Daily News*, August 11, 2012, http://www.dailynews.com/breakingnews/ci_21292221/concerns-arise-that-civilian-drones-can-be-hijacked.

[145] Ibid.

[146] Ibid.

Planning for change is part of the process for implementing new technologies. As discussed earlier, community policing is a process designed to adjust to change as it improves community services. The law enforcement agency moving forward with UAS will need to plan for potential resistance from employees and be aware of fears employees might have. Regardless of the benefits, the new UAS project might bring to the community, the possibility does exist that some employees might fear that job security will be threatened with the implementation of UAS, which is especially true for law enforcement aviation professionals. Change as simple as a digital camera attached to a small remote-controlled helicopter can cause serious concern from fearful or uninformed end users. Public safety executive need to be cognitive of this issue to look for any warning signs of employee anxiety during the implementation process, and if detected, address them immediately. Nothing can destroy the implementation process faster then fearful or uninformed end users. Training can serve to increase individual expertise levels if approached properly.

Just as important, internal leadership must be present and supportive of change. Without a foundational understanding of the technology being implemented, it is impossible for administrators to understand and deal with the problems and subsequent resistance inherent in change. In the next chapter, several recommendations are presented to form a usable course of action to allow for integrating UAS into a modern policing urban environment.

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V. CONCLUSION

A. REVIEW

This thesis explored the potential use of military UAS in civilian law enforcement and public safety applications. The technology reviewed is in existence and has been used in combat missions by the U.S. military. Even with all the potential advantages to public safety, clear direction from the FAA does not yet exist as to when flights over urbanized areas might be approved. Currently, no fully developed UAS operational deployments are occurring, nor have fully developed policies and procedures in urbanized areas within the boarders of the United States been implemented. The FAA has issued several temporary COAs to law enforcement agencies under very limited operational guidelines that include no night flights or flights over populated areas. Substantial FAA regulations and processes need to be understood by policy makers as UAS are introduced into operational activities in domestic airspace.

Even though on March 29, 2012 the FAA has been authorized to "allow government public safety agency to operate an unmanned aircraft weighing 4.4 pounds or less" under certain restrictions,[147] the authorization states that UAS must be flown within line of sight of the operator, less than 400 feet above the ground, during daylight conditions, inside Glass G (uncontrolled) airspace, and more than five miles from any airport or other location with aviation activities.[148] Even with this change, the FAA is still reluctant to allow controlled test flights in urbanized areas. In August 2012, the Los Angeles County Sheriff's Department attempted to test fly UAS within the County of Los Angeles. It planned to test drones on a movie set in Downey designed to look like a suburban street, but the FAA would not allow it to fly so close to other commercial air traffic. FAA officials also rejected a plan to fly unmanned planes over the Port of Long Beach to

[147] Federal Aviation Administration, "FAA Makes Progress with UAS Integration."

[148] Ibid., 2.

ascertain whether they could duck under the morning fog layer to track small boats that might smuggle drugs or attack a ship.[149] Thus, no comprehensive testing was conducted.

The evolution of UAS technology is not a new process. The development and reliability were always a concern. With the advancement of technology and continued enhancements over the past 20 years, safety and reliability have increased dramatically. Unfortunately, as mentioned earlier, the small UAS have been viewed as disposable pieces of equipment during combat missions in the military, and thus, misrepresent or skew information related to flight safety.[150] The usefulness of UAS has been proven repeatedly during the military conflicts in Iraq and Afghanistan. This proven combat ability to gathering intelligence during military conflict certainly has a potential role in assisting local public safety to complete their expanded role in homeland security.

A scarcity of programs exists in a law enforcement or urban public safety setting either domestically or internationally but are available to examine for the civilian development of UAS. Therefore, military applications were analyzed and placed into context for a realistic application.

Information gathered by the means of utilizing UAS needs to be actionable intelligence. It also needs to be obtained in a manner that will benefit criminal investigations and in conformity with practices that meet the standards of legal retention and proper preservation for evidential purposes. Even with the assumption of FAA allowance, community safety is of the upmost importance. Each operator will be required to complete a comprehensive training program conforming to all FAA operational requirements. Legal and regulatory issues in regards to public and administrative laws will continuously be compared and

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[149] Homeland Security News Wire, "UAVs Law-enforcement Technology," *Homeland Security News Wire*, August 8, 2012, http://www.homelandsecuritynewswire.com/dr20120808-drones-used-by-police-firefighters-raise-privacy-concerns.

[150] Weinberger, "Border Patrol Drones Plagued by High Accident Rate, Pilot Shortage."

contrasted to the benefit of public security; while at the same time, ensuring no perceived governmental intrusion occurs.

UAS offer an aviation alternative to law enforcement agencies for a low-cost, low risk aerial surveillance to that of traditional helicopters. UAS provide for the opportunity to capitalize on military technology in the areas of surveillance, communications, and advanced optical cameras. Areas to benefit law enforcement are crowd control/demonstrations, tactical operations, criminal apprehension, narcotic activities, and search and rescue missions. However, in doing so, special consideration needs to be taken to safeguard constitutional rights of privacy and violations of search and seizure rights. Even more importantly, it is essential to safeguard and use the information and intelligence obtained by using UAS properly and legally.

Certain types of information from UAS, such as thermal imaging, could raise the most significant privacy concerns because they are capable of penetrating ceilings and capture images of activities and heat sources inside a building.[151],[152] Public perception of UAS implementation has been mixed as either an intrusion of government or as a means of providing public security. As discussed, surveillance technologies have the potential for both increased security measures and abuse. These competing interests need to be recognized by policy makers and law enforcement managers for successful implementations of UAS into local public safety operations.

B. RECOMMENDATIONS

The FAA needs to define and provide standards and regulations by which civilian use of UAS can be tested and eventually deployed for operational use in the NAS. Many public safety agencies within the state and federal government

[151] Geoffrey Christopher Rapp, "Unmanned Aerial Exposure: Civil Liability Concerns Arising from Domestic Law Enforcement Employment of Unmanned Aerial Systems," *North Dakota Law Review* 85:623 (2009): 631–632.

[152] U.S. Court of Appeals—Ninth Circuit, *Kyllo V. United States*.

can benefit from the use of UAS technologies. This author fully supports the position that UAS should be widely used for the purposes of enhancing local law enforcements abilities to increase community safety. FFA staff estimates that there are “50 companies, universities, and government organizations that are developing and producing some 155 unmanned aircraft designs” for use in the NAS for civilian purposes.[153]

Based on the research to address both the primary and secondary questions of this thesis, three recommendations for consideration are made. The first recommendation is that the FAA develops meaningful changes to allow for “small” UAS use within the NAS. A significant latent demand exists for the ability to operate UAS for a variety of applications in civil airspace. However, a lack of federal regulations has been a barrier to achieving routine operation in the NAS. Current federal rules governing unmanned aircraft are limited in scope to recreational model aircraft, unmanned balloons, kites, and rockets. Any UAS flight in the NAS not governed under the existing rules must be individually approved through a COA, a process for exemption from current regulations. The process was originally utilized for non-routine military UAS operations in civil airspace. It is, therefore, lengthy and inefficient when applied to many civil operations and requires detailed review and approval by FAA authorities for each individual flight to be conducted in the NAS.

1. The United States should form a formal collaboration between government and private sector as done in Canada.
2. The FAA should establish regulations for the use of miniature UAS by local municipalities to enhance public safety. These regulations and processes shall fall within a visual range operation with FAA oversight.
3. Legislation should be enacted to increase funding for the FAA for both the governmental and commercial use of unmanned aircraft systems within civilian airspace.
4. The policies and procedures of the FAA should be enacted that allow for the usage of unmanned aircraft that considers the form, fit,

[153] Federal Aviation Administration, “Fact Sheet—Unmanned Aircraft Systems (UAS).”

> and function, in addition to mission profile of the device being used, and should be consistent with the overlying regulatory airspace classifications for certification and operation.

The combined action of regulatory agencies, UAS manufacturers, and research into enabling technologies is expected to result in a significant increase in civil UAS operations in the future. The character and scope of UAS operations will depend upon the regulatory requirements placed on civil UAS systems. With their potential utility for a variety of applications, it is in the public interest to achieve the full potential benefit of UAS operations, while maintaining an acceptable level of safety.

The second recommendation is that further technological development of the UAS be continued. The advantages that this particular technology can bring about can be essential for future applications and utilization and public safety. It is also recommended that the most advanced technology be applied to the programs involved in developing these UAS. In such case, the safety and security in its application can be achieved through in-depth research using the most advanced machinery and techniques. The advantages that UAS could deliver cannot be ignored. Therefore, it is important that all governmental agencies involved work together to ensure the success of all UAS-related programs.

In regards to this second recommendation, a greater need exists than just moving forward with the technology. More importantly is the aspect of community policing and continued public trust. This recommendation includes the need for community engagement and continued partnerships. For the community to accept and embrace this technology, the community will need to understand fully the benefits of UAS as they relate to increased public safety to include an educational component, which outlines the policies and procedures related to the use and deployment of UAS. The agency needs to make a strong statement on the importance of privacy rights; thus ensuring the community that all UAS uses will comport with constitutional rights related to search and seizure laws.

The third recommendation is the use of proper strategic planning and the creation of policies and procedures for the implementation of UAS into the public sector. Understanding technologies is an important key to the effectiveness of the entire implementation process, as is the understanding of the budgeting and procurement processes. Local governments, which do not make use of a strategic plan for UAS implementation, run the risk of investing in technologies that may not prove to be viable in the long term. In addition, the lack of a plan might foster other problematic issues. Failure to engage in a formal planning process may ignore many of the factors, which could enhance or hinder UAS implementation.

Interdepartmental coordination may be ignored, which could result in multiple standards, poor integration of systems, duplication of efforts and resources, as well as a failure to meet individual and organizational needs. When strategic planning is used, system purchases may be planned over time and advance planning for costs may facilitate investments, which support the eventual goals of the municipality. Strategic planning is critical to the effective design and implementation of information technologies and surveillance applications within a public safety organization.

The public safety organization and its administrators must view strategic planning for UAS implementation as a necessity and not as an option. To achieve this level of commitment, significant changes in the organizational environment, including its leadership and management processes, may need to be enacted. This perception of IT planning importance is really a top-down view of organizational goals.

Any information gathering implementation is a major undertaking of the organization and requires a substantial investment of effort, time, and money that necessarily requires firm backing and support of top management, not just on the outset, but also from the initial planning stages through the completion of implementation. Organizational leaders must be committed to obtaining necessary funding, as well as taking an active role in the development an

implementation of the systems to include the creation of strong policies and procedures. The Appendix provides a sample policy that can be incorporated into the planning and implementation process for UAS.

C. SUMMARY

The unlimited potential of unmanned aircraft systems within the homeland security enterprise is going to be a force multiplier for private industry to make further capital investments in the development and advancement of technologies of UAS. Beyond homeland security, the lead to commercial use is visible on the horizon. The evolving abilities of UAS are capturing the attention in the civilian field, potentially opening a new and lucrative market. UAS have potential use as communication nodes, such as temporary cell towers, during times of disaster and as news media platforms for long-term persistent events and for monitoring transportation of hazardous materials and logistical supplies. This potential market will not be far behind when governmental use is widespread in the unmanned aircraft venue.

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APPENDIX. SAMPLE POLICY AND PROCEDURES

As stated in Chapter IV when referring to the writing of policies and procedures, police operations are similar throughout the United States. It is not necessary to reinvent the wheel. Policies from other departments are an excellent resource for expediting the development process. The following best practice example is a combination of several draft UAS policies derived from the Riverside Police Department,[154] Miami-Dade Police Department,[155] and Mesa County Sherriff's Office.[156]

A. EXAMPLE BEST PRACTICE POLICY AND PROCEDURE

1. Policy

The use of UAS by the Anytown Police Department Aviation Unit is expected to enhance, not replace manned aircraft operations. While UAS operations for specific mission capabilities that make the use of this device is advisable in some tactical operations, they currently lack the flexibility available to manned aircraft. Depending on the tactical situation, UAS operations may be integrated with manned aircraft operations to provide the most successful response. UAS can be used to carry sensing equipment. The UAS and sensing equipment will be used by a trained operator in a manner consistent with current accepted standard operating procedures (SOP) and manufacturers' recommendations. Due regard should be used with respect to safety and the observance of any laws pertaining to the equipment use.

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[154] Sergio G. Diaz, Chief of Police, "Riverside Police Department," *Riverside Police Department*, August 1, 2012, http://www.riversideca.gov/rpd/.

[155] James Loftus, Director/Chief of Police, "Miami-Dade Police Department," *Miami-Dade Police Department*, August 1, 2012, http://www.miamidade.gov/police/.

[156] Stan Hilkey, Sheriff, "Mesa County Sheriff's Department," *Mesa County Sheriff's Department*, August 1, 2012, http://sheriff.mesacounty.us/.

2. Mission

The mission of the UAS program is to provide tactical aerial support and assistance to the Anytown Police Department SWAT in high threat situations in which the operating environment is hazardous to manned flight to include, but are not limited to, subjects armed with high-powered weapons or hazardous materials. The UAS program will also be an asset for other divisions within the department, such as patrol and investigations.

3. Definitions

Acrobatic flight: unintentional maneuver involving an abrupt change in aircraft altitude, an abnormal attitude, or abnormal exhilaration not necessary for normal flight.

Aircraft: a device that is used or intended to be used for flight in the air.

Airplane: an engine driven, fixed wing aircraft, heavier than air, that is supported in flight by the dynamic reaction of the error against its wings.

Air Vehicle: refers to the vertical takeoff and landing aircraft portion of the UAS.

Avionics pod: contains the UAS global positioning system and battery to power UAS operations.

Confined area: any area where flight of the UAS is limited in some direction by terrain with the presence of obstructions, natural or man-made.

Emergency: any situation posing an immediate threat to life or property.

Equipment: any equipment used by the UAS unit.

External load: a load that is carried, or extends, outside of the UAS fabricated body.

FAA: Federal Aviation Administration.

Flight plan: specified information relating to the intended flight of aircraft or aircraft system filed orally or in writing within FSS or an ATC facility.

Flight time: the time from the moment the aircraft first moves under its own power for the purpose of flight until the movement comes to rest at the next point of landing.

Gross weight: the total weight of the aircraft and its contents.

Ground Control Station (GCS): consists of the Operator Control Unit (OCU), Ground Data Terminal (GDT) and associated cables and tennis. This GCS provides the interface between the Pilot in Command (PIC) and the UAS.

Ground Data Terminal (GDT): contains the necessary equipment for the communication links between the UAS and the OCU for both data and video. Also contains a Global Positioning System (GPS) to enable the operator to determine the systems location.

Ground visibility: the prevailing horizontal visibility near the earth's surface as reported by the U.S. National Weather Service or an accredited observer.

IP: Instructor Pilot

Maneuver: any planned motion of an aircraft in the air or on the ground.

Observer: responsible for the visual observation of the UAS while in flight.

Operation Control Unit (OCU): consists of a laptop computer (ruggedized) with a touchscreen capability utilized to control the system and provide data and video transmitted by the UAS.

Liaison: the liaison officer will lay eyes on with the SWAT personnel on behalf of the UAS unit.

Payload Pod: consists of two portions. The upper portion contains the radio and antenna for command and control communications. The lower portion contains the camera and antenna for video signal downlink.

Pilot In Command (PIC): the person directly responsible for the operation of the UAS and described by Federal Aviation Regulations (FARS) 91.3.

Safety Officer: responsible for providing support during UAS operations.

SOP: Standard Operating Procedure.

UAS: Unmanned Aircraft Systems.

4. Procedure

All sworn members of the Anytown Police Department can make a request for the deployment of the UAS unit by contacting the unit supervisor. The primary operator or PIC assigned to that appointment will gather the information pertaining to the request and determine if UAS can be deployed safely and practically. Factors to be considered whether (both current and forecast), location, time of day, population density of location and suitability for landing and take off points. Safety is a primary operational consideration. If deployment is appropriate, the PIC will make any necessary notifications needed for the operation.

5. Organization

a. Equipment

UAS and their related support equipment will be stored at an aviation facility whenever possible.

b. Unit Compliment

A team consisting of a minimum of four members will operate the UAS. Each member of the team will be assigned a specific role during UAS operations. Roles may be rotated when more than one flight will be completed during an operation. Each member should be clearly designated with an assignment prior to any flights taking place.

c. Qualifications

UAS operators/team members must be certified in the operation of UAS by successfully completing a manufacture approved training course or by completing training conducted by Anytown Police Department instructor pilots (IP). They must meet the standards required by the FAA (possess a valid 2nd class or higher medical certificate, must pass required knowledge test for private pilot certificate, and must keep their aeronautical knowledge current). Additionally, they must meet the minimal department standards on the last fitness report with approval of unit supervision.

6. Duties

Pilot in Command (PIC): the PIC will function as team leader and operator of UAS. The PIC will be alternately responsible for the operation and solely responsible for input of commands/piloting of UAS during flight. The PIC will be responsible for GCS assembly, GCS flight preparation, GCS post flight procedures, and GCS disassembling and storage. Additionally, the PIC will appoint the observer and safety officer at his discretion.

Observer: the observer maintains a visual observation of the UAS while in flight and alerts the PIC of any conditions (obstructions, terrain, structures, air traffic, weather, etc.) that affect the safety of the flight. Additionally, the observer will be responsible for all aviation related communications required by FARS. To accomplish this task effectively, the observer will be in close proximity to the PIC to ensure instant relaying of information. The observer will also assist the safety officer in completing his functions.

Safety Officer: the safety officer will complete all ground operations regarding the UAS to include assembly, mixing fuel, fueling, de-fueling, tuning, and launch preparations. During flight, the safety officer will ensure that the operations area remains secure and that the PIC and observer are not interrupted.

Liaison Officer: the liaison officer will be a UAS supervisor whose function is to provide a conduit of information and requests from the SWAT team. As a liaison officer may not be physically located with the other UAS unit members, communications will be paramount. The PIC will have discretion as to which team member will monitor police communications with the liaison officer during UAS operations as any requests for UAS to perform a specific function will be communicated to the PIC via the liaison officer.

B. SAFETY OF OPERATIONS

- Safety of UAS operations (including persons and property) is the responsibility of the entire unit. UAS team members should bring to the attention of other members any conditions that they feel is a safety concern.
- Except as required by the mission, all UAS unit members will ensure that no persons are in the vicinity of UAS during operations to avoid flying over non-hostile persons or vehicles.
- Under no circumstances shall UAS be utilized directly over large gatherings of people, as a chase vehicle in a vehicle pursuit or operated from a moving vehicle.
- UAS unit members will comply with the operators' manual, warning, limitations, placards, and/or checklists at all times unless emergency dictates otherwise.
- UAS PICs are authorized to evaluate and accept or decline any mission or portion thereof that compromises the safety of operations.
- All UAS unit members will be familiar with the COA and attachments that relate to the operation of UAS and comply with same.

1. Normal Operations

a. Operations Area

The operation area selected by the UAS unit shall be located within a secure perimeter, whenever possible. The area should be evaluated for adequate space and clearance to safely assemble, launch, and recover UAS.

Attention should be given to the overhead obstacles and obstructions that may pose a risk to UAS during operation. The site selected and utilized by the UAS unit should be respected and access granted to personnel for operational purposes only.

b. Pre-Flight Procedures

A pre-flight check of the UAS (including tuning if necessary) will be completed in accordance with the manufacturer's recommendation and applicable FARs utilizing the UAS checklist and GCS preparation for flight log.

c. Communications

- All radio communications required by the FAA will be complied with.
- Communications with UAS unit members during operations will be limited to operationally necessary communications to minimize disruptions to UAS unit members.
- If applicable, prior to any UAS operation, the PIC will ensure that all supervisors on scene are aware that UAS will be launched. Flight operations will not be conducted if SWAT team members are utilizing electronic countermeasures equipment.

d. Flight Operations

- UAS shall be operated in accordance with manufacturer specifications and applicable FAA limitations and restrictions.
- Care shall be taken in the operation of UAS to avoid overflying persons and properties that could result in injury or damage whenever possible.
- A copy of the current valid COA shall be present whenever UAS operations are conducted.
- The loss link response shall be set to rally point and maximum altitude set in accordance with the altitude limit of the COA.
- For all operations, observers shall utilize a distance from UAS that will adequately permit them to maintain a visual observation on UAS while maintaining a safe distance.
- All UAS unit members will comply with all limitations and restrictions in requirements as enumerated in the COA.

e. Post-Flight Procedures

A post-flight check of the UAS will be completed in accordance with the manufacturer's recommendation and applicable FARs utilizing the post flight checklist. UAS shall then be prepared for redeployment or for disassembly and storage.

f. Documentation

The PIC shall be responsible for the completion of the Vehicle Time Tracking Form following each flight. Each flight will be listed on the Vehicle Time Tracking Form along with the PIC, the flight time and engine time for purposes of maintenance, proficiency and reporting and/or documentation to the FAA.

2. Emergency Procedures

Emergency procedures stated in the manufacturer's operations manual shall be complied with for all UAS operations.

a. Loss of UAS Flight Control

UAS lost link procedures shall be set for 15 seconds to the rally point response that shall automatically cause the UAS client to its ceiling altitude and return to and land at the launch site. If positive control of UAS cannot be maintained, and are leaving the operation area or pose a risk to life and/or property, the PIC will issue an Engine Kill command.

b. Loss of UAS Visual Contact

If visual contact with UAS is lost, the PIC shall command the aircraft into a hover mode and the observer shall try to reestablish visual contact. If the visual contact cannot be reestablished within a reasonable amount of time determined by the PIC, then a lost link procedures shall be executed.

c. Loss of GPS Signal

Should UAS lose GPS signal during autonomous operations, the PIC must immediately command UAS into manual mode and land as soon as practical. If positive control of UAS cannot be maintained and are leaving the operational area or pose a risk to life and/or property, the PIC will initiate an Engine Kill command.

d. Loss of Power (Engine Failure) or UAS Crash

In case of an engine failure, UAS will not be able to maintain flight. UAS unit members will immediately attempt to locate UAS, assess the scene for injuries, and render first aid if necessary.

3. Training/Proficiency

a. Initial Training

Initial UAS training will be accomplished by manufacturer personnel or UAS instructor pilots who have completed a training course established for this purpose.

b. Reoccurring Training

Operation permitting, UAS training will be conducted on a regular basis by all certified personnel. The training will consist at a minimum of one takeoff and landing event to meet proficiency requirements. UAS certified personnel not able to attend a training session would attempt to make up the session at the earliest possible opportunity. The intent is to have UAS pilots maintain certification to be properly prepared for missions.

c. Proficiency

All UAS pilots will maintain proficiency in UAS to be readily available for assignments as a UAS unit member. Proficiency for UAS operations

will consist of three takeoffs and landings events within at least 90 days prior to acting as a PIC. If UAS pilots are not current, they must notify their immediate supervisor and will not be eligible to operate the UAS as a PIC until they regain proficiency ratings.

d. Training Site

UAS training will only occur at a site designated and approved by FAA for such purposes.

e. Training Notifications

In compliance with FAA COAs, which have been issued to the Anytown Police Department, notifications will be made to the appropriate FAA facility prior to UAS operations. Additionally, notifications deemed appropriate for airship safety purposes will also be made to the ATC tower controlling the affected airspace.

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