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THESIS

**CONSIDERATIONS FOR DOMESTIC LAW
ENFORCEMENT IMPLEMENTATION OF A UAS
PROGRAM IN THE PROPOSED FAA REGULATORY
ENVIRONMENT OF INTEGRATION INTO THE
NATIONAL AIRSPACE SYSTEM**

by

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December 2015

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IMPLEMENTATION OF A UAS PROGRAM IN THE PROPOSED FAA
REGULATORY ENVIRONMENT OF INTEGRATION INTO THE NATIONAL
AIRSPACE SYSTEM**

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ABSTRACT

This thesis identifies the potential future mission profile of an unmanned aircraft systems (UAS) program within a domestic law enforcement agency after implementation of UAS regulations, a task currently in progress by the Federal Aviation Administration (FAA).

First, the author reviews current academic literature and provides analysis on key policy issues of safety, the transfer of risk, and constitutional rights. Then, the author consults the knowledge and experience of individuals responsible for the integration architecture of UAS through an IRB-approved online survey. The survey of these subject matter experts using the Delphi method resulted in the following recommendations:

- early public engagement and transparency for intended UAS use by law enforcement
- a policy framework that addresses safe operation and privacy
- further investment in “sense and avoid” technology
- the development of a comprehensive UAS training program

This academically rigorous consultation provides law enforcement executives and elected officials the policy implications of initiating a new UAS program and the groundwork to assess existing UAS programs.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACLU	American Civil Liberties Union
ALEA	Airborne Law Enforcement Association
AUVSI	Association of Unmanned Vehicle Systems International
CBP	Customs and Border Protection
DPT	Department of Transportation
FAA	Federal Aviation Administration
GAO	Government Accountability Office
IACP	The International Association of Chiefs of Police
NAS	National Airspace System
UAS	unmanned aircraft systems

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EXECUTIVE SUMMARY

Written in 1948, George Orwell's *Nineteen Eighty-Four* prophesied a totalitarian nightmare, one specter of which was a police patrol helicopter that skimmed down between the roofs like a small blue bottle and snooped into windows. That capability is now reality. U.S. law enforcement agencies, leveraging a decade of military combat success, are considering the implementation of unmanned aircraft systems (UAS) programs. Communities big and small have grown accustomed to both helicopters and planes of different sizes, weights, and speeds crossing the sky above them. However, it has been and continues to be a challenge to integrate UAS into airspace designed for manned aircraft and rules written from a legacy framework. In 2008 and 2012, the Government Accountability Office (GAO) insisted that the United States “develop a clear and common understanding of what is required to safely and routinely operate UAS in” the National Airspace System (NAS).¹ Congress also recognized the importance of UAS integration with the enactment of the FAA Modernization and Reform Act of 2012.²

The policy discourse related to UAS integration is technically, legally, and politically complex. Placing UAS in the hands of law enforcement has become a flashpoint, triggering intense debates for an American public concerned with losing privacy and pieces of humanity to UAS in the sky, a framework described in Orwell's fictional prophecy. There is an opportunity to not only expand UAS capabilities, but also assuage fears if law enforcement leaders properly construct and execute UAS policy.

Domestic UAS use, specifically by law enforcement, represents uncharted policy territory. While there is a solid body of knowledge on aviation principles, airspace management and the legal constructs that will most certainly be involved in the policy development, additional research on the use of UAS after proposed integration into the NAS for domestic law enforcement operations is warranted. This will allow law

¹ Government Accountability Office (GAO), *Unmanned Aircraft Systems: Federal Actions* (GAO-08-511) (Washington, DC: GAO, 2008); Government Accountability Office (GAO) *Unmanned Aircraft Systems Measuring Progress and Addressing Potential Privacy Concerns Would Facilitate Integration into the National Airspace System* (GAO-12-981) (Washington, DC: GAO, 2012).

² Federal Aviation Administration Modernization and Reform Act of 2012, Pub. L. No. 112-95, 2012.

enforcement executives and elected officials to make informed decisions when determining whether a UAS program is appropriate for the community they pledge to protect. Within the homeland security enterprise, a UAS program has unlimited potential. However, concerns for safe operation, integration into NAS, the transfer of risk and liability to autonomous unmanned systems, and debates on constitutional rights raise questions as to whether UAS are appropriate for law enforcement, and if so, under what policy frameworks.

This researcher sought to identify knowledge gaps and find answers to important UAS policy questions that law enforcement executives are considering while attempting to leverage technology to achieve greater efficiency and effectiveness in the face of dwindling resources and growing demands for service. The questions addressed:

- How might the integration of UAS under the FAA's *Integration of Civil Unmanned Aircraft System NAS Roadmap*³ affect their use by law enforcement?
- How will new regulations address the issues of safety, liability, and privacy. UAS technologists have focused on expanding their capabilities by developing more diverse functions, and the possibility of useful application within law enforcement seems endless.
- What might the mission profile of a law enforcement UAS program look like after the proposed regulatory environment is in place?

This research was conducted on the assumption that law enforcement executives and elected officials will need to contend with a plethora of complex policy issues when deciding whether a UAS program is appropriate for their jurisdiction, whether such a program supplements existing aviation capabilities, or whether it establishes new ones. The conceptual framework and core principles for law enforcement UAS policy will be established by merging the knowledge base and experience of implementing new technologies with existing case law and early engagement with a concerned public. These additional findings and recommendations will change as the policy landscape develops.

³ Department of Transportation and Federal Aviation Administration, *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap* (Washington, DC: FAA, 2013).

Following a comprehensive literature review of the key policy issues, the Delphi Method was deployed to aggregate and code the knowledge and judgment of subject matter experts involved with UAS integration and law enforcement UAS policy development. The subject matter experts recruited for the Delphi panel were identified by senior personnel at the Unmanned Aircraft Systems Integration Office, Federal Aviation Administration, and Department of Transportation. The literature review confirmed that these individuals were centrally involved in the development of UAS regulations and possessed experience with law enforcement UAS policy. Nine respondents were recruited for participation, and all nine participated in all three rounds of data collection.

To combine independent analysis with maximum feedback for building consensus and recognizing dissent among UAS integration experts, an institutional review board (IRB)-approved sequence was established for Delphi panel participants. The collection of data from the Delphi panel established the framework for predictions and recommendations.

The analysis of the literature review and Delphi panel concluded that a UAS program could be established and/or sustained effectively with the appropriate policy framework.

A police department should plan for early community engagement, prior to UAS program implementation with these guidelines in mind:

- Engage the public early with transparency on intended use will assist in building public trust;
- Educate the public with a focus on the dramatic differences between a large military predator drone reserved for combat operations and the small quad copters (similar to an radio-controlled flyer) under evaluation as a tool for law enforcement;
- Build a UAS mission profile based on input from the local community that allows the mission to drive the use of the technology and does not encroach on the fringe or outside the boundaries of public acceptance;
- Select an advisory board that will develop your concept of operations; and
- Mandate that operators follow established FAA regulations and receive approval through the COA process. Police executives and elected officials

must know that the COA process does not equate to safe operations, and is only the minimal requirement threshold to operate a UAS in the NAS. Implementation of safety management system similar to those in manned aviation is recommended.

An agency must adopt a comprehensive policy framework that addresses safe operations and privacy—including data retention and storage—and that protects personally identifiable information and identifies a specific mission profile. The International Association of Chiefs of Police (IACP) publication *Guidelines for the Use of Unmanned Aircraft*⁴ offers a model that can act as a template for such policy development.

The lack of regulatory airworthiness standards remains a barrier to safe operations. Police departments should therefore model practices from manned aviation and develop standards for UAS procurement, maintenance, and inspection intervals. Opening dialogue with approved UAS test sites may be helpful to policy development in this area.

The combined action of regulatory agencies, UAS industry professionals, academics, public safety professional and private sector interests is required to fully develop, implement and mandate “sense and avoid technology” to increase safe operations. Police employees, including commanders who are assigned UAS must complete a robust agency-approved training program to ensure proper use and operations.

The UAS policy landscape is highly fluid at the time. This thesis focused on whether a law enforcement agency should operate a UAS. The findings show that with the acquisition and maintenance of technical, legal, and policy expertise, law enforcement agencies can and should take advantage of the cost savings, technical capabilities, and mission performance offered by this technology.

⁴ International Association of Chiefs of Police (IACP), *Recommended Guidelines for the Use of Unmanned Aircraft* (Alexandria, VA: IACP, August 2012) http://www.theiacp.org/portals/0/pdfs/iacp_uaguidelines.pdf.

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I. INTRODUCTION

Written in 1948, George Orwell's *Nineteen Eighty-Four* prophesied a totalitarian nightmare, one specter of which was a police patrol helicopter that skimmed down between the roofs like a small blue bottle and snooped into windows. That capability is now reality. U.S. law enforcement agencies, leveraging a decade of military combat success, are considering the implementation of unmanned aircraft systems (UAS) programs. Communities big and small have grown accustomed to both helicopters and planes of different sizes, weights, and speeds crossing the sky above them. However, it has been and continues to be a challenge to integrate UAS into airspace designed for manned aircraft and rules written from a legacy framework. In 2008 and 2012, the Government Accountability Office (GAO) insisted that the United States “develop a clear and common understanding of what is required to safely and routinely operate UAS in” the National Airspace System (NAS).¹ Congress also recognized the importance of UAS integration with the enactment of the FAA Modernization and Reform Act of 2012.²

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Domestic UAS use, specifically by law enforcement, represents uncharted policy territory. While there is a solid body of knowledge on aviation principles, airspace management and the legal constructs that will most certainly be involved in the policy development, additional research on the use of UAS after proposed integration into the NAS for domestic law enforcement operations is warranted. This will allow law

¹ Government Accountability Office (GAO), *Unmanned Aircraft Systems: Federal Actions* (GAO-08-511) (Washington, DC: GAO, 2008); Government Accountability Office (GAO) *Unmanned Aircraft Systems Measuring Progress and Addressing Potential Privacy Concerns Would Facilitate Integration into the National Airspace System-* (GAO-12-981) (Washington, DC: GAO, 2012).

² Federal Aviation Administration Modernization and Reform Act of 2012, Pub. L. No. 112-95, 2012.

enforcement executives and elected officials to make informed decisions when determining whether a UAS program is appropriate for the community they pledge to protect. Within the homeland security enterprise, a UAS program has unlimited potential. However, concerns for safe operation, integration into NAS, the transfer of risk and liability to autonomous unmanned systems, and debates on constitutional rights raise questions as to whether UAS are appropriate for law enforcement, and if so, under what policy frameworks.

UAS make for an appealing public safety tool. They are small, lightweight, agile, and remotely controlled with surveillance capabilities, and they are considered cost effective.³ A law enforcement executive must weigh the capabilities of this technology with the needs of the community: A well-trained law enforcement agency applies Fourth Amendment protections when it considers the use of technology and understands when search warrants are necessary. Emerging technologies and the application of the Fourth Amendment have been the subjects of much debate. The privacy issues are the most difficult to navigate because they elicit human emotions, attitudes and interpretations reminiscent of Orwell.

Law enforcement officials will have to engage the community early and with effective messaging if they expect the public to support UAS use for public safety missions. Transparency about the risks, the advantages, the costs, and limits; about the thoughtful, thorough, and rigorous process by which the policies and programs have been developed; and even about the public's role in the success and oversight of a new capability are critical to gaining the public trust and UAS programs sustainability.⁴

3 Craig Schlag, "The New Privacy Battle: How the Expanding use of Drones Continues to Erode our Concept of Privacy and Privacy Rights," *Journal of Technology, Law and Policy* 13 (2013).

4 Donald Shinnamon, "Personal Privacy and the use of Small Unmanned Aircraft by Law Enforcement," *Air Beat*, August 2011.

A. RESEARCH QUESTIONS

How might the integration of UAS under the FAA's *Integration of Civil Unmanned Aircraft System NAS Roadmap*⁵ affect their use by law enforcement? A qualitative analysis of the integration plans that will regulate law enforcement UAS operations is necessary. How will new regulations address the issues of safety, liability and privacy so that law enforcement executives and elected officials can make informed decisions as to the implementation of a UAS program in their community?

While government regulations are still in development, many public safety agencies already have approved the limited use of UAS. These specific missions are defined by the FAA's precedence of approving only certificates of authorizations for incidents involving a "defined perimeter." However, in recent years, UAS specialists have focused on developing more diverse functions, and the possibilities of useful application within law enforcement seem endless. What might the mission profile of a law enforcement UAS program look like after the proposed regulatory environment is in place?

B. IMPORTANCE

Today's law enforcement executives and elected officials, faced with dwindling resources and growing demands for service, are striving to leverage technology to achieve greater efficiency and effectiveness. Emerging technologies such as UAS could play a vital role in the daily work of both frontline police officers and homeland security officials of other disciplines, equipping them with a cost-effective aerial platform that has the potential of making them better informed, more efficient, safer, and more effective. Police executives and elected officials considering implementing a UAS program must manage an increasingly complex array of policy issues and be proactive with messaging that will counter a narrative of public intrusiveness. It also will be necessary to mitigate risk by ensuring compliance with safe operational standards and advocate for additional technology that will increase safety and reduce vicarious liability. In a proposed

⁵ Department of Transportation and Federal Aviation Administration, *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap* (Washington, DC: FAA, 2013).

regulatory environment, certain knowledge gaps require research so that police executives and elected officials can consider UAS technology implementation in support of their agencies' strategic goals.

C. OBJECTIVES AND LIMITS

The objective of this thesis is to predict a viable mission profile for UAS within a domestic law enforcement agency that incorporates proposed and pending FAA regulations on UAS integration into NAS. It is designed for use by law enforcement leadership and local elected officials as they consider the policy implications of initiating and sustaining a LE/UAS program.

This research was conducted with the assumption that law enforcement executives and elected officials will need to contend with complex policy issues when deciding whether a UAS program is appropriate for their jurisdiction, and whether such a program supplements existing aviation capabilities or establishes new ones.

The conceptual framework and core principles for law enforcement UAS policy will be established by merging the knowledge base and experience of implementing new technologies with existing case law and early engagement with a concerned public. These additional findings and recommendations will change as the policy landscape develops.

D. UPCOMING CHAPTERS

Three themes dominate current academic literature related to UAS. First, safe operation has plagued the UAS industry dating back to its military applications; it is still the primary concern of UAS integration by the FAA. Second, a new privacy battle has emerged during a period of expanding UAS use. Third, a theme has emerged as a parallel policy debate with the development of the autonomous car: the transfer of risk and liability.

Concentrating on these three issues, the following chapters provide an introduction to the key considerations for law enforcement executives by conducting an extensive literature review and surveying subject matter experts responsible for

developing the proposed UAS architecture. The remainder of this thesis is organized as follows:

- Chapter II establishes the role of aviation in past and present policing and summarizes the academic literature of the UAS regulatory landscape. Recognizing that practices of other nations provides positive and negative lessons. A comparative approach of international UAS integration focuses on the analytical UAS policy framework employed by other democratic countries with different legal, political, and social context. The research attempts to predict the future mission profile of a law enforcement UAS program after reviewing the major policy issues of privacy, safety, and liability.
- Chapter III addresses the Delphi method and its application. It examines the most current and topical opinions of subject matter experts responsible for developing the proposed UAS architecture and opening the dialogue that has shaped the early stages of UAS policy development for law enforcement. The Delphi method is applied in this research project to investigate the key policy issues prevalent in the literature.
- Chapter IV summarizes the responses of subject matters experts that voluntarily participated in Delphi surveys under an approved IRB by the Naval Postgraduate School. The objective of the survey questions was to fill the existing knowledge gaps of safe operations, liability, and safe operation.
- Chapter V concludes with policy recommendations and an analysis of the themes that dominate the survey responses. These recommendations will be available to law enforcement executives.

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II. BACKGROUND AND LITERATURE REVIEW

A. HISTORICAL CONTEXT ON POLICE AVIATION

The use of aircraft in support of law enforcement operations has been an integral part of many agencies' public safety missions for years. Because airborne assets, including helicopters and fixed-wing aircraft, require extensive training, maintenance, and regulatory commitments, only large agencies with sufficient resources can support airborne operations.

The history of police aviation does not figure prominently into any scholarship. The limited amount of existing academic research provides only basic history. Aircraft was first used in police work in 1914 in Miami, FL, for the pursuit of a jewel thief.⁶ The NYPD is recognized as creating the first official airborne law enforcement unit in the mid-1920s by using fixed-wing aircraft to track barnstormers that would recklessly fly over the city, launching from fields just outside the city limits. In the 21st century, police aviation units are thought to be a beneficial support function to a law enforcement agency, although little to no academic research has been completed to support such a claim.

However, evidence that police departments believe the benefits outweigh the costs of financially supporting aviation programs exists in a special report published by the Department of Justice, Bureau of Justice Statistics in 2007, *Aviation Units in Large Law Enforcement Agencies*.⁷ A police aircrew brings a broader sense of vision than an officer on the ground, allowing a well-trained police aircrew to give advanced alerts of upcoming dangers and opportunities that may not be visible from the ground.⁸ The aircrew can remain undetected for long periods of time, allowing them to monitor a

⁶ Bryn Elliott, "Police Aviation, a History," *Police Aviation News*, 2004, <http://www.policeaviationnews.com/policeaviation%201914-1990.pdf>.

⁷ Lynn Langton, *Bureau of Justice Statistics Special Report: Aviation Units in Large Law Enforcement Agencies* (Washington, DC: U.S. Department of Justice, July 2007), <http://www.bjs.gov/content/pub/pdf/aullea07.pdf>.

⁸ Kevin P. Means, *Tactical Helicopter Missions How to Fly Safe, Effective Airborne Law Enforcement Missions*. (Springfield, IL: Charles C Thomas, 2007).

public safety situation and communicate their observations to incident commanders. Additionally, aircrews can cover more distance in less time, allowing for a more timely response to certain calls for service.

B. ADMINISTRATIVE AND REGULATORY RESTRICTIONS

In August 2012, a subcommittee of the nation's largest police executive organization, the International Association of Chiefs of Police (IACP), working in collaboration with the Airborne Law Enforcement Association (ALEA), released a position paper that provides guidelines for the use of unmanned aircraft by law enforcement agencies.⁹ The *Recommended Guidelines on the Use of Unmanned Aircraft* suggested early community engagement to include discussions related to search and seizure concerns and basic system requirements.¹⁰ IACP guidelines for operational procedures focused on safety and image retention were included in the recommendations. The following year, the Office of the Inspector General Audit Division within the U.S. Department of Justice (DOJ) released an interim report on the use and support of UAS.¹¹ The report listed eight recommendations for future policy development, reporting requirements and UAS grant funding oversight. Both reports signal recognition within the law enforcement community that small UAS are an attractive, lower-cost enhancement to existing police aviation programs.

The current national policy on unmanned public aircraft operational approval by the FAA went into effect in 2013.¹² The policy has been published as temporary, internal guidance to provide both an approval process and regulatory environment while more

⁹ International Association of Chiefs of Police (IACP), *Recommended Guidelines for the Use of Unmanned Aircraft*. (IACP: Alexandria, VA, August 2012), http://www.theiacp.org/portals/0/pdfs/iacp_uaguidelines.pdf.

¹⁰ International Association of Chiefs of Police (IACP), *Recommended Guidelines for the Use of Unmanned Aircraft* (IACP: Alexandria, VA, August 2011), http://www.theiacp.org/portals/0/pdfs/iacp_uaguidelines.pdf

¹¹ Department of Justice, Office of the Inspector General, Audit Division, *Interim Report on the Department of Justice's Use and Support of Unmanned Aircraft Systems*. (Washington, DC: Department of Justice, Office of the Inspector General, Audit Division, September 2013), <http://www.justice.gov/oig/reports/2013/a1337.pdf>.

¹² Department of Transportation. *Unmanned Aircraft Systems (UAS) Operational Approval* (N 8900.227) (Washington, DC: FAA, July 30, 2013), http://fsims.faa.gov/wdocs/notices/n8900_227.htm.

permanent, integrated regulations were being developed. It incorporates many of the same concepts used in manned aviation, such as pilot and observer qualifications and risk management strategies. The UAS industry has seen a successful challenge to the temporary guidance. In March 2014, a National Transportation Safety Board administrative judge ruled that the Federal Aviation Administration lacked the authority to enforce rules on UAS because it had not followed the legislatively mandated government rule-making process, leaving them non-binding to the public at large. New federal rules need to follow a specific procedure under federal law if they are to be valid. The decision struck down the FAA's ban regarding model aircraft and small UAS for commercial use.

In the fall of 2013, the FAA released the *Integration of Civil Unmanned Aircraft System in the National Airspace System (NAS) Roadmap* and the *UAS Comprehensive Plan. A Report on the Nation's UAS Path Forward*.¹³ These documents govern civil UAS flights in the United States and include an FAA plan to work directly with the Department of Justice-National Institute of Justice to expand the number of law enforcement agencies legally permitted to operate a UAS. The critical question that the framework attempts to answer is this: How do we integrate UAS into an already overloaded air traffic control system?¹⁴

In developing a roadmap for integration, the FAA worked with manufacturers, vendors, trade associations, technical standards organizations, academic institutions, research and development centers and governmental agencies. These representatives were tasked with developing a plan that would not negatively impact current airspace capacity, decrease safety or increase risks of persons or property in the air or on the ground.¹⁵

¹³ Department of Transportation (DOT) and the Federal Aviation Administration (FAA), *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS)* (Washington, DC: DOT and FAA), http://www.faa.gov/uas/media/uas_roadmap_2013.pdf; The Joint Planning and Development Office (JPDO), *Unmanned Aircraft Systems (UAS) Comprehensive Plan, A Report on the Nation's UAS Path Forward* (Washington, DC: JPDO, September 2013), http://www.faa.gov/about/office_org/headquarters_offices/agi/reports/media/uas_comprehensive_plan.pdf.

¹⁴ Stephen Pope, "FAA Releases Drone Integration Roadmap," *Flying Magazine*, November 7, 2013. <http://www.flyingmag.com/news/faa-releases-drone-integration-roadmap>.

¹⁵ Department of Transportation and Federal Aviation Administration, *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap* (Washington, DC: FAA, 2013).

Included in the roadmap was an implementation timeline that has been the focal point of UAS industry expansion.

Only a small amount of scholarly literature provides recommendations on how to best approach integration. These documents govern civil UAS flights in the United States and include an FAA plan to work directly with the Department of Justice-National Institute of Justice to expand the number of law enforcement agencies legally permitted to operate a UAS. The Association of Unmanned Vehicle Systems International (AUVSI), a lobby to advance the unmanned systems and robotics community, published a report in 2010 aimed toward its legislative objective of increasing airspace “access to ensure that obstacles to advancing and fielding UAS and robotics are removed.”¹⁶ The report argues that “the U.S. economy would benefit enormously if UAS had access to the NAS. AUVSI also warned that a failure to integrate UAS would impede military readiness by limiting the Department of Defense’s ability to stay at the forefront of new technology, and negatively impact jobs and the aviation industry.”¹⁷ The argument spurred action that resulted in bi-partisan support for integration. The report recommends that public/private partnerships be developed to support civil UAS test sites focused on furthering the development of three technological objectives, which are

sense and avoid systems, control and communications links, and general UAS safety. Manned aircraft implements a concept known as “see and avoid.” However, a remotely piloted aircraft requires an alternative safety system because it cannot always “see” obstacles.¹⁸

Innovations in UAS technology have the potential of impacting manned aviation in a positive way by improving cockpit and air traffic automation and fostering an

¹⁶ Stephen Maddox and David Stuckenberg, “Drones in the U.S. National Airspace System: A Safety and Security Assessment,” *Harvard Law School National Security Journal*, February 24, 2015. http://harvardnsj.org/2015/02/drones-in-the-u-s-national-airspace-system-a-safety-and-security-assessment/#_edn12.

¹⁷ Stephen Maddox and David Stuckenberg, “Drones in the U.S. National Airspace System: A Safety and Security Assessment,” *Harvard Law School National Security Journal*, February 24, 2015. http://harvardnsj.org/2015/02/drones-in-the-u-s-national-airspace-system-a-safety-and-security-assessment/#_edn12.

¹⁸ Stephen Maddox and David Stuckenberg, “Drones in the U.S. National Airspace System: A Safety and Security Assessment,” *Harvard Law School National Security Journal*, February 24, 2015. http://harvardnsj.org/2015/02/drones-in-the-u-s-national-airspace-system-a-safety-and-security-assessment/#_edn12.

environment of air traffic separation necessary to avoid collisions. These improvements will be brought on by the advancement of novel communications architectures, collision and terrain avoidance systems, autonomous controls, information-sharing networks and alternative fuels.¹⁹ The digital age has created a time in history when more tasks can be completed virtually and by remote control, saving a considerable amount of personnel and resources.²⁰

The Center of International Policy has led a dissenting debate within the public policy community. This public policy think tank places a spotlight on an alleged or feared lack of transparency and governance over the proliferation of drone use over the homeland.²¹ It has raised ethical issues, for example, alleging that large sums of money funneled by the industry to lawmakers have poisoned the process to select UAS test sites. Proliferation of UAS has advanced far ahead of the processes of democratic governance, creating an anxiety about a technology that has the potential to shift the power balance between the framework entrusted to protect the public and civil liberties.²² U.S. Congress and the Executive Branch have an obligation to ensure that civil liberties and privacy are not violated. There remains concern that the U.S. military and intelligence apparatus related to UAS will too broadly spill over to domestic affairs without proper oversight. This obligation can be met by formulating policy that establishes regulations that provide the necessary protections.

¹⁹ Matthew T. DeGarmo, *Issues Concerning Integration of Unmanned Aerial Vehicles in Civil Airspace* (McLean, VA: MITRE Center for Advanced Aviation System Development, November 2004).

²⁰ Timothy Ravich, *The Integration of Unmanned Aerial Vehicles into the National Airspace*, accessed September 15, 2015. <http://ravichaviation.files.wordpress.com/2014/06/the-integration-of-unmanned-aerial-vehicles-into-the-national-airspace1.pdf>.

²¹ Tom Barry, *Drones Over the Homeland: How Politics, Money and Lack of Oversight Have Sparked Drone Proliferation, and What We Can Do* (Washington, DC: Center for International Policy, April 2013). http://www.ciponline.org/images/uploads/publications/IPR_Drones_over_Homeland_Final.pdf.

²² Tom Barry, *Drones Over the Homeland: How Politics, Money and Lack of Oversight Have Sparked Drone Proliferation, and What We Can Do* (Washington, DC: Center for International Policy, April 2013). http://www.ciponline.org/images/uploads/publications/IPR_Drones_over_Homeland_Final.pdf.

C. MEDIA SOURCES

Media headlines are indicative of the burgeoning trend toward integration and acceptance of domestic UAS operations. An article that appeared in *USA Today* highlights the investment that the FAA is making in preparation for integration and the partnerships with academia and the private sector it feels are necessary to be successful.²³ There is growing recognition that police executives and elected officials are actively examining the potential application and impact on the use of UAS in their community as evidenced by news articles from cities such as Los Angeles.²⁴ The UAS industry's largest trade group predicts "hundreds of thousands of jobs and tens of billions in economic impacts from domestic commercial UAS use."²⁵ Customers in the petroleum and agriculture industry are among some of the first to receive approval from the FAA.²⁶ Media coverage of UAS used by the military abroad during counterterrorism operations and in civil missions within the homeland has increased substantially since 2009.²⁷

D. UNITED KINGDOM AND CANADIAN PERSPECTIVE

The United Kingdom (UK) is well ahead of the United States with integration into European airspace by the Civil Aviation Authority (CAA) under CAP722 regulations first established in May 2002.²⁸ The original UK UAS regulations mirrored those of manned aircraft, requiring airworthiness certification and an approval process for companies designing, developing and manufacturing unmanned aircraft. As a result of shifts in regulatory responsibilities since the formation of the European Aviation Safety

23 Bart Jansen, "FAA Names 6 Sites for Testing Drones, *USA Today*, December 30, 2013. <http://www.usatoday.com/story/news/nation/2013/12/30/drone-test-sites/4248771/>.

24 Ruben Vives, "LAPD's Beck Says He'll Seek Input before Considering Using Drones," *Los Angeles Times*, <http://www.latimes.com/local/la-me-lapd-drone-20140606-story.html>.

25 Darryl Jenkins and Bijan Vasigh, *The Economic Impact of Unmanned Aircraft Systems Integration in the United States* (Arlington, VA: Association for Unmanned Vehicle Systems International, March 2013).

26 T. S. Blanchard, "Commercial Drone Industry Aiming for Lift-Off," *Record*, June 27, 2014.

27 Tara McKelvey, *Media Coverage of the Drone Program* (Cambridge, MA: Joan Shorenstein Center on the Press, Politics and Public Policy), <http://journalistsresource.org/wp-content/uploads/2013/02/D-77-McKelvey.pdf>.

28 D. R. Haddon and C. J. Whittaker, *UK-CAA Policy for Light UAV Systems* (London: UK Civil Aviation Authority, 2004). <http://www.caa.co.uk/default.aspx?catid=1416&pageid=8547>.

Agency (EASA), the regulations were targeted for review. Other factors included in revisions to these regulations included the development of new technologies such as “sense and avoid.” In an effort to modernize its regulations, UK aviation authorities have released five revisions to UAS regulations since 2002. Each time, it attempts to predict how the civil UAS market is likely to grow in terms of aircraft mass and altitude capability.²⁹ The benefit of this literature is that it sheds light on an environment in which the use of this technology is ahead of the United States, but it also recognizes the different political and legal framework. The flagship public safety event in the UK in which a UAS was deployed by the police occurred in 2007, during a large music festival that had traditionally been plagued with mass violence.³⁰ The use of UAS for mass surveillance in the UK has gained more public acceptance than is anticipated in the United States.

Canadian police also have deployed drones to support their field forces under strict conditions that are monitored by Transport Canada, the regulatory body responsible for enforcing UAS regulation in that country.³¹ In October 2012, in response to an increase in requests to deploy a UAS by local police departments across Canada, Transport Canada published a *Guidebook for the Integrating Micro Unmanned Aerial System in Police and Emergency Operations*.³²

29 UK Civil Aviation Authority, *Unmanned Aircraft System Operations in UK Guidance. CAP 722*, March 31, 2015. <http://www.caa.co.uk/docs/33/cap722.pdf>.

30 “‘Spy Helicopter’ Used at Festival, BBC News, August 19, 2007. http://news.bbc.co.uk/2/hi/uk_news/england/6953650.stm.

31 Jennifer Quinn, “Police Drones Spark Debate over Personal Privacy, *Toronto Star*, February 5, 2013, http://www.thestar.com/news/world/2013/02/05/privacy_vs_security_when_does_the_use_of_drones_cross_the_line.html.

32 Jerome Engele, Marc Sharpe, and John Evans, *Guidebook for Integrating a Micro Unmanned Aerial System* (DRDC CSSCR 2012–012) (Ottawa, ON, Canada: Defense R&D Canada). <http://lgdata.s3-website-us-east-1.amazonaws.com/docs/1314/785668/micro.pdf>.

Today, with many police forces in major cities in Canada now using UAS, similar concerns have been growing over privacy and surveillance.³³ The Office of the Privacy Commissioner of Canada (OPC) has raised various concerns regarding UAS use in law enforcement.³⁴ Highlighted in a March 2013 report, the privacy watchdog has expressed that the characteristics and capabilities of a UAS can result in a covert form of surveillance a similar argument from privacy groups in the United States.³⁵ An argument is made by the OPC that existing Canadian regulations fail to strike the balance between intended use and the related privacy implications. Current Canadian regulations governing UAS operations have more to do with ensuring their safe flight. The Canadian OPC has recommended use of UAS video surveillance in a way that minimizes invasion of privacy, public transparency, and continued impact assessment; recommendations similar to that of the IACP.

E. CURRENT PROFILE OF LAW ENFORCEMENT UAS PROGRAMS

The introduction of UAS in domestic law enforcement operations and policy has occurred or is being considered at local, state and federal levels of law enforcement. At the federal level, a May 2013 report highlighted established UAS program offices within several federal law enforcement agencies; the FBI, ATF, and DHS Customs and Border Protection.³⁶ The same report that documented these programs, found that the FBI and ATF deploy UAS for specific operational needs such as a hostage crisis and only under very limited circumstances after receiving required approvals including an FAA

³³ David Wright, "Should Privacy Impact Assessments Be Mandatory?," *Communications of the ACM* 54 (2011): 121–131; Ira Lamcja, "Canada's Police Forces Take to the Sky With Drones," *Toronto Metro* March 18, 2015, <http://www.metronews.ca/news/canada/2015/03/19/canadas-police-forces-taking-to-the-sky-with-drones.html>; Ciara Bracken-Roche et al., *Surveillance Drones: Privacy Implications of the Spread of UAVs in Canada* (Kingston, ON, Canada: Surveillance Studies Centre, April 30, 2014), http://www.sscqueens.org/sites/default/files/Surveillance_Drones_Report.pdf.

³⁴ Office of the Privacy Commissioner of Canada (OPC), *Drones in Canada: Will the Proliferation of Domestic Drone Use in Canada Raise New Concerns for Privacy?* Quebec, Canada: OPC.

³⁵ Office of the Privacy Commissioner of Canada (OPC), *Drones in Canada: Will the Proliferation of Domestic Drone Use in Canada Raise New Concerns for Privacy?* Quebec, Canada: OPC.

³⁶ Department of Justice, Office of the Inspector General, Audit Division, *Interim Report on the Department of Justice's Use and Support of Unmanned Aircraft System*. (Washington, DC: Department of Justice, Office of the Inspector General, Audit Division, September 2013), <http://www.justice.gov/oig/reports/2013/a1337.pdf>.

certificate of airworthiness (COA). In May 2015, a Department of Justice working group released a white paper after studying DOJ use of UAS over several years and considered how the technology is likely to evolve in the future.³⁷ The paper focused on three core areas: respect for civil rights and liberties, protection of privacy, and accountability. DOJ policy guidance requires federal agencies to report UAS use describing the types and categories of missions flown to the Deputy Attorney General on an annual basis. The DOJ policy guidance referenced above linked nicely to the “Presidential Memorandum: Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights and Civil Liberties in Domestic Use of UAS.”³⁸ The DHS program focuses on the use of UAS for the nation’s border security, is operational on a daily basis, and was established in 2003.³⁹ Deployed by agents from Customs and Border Protection (CBP), unarmed Predator drones operated by CBP have become an important countermeasure for border security through their ability to provide high-tech intelligence, surveillance and reconnaissance.⁴⁰ A watchdog group and some lawmakers were critical of the number of times that CBP allowed other departments such as the Coast Guard and Drug Enforcement Administration (DEA) to borrow their UAS for unspecified missions deemed classified and that the practice was unmonitored.⁴¹ Civil libertarians remain concerned that the camera technology on board a CBP drone could be used for persistent surveillance of Americans.

³⁷ Department of Justice, “Domestic Use of Unmanned Aircraft Systems,” accessed September 10, 2015, <http://www.justice.gov/file/441266/download>.

³⁸ The White House, “Presidential Memorandum: Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights and Civil Liberties in Domestic Use of UAS, press release, February 5, 2015. <https://www.whitehouse.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua>

³⁹ Department of Homeland Security Office of the Inspector General (DHS OIG), *Use of Unmanned Aircraft Systems in the Nation’s Border Security* (Washington, DC: DHS OIG), http://www.oig.dhs.gov/assets/Mgmt/2012/OIG_12-85_May12.pdf.

⁴⁰ Tom Barry, *Drones Over the Homeland: How Politics, Money and Lack of Oversight Have Sparked Drone Proliferation, and What We Can Do* (Washington, DC: Center for International Policy, April 2013), http://www.ciponline.org/images/uploads/publications/IPR_Drones_over_Homeland_Final.pdf.

⁴¹ Craig Whitlock and Craig Timberg, “Border-Patrol Drones Being Borrowed By Other Agencies More Often than Previously Known,” *Washington Post*, January 14, 2014, http://www.washingtonpost.com/world/national-security/border-patrol-drones-being-borrowed-by-other-agencies-more-often-than-previously-known/2014/01/14/5f987af0-7d49-11e3-9556-4a4bf7bcdb84_story.html.

It is difficult to determine the number of police departments that are operating UAS at this time. Early and careful data collection on law enforcement use of UAS is nearly absent in the literature, reflecting the fact of their early and limited use. This researcher has used two methods to determine their use by state and local law enforcement. First, the FAA has released a list of public agencies for which they have issued a Certificate of Authorization (COA) to operate a UAS in response to a lawsuit filed by the Electronic Frontier Foundation.⁴² There are 19 police departments on the list. The second method that this researcher used to determine the number of police departments that may be operating a UAS was drawn from a DOJ grant receipt list published in 2013. The literature suggests that UAS are not widely used domestically for homeland security support despite their many benefits due to sluggish integration and technology that has not matured to allow safe routine operations.⁴³

The first known deployment of a UAS by a local and state police department occurred in 2009 outside Austin, Texas.⁴⁴ As dawn broke, SWAT commanders from the Texas Department of Public Safety used the UAS to surveil for unforeseen dangers before executing a high-risk search warrant. The decision mitigated risk because it avoided placing a police helicopter crew in a situation where it could have been shot down, one of the central themes that advocates for UAS use on certain missions in lieu of placing a manned aircraft in harm's way. The tactical decision set in motion much public debate about the use of UAS for surveillance by domestic law enforcement. Two years later, the first arrest and conviction aided by a UAS of a North Dakota cattle rancher took place. This situation involved a 16-hour standoff with police that ended when the local police department borrowed a Predator drone operated by the CBP along the U.S.

⁴² Electronic Frontier Foundation, "Proponent COA," accessed September 10, 2015. https://www.eff.org/files/filenode/20120416_FAA_Drones_COA_0.pdf.

⁴³ Bart W. Darnell, "Unmanned Aircraft Systems: A Logical Choice for Homeland Security Support," (Master's thesis, Naval Postgraduate School, 2011).

⁴⁴ Peter Finn, "Domestic use of Aerial Drones by Law Enforcement Likely to Prompt Privacy Debate," *Washington Post*, January, 23, 2011. <http://www.washingtonpost.com/wp-dyn/content/article/2011/01/22/AR2011012204111.html>.

northern border to locate the subject on his ranch, making it safe for a SWAT team to take the heavily armed man into custody.⁴⁵

Local and state law enforcement agencies currently operating a UAS are required by the FAA to have a COA.⁴⁶ A COA is issued by the FAA for a specific UAS activity. The FAA conducts a comprehensive operational and technical review before issuing an UAS COA. Provisions and limitations may be imposed as part of the approval to ensure the UAS can operate safely in the NAS. A Memorandum of Understanding (MOU) between the FAA UAS Integration Office and the DOJ Office of Justice Programs has established an accelerated approval path for law enforcement while the FAA determines the best method of integration.⁴⁷

F. FUTURE USE OF UAS BY U.S. LAW ENFORCEMENT

At present, local and state law enforcement officials have exercised caution in authorizing UAS operations in a cloudy policy and regulatory environment while UAS technologists have focused on expanding their capabilities to capitalize on the anticipated explosion of the commercial UAS industry by developing more diverse functions.⁴⁸ UAS come in all shapes and sizes, from extremely small versions that fit in a backpack to considerable large aircraft-sized drones.⁴⁹ Hundreds of UAS exist on the market. When selecting a UAS for public safety missions, an agency should allow the mission to drive the purchase of the technology.

Technological innovation within the UAS industry has created a multitude of capabilities of interest to domestic law enforcement agencies to include remote sensing of homeland threats such as biological, chemical, and physical environmental factors, and

⁴⁵ Jason Koebler, "North Dakota Man Sentenced to Jail in Controversial Drone Arrest Case," *U.S. News Digital Weekly*, January 15, 2014.

⁴⁶ Federal Aviation Administration, "Fact Sheet – Unmanned Aircraft Systems (UAS)," January 6, 2014, http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153.

⁴⁷ Airborne Law Enforcement Association, "Memorandum of Understanding," accessed September 10, 2015, <http://www.alea.org/assets/pressReleases/assets/1805/DOJ%20FAA%20MOU.pdf>.

⁴⁸ Department of Defense (DOD), *Unmanned Systems Integrated Roadmap FY2011–2036*, (n.p.: Progressive Management, 2012).

⁴⁹ Jeremiah Gertler, *U.S. Unmanned Aerial Systems* (CRS Report No. R42136) (Washington, DC: Congressional Research Service, 2012), <https://www.fas.org/sgp/crs/natsec/R42136.pdf>.

aerial surveillance with automated object detection useful for suspect identification and tracking.⁵⁰ A UAS equipped with an advanced optical camera has the potential to assist law enforcement with crowd control/demonstrations, tactical operations, criminal apprehension, and counter narcotics operations. Unfortunately, there is little empirical data that assists in defining an appropriate mission profile for law enforcement against the backdrop of the public appetite for acceptance. Progressive UAS technology has also led to the development of UAS focused on challenging search and rescue (SAR) missions too dangerous for a piloted aircraft or individuals on foot.⁵¹

There is the potential for UAS to play a significant role in emergency management, a humanitarian role often coordinated by law enforcement agencies. The use of a UAS high-tech camera and infrared systems has been found to be extremely valuable in assessing disaster stricken areas following natural disasters such as earthquakes, floods, tornados, hurricanes, wild fires, and the like. Because there is inherent risk to flying UAS in close proximity to humans in inhabited areas, risk mitigation strategies should be implemented.⁵²

G. PRIVACY CONCERNS OF UAS OPERATIONS

The privacy issues that surround the domestic use of UAS form a significant, deep-rooted barrier for public support of UAS in public safety.⁵³ The potential deployment of UAS by law enforcement agencies has prompted concerns that their use could result in violations of privacy and civil liberties if mass surveillance were allowed. It is important for an agency to be transparent with the mission profile and develop policies to help

⁵⁰ Mitch Joel, "The Booming Business of Drones," *Harvard Business Review Blog*, January 4, 2013, <http://blogs.hbr.org/2013/01/the-booming-business-of-drones/>.

⁵¹ AeroVironment, "Search & Rescue," accessed September 10, 2015, <http://www.avinc.com/public-safety/applications/searchandrescue>.

⁵² Gerald Baron, "UAVs and Emergency Management: Progress and Regress," *Emergency Management*, June 26, 2014, <http://www.emergencymgmt.com/emergency-blogs/crisis-comm/UAVs-and-Emergency-Managementprogress-and-regress.html>.

⁵³ Donald L Shinnamon, "Personal Privacy and the Use of Small Unmanned Aircraft by Law Enforcement," accessed September 10 2015, <http://atca.kma.net/atca/files/ccLibraryFiles/Filename/000000001515/Personal%20Privacy%20and%20the%20Use%20of%20Small%20Unmanned%20Aircraft%20by%20Law%20Enforcement%20by%20Shinnamon.pdf>.

safeguard the privacy of the public they serve. The concerns for violations of individual privacy develop from the ability of UAS to fly high, undetected by the naked eye and in almost total silence.⁵⁴ Criminal justice professionals, operating within the parameters of the Fourth Amendment, obtain warrants through the normal judicial process when the use of technology is needed to investigate criminal activity. The privacy issues are the most difficult to navigate because they elicit human emotions, attitudes, and interpretations. The literature indicates that the debate has been particularly volatile during the 20th and 21st centuries—when the court’s view of a constitutional right (or at least “value”) and the public’s expectation of the sphere activity free from government observation changed.⁵⁵

The problem begins with the fact that the word “privacy” does not appear in the U.S. Constitution; rather the right, whatever its extent, has been read into various provisions, most notably the Fourth Amendment, which protects “[t]he right of the people to be secure persons, houses, papers and effects against unreasonable searches and seizures”⁵⁶ by the government, most urgently by law enforcement. The wording has been held to apply to all kinds of law enforcement searches and seizures. As such, the following Supreme Court decisions bind law enforcement aviation, whether manned or unmanned as a function of surveillance and search:

1. *Katz v. United States*—1967

The Court in *Katz v. United States*⁵⁷ expanded the parameters considerably, holding that warrantless wiretapping is, by definition, an unreasonable search.⁵⁸ The novelty of this case came in the switch to applying the Fourth Amendment expectation of

⁵⁴ American Civil Liberties Union (ACLU). *Protecting Privacy from Aerial Surveillance: Recommendations for Government Use of Drone Aircraft* (New York: ACLU, December 2011), <http://www.aclu.org/files/assets/protectingprivacyfromaerialsurveillance.pdf>.

⁵⁵ M.E. Bowman, “National Security and the Fourth and Fifth Amendment,” in *National Security Law*, eds. John Norton Moore and Robert F. Turner, 2d. ed. (Durham, NC: Carolina Academic Press, 2005), 1063

⁵⁶ U.S. Const., amend IV.

⁵⁷ *Katz v. United States*, 389 U.S. 347 (1967).

⁵⁸ *Katz*, 389 U.S. at 356–57.

privacy to persons, rather than just places.⁵⁹ In other words, officials needed a warrant to tap a telephone booth where Katz was illegally wagering on college basketball games,⁶⁰ because a search occurs whenever a person has a reasonable expectation of privacy: “Wherever a man may be, he is entitled he to know that he will remain free from unreasonable searches and seizures.”⁶¹

This case also signaled the extent to which the telephone had become central to the daily life of Americans.⁶² The widespread acceptance of an expanded warrant regime also appeared in the Omnibus Crime/Safe Street Act,⁶³ which was signed into law by President Lyndon B. Johnson in 1968. Title III of the statute expressively added law enforcement use of electronic surveillance to the kinds of searches and seizures that require warrants or the equivalent order.⁶⁴

2. *California v. Ciarolo*—1986

Technology continued to advance and, eventually, so did the controlling jurisprudence. In *California v. Ciarolo*,⁶⁵ the Supreme Court held that a flyover observation from 1000 feet of a back yard—even though the yard was double fenced to obscure view from the street was a reasonable search within the Fourth Amendment: “The Fourth Amendment simply does not require the police traveling in the public airways ... to obtain a warrant in order to observe what is visible to the naked eye.”⁶⁶ In this case, what was visible was a stand of 73 marijuana plants.⁶⁷ Writing for the majority, Chief Justice Warren Burger noted:

⁵⁹ Katz, 389 U.S. at 353.

⁶⁰ Harvey A. Schneider, “*Katz v. United States*: The Untold Story,” *McGeorge Law Review* 40, no. 13 (2009), 13. Judge Schneider, who, as a young lawyer, argued Charles Katz’s case before the Supreme Court, calls Katz “probably the preeminent college basketball handicapper in America in 1967.”

⁶¹ Katz, 389 U.S. at 359.

⁶² Bowman, “National Security and the Fourth and Fifth Amendments,” 1063.

⁶³ Omnibus Crime Control and Safe Streets Act, 18 U.S.C. §§2510–20 (1968).

⁶⁴ Bowman, “National Security and the Fourth and Fifth Amendments,” 1063, n. 18.

⁶⁵ *California v. Ciarolo*, 476 U.S. 207 (1986).

⁶⁶ *Ciarolo*, 476 U.S. at 215.

⁶⁷ *Ciarolo*, 476 U.S. at 209.

That the observation from aircraft was directed at identifying the plants and the officers were trained to recognize marijuana is irrelevant. Such observation is precisely what a judicial officer needs to provide a basis for a warrant. Any member of the public flying in this airspace who glanced down could have seen everything that these officers observed. On this record, we readily conclude that respondent's expectation that his garden was protected from such observation is unreasonable, and is not an expectation that society is prepared to honor.⁶⁸

The lower courts had made much of Ciarolo's back yard forming part of the "curtilage" of the house—which Chief Justice Burger defined as the common-law view of "the area to which extends the intimate activity associated with the 'sanctity of a man's home and the privacies of life.'"⁶⁹ Even so, the Court wrote: "That the area is within the curtilage does not itself bar all police observation,"⁷⁰ including observation from the public airways. After all, an earlier Court as long ago as 1946 had already determined that the "ancient doctrine that at common law ownership of the land extended to the periphery of the universe—*cujus est solum ejus est usque and coelom*[—] ... has no place in the modern world."⁷¹

3. *Dow Chemical v. United States*—1986

In the same term as the Ciarolo decision, the Supreme Court extended authority to government inspectors flying over commercial property in *Dow Chemical v. United States*.⁷² The Court held the EPA had statutory authority to use aerial photography to perform the inspections under the Clean Air Act: "EPA, as a regulatory and enforcement agency, needs no explicit statutory provision to employ methods of observation commonly available to the public at large: we hold that the use of aerial observation and photography is within EPA's statutory authority."⁷³ Whatever protections trade secrecy laws at the state level might afford Dow Chemical, they are irrelevant to the constitutional question; unless the government wanted to use the information from the

⁶⁸ Ciarolo, 476 U.S. at 213–14.

⁶⁹ Ciarolo, 476 U.S. at 212.

⁷⁰ Ciarolo, 476 U.S. at 213.

⁷¹ *United States v. Causby*, 328 U.S. 256 (1946) at 260–61.

⁷² *Dow Chemical v. United States*, 476 U.S. 227 (1986).

⁷³ *Dow Chemical*, 476 U.S. at 234.

photographs to compete with Dow, the company has no legal grounds to prohibit the taking or use of the photos.⁷⁴ Indeed, as Chief Justice Burger’s opinion noted, aerial photography had become a fact of daily experience:

The photographs at issue in this case are essentially like those commonly used in mapmaking. Any person with an airplane and an aerial camera could readily duplicate them. In common with much else, the technology of photography has changed in this century. These developments have enhanced industrial processes, and indeed all areas of life; they have also enhanced law enforcement techniques.⁷⁵

Finally, Dow attempted to argue that its sprawling industrial campus, which encompassed some 2000 acres, constituted its “curtilage,” in which space it had a reasonable expectation of privacy. The Court disagreed, concluding instead that “such an industrial complex is more comparable to an open field, and, as such, it is open to the view and observation of persons in aircraft lawfully in the public airspace immediately above or sufficiently near the area for the reach of cameras.”⁷⁶ Thus, ultimately, the Court found that “the taking of aerial photographs of an industrial plant complex from navigable airspace is not a search prohibited by the Fourth Amendment.”⁷⁷

4. *Florida v. Riley*—1989

How close can authorities get to the curtilage? In *Florida v. Riley*,⁷⁸ respondent Michael A. Riley argued that police officers in a helicopter 400 feet above his property—and below the FAA’s 500-foot minimum for navigable airspace—had crossed that line. In a plurality opinion—a somewhat surprising show of disunity granted the clear precedent set by *Ciarolo*—the Court at least agreed that the helicopter observation constituted no search in the Fourth Amendment sense and, thus, required no warrant.⁷⁹ The Court’s conclusion was cautionary, however:

⁷⁴ Dow Chemical, 476 U.S. at 232.

⁷⁵ Dow Chemical, 476 U.S. at 231.

⁷⁶ Dow Chemical, 476 U.S. at 239.

⁷⁷ Dow Chemical, 476 U.S. at 239.

⁷⁸ *Florida v. Riley*, 488 U.S. 445 (1989).

⁷⁹ *Florida v. Riley*, 488 U.S. at 445.

This is not to say that an inspection of the curtilage of a house from an aircraft will always pass muster under the Fourth Amendment simply because the plane is within the navigable airspace specified by law. But it is of obvious importance that the helicopter in this case was not violating the law, and there is nothing in the record or before us to suggest that helicopters flying at 400 feet are sufficiently rare in this country to lend substance to respondent's claim that he reasonably anticipated that his greenhouse would not be subject to observation from that altitude. Neither is there any intimation here that the helicopter interfered with respondent's normal use of the greenhouse or of other parts of the curtilage. As far as this record reveals, no intimate details connected with the use of the home or curtilage were observed, and there was no undue noise, and no wind, dust, or threat of injury. In these circumstances, there was no violation of the Fourth Amendment.⁸⁰

5. *Kyllo v. United States*—2001

The Court's penchant for identifying disqualifying characteristics of a given search—as a means of reining in the seemingly limitless realm in which a person has a reasonable expectation of privacy from government surveillance—gained real traction in *Kyllo v. United States*.⁸¹ In this case, the Court held that the use of thermal imaging to detect heat emanating from the petitioners triplex home was a search. Of particular concern was the thermal imaging equipment that the police used in their search for characteristic heat exhaust from high-powered lights used to grow marijuana indoors. Although the police investigators were on the public street at the time they pointed their sensors at Kyllo's house, the technology allowed them “to explore details of the home that would previously have been unknowable without physical intrusion.”⁸² As Justice Antonin Scalia wrote for the majority:

It would be foolish to contend that the degree of privacy secured to citizens by the Fourth Amendment has been entirely unaffected by the advance of technology. For example, ... the technology enabling human flight has exposed to public view (and hence, we have said, to official observation) uncovered portions of the house and its curtilage that once were private. ... The question we confront today is what limits there are upon this power of technology to shrink the realm of guaranteed privacy.⁸³

⁸⁰ Florida v. Riley, 488 U.S. at 451–52.

⁸¹ Kyllo v. United States, 533 U.S. 27 (2001).

⁸² Kyllo, 533 U.S. at 40.

⁸³ Kyllo, 533 U.S. at 33–34.

Scalia found some limits in the thermal imagery equipment, for two reasons: “We think that obtaining by sense-enhancing technology any information regarding the interior of the home that could not otherwise have been obtained without physical ‘intrusion into a constitutionally protected area,’ *Silverman*, 365 U. S., at 512, constitutes a search at least where (as here) the technology in question is not in general public use.”⁸⁴

6. *United States v. Jones*—2012

Finally, in *United States v. Jones*,⁸⁵ the Supreme Court took a significant step back from the *Katz* standard of attaching Fourth Amendment privacy rights to people rather than places. In this case, the FBI and police authorities in Maryland and the District of Columbia affixed a GPS tracking device to a Jeep Grand Cherokee registered to the wife of Antoine Jones, a nightclub owner suspected of narcotics trafficking. The authorities actually had applied for and received a warrant for this measure, “authorizing installation of the device in the District of Columbia and within 10 days.”⁸⁶ The tracker was not installed until the eleventh day, however, and it happened in Maryland. The tracker remained in place for 28 days.⁸⁷

The Court’s frustration with authorities for their careless treatment of the warrant conditions is evident in the majority opinion, but the crux of the decision is the trespass committed when law enforcement officials placed the GPS device in the vehicle, Jones’s personal property.⁸⁸ Justice Scalia wrote:

It is important to be clear about what occurred in this case: The Government physically occupied private property for the purpose of obtaining information. We have no doubt that such a physical intrusion would have been considered a “search” within the meaning of the Fourth Amendment when it was adopted.⁸⁹

⁸⁴ *Kyllo*, 533 U.S. at 33.

⁸⁵ *United States v. Jones*, 565 U.S. (2012).

⁸⁶ *Jones*, 565 U.S. at 2.

⁸⁷ *Jones*, 565 U.S. at 2.

⁸⁸ *Jones*, 565 U.S. at 3.

⁸⁹ *Jones*, 565 U.S. at 5.

The trespass made the search unreasonable and, thus, illegal, according to the *Jones* opinion. The question of whether the widespread availability and civilian use of GPS did not enter into the majority decision—and thus leaves open one of the major threshold issues for UAS use in police surveillance.

Legal issues that arise as technologies emerge remain unsolved and will be at the center of future debate and UAS legislation. Scholars have recommended voluntary measures that law enforcement can take until additional case law is established.⁹⁰ These recommendations include adopting IACP policy and the code of conduct from AUVSI.

H. LEGISLATION

The general mistrust of the federal government by the American people has legislative bodies debating and attempting passage of regulations limiting UAS use. There are long periods of great overlap of the related privacy issues that concern the citizenry. It comes as no surprise that when Congress blesses an idea as law, then it is presumably the will of the people. Many states have taken steps in response to advocacy groups such as the ACLU to propose state-specific legislation about UAS use within state borders.⁹¹ Though the focus and goals of proposed legislation vary from state to state, an impressive amount of legislation was enacted or proposed in 2013 and 2014.⁹² Among the state legislation being considered are proposals that would ban an operator's ability to arm a UAS with lethal or less-than-lethal weaponry (a position adopted by the IACP).⁹³ Other states have focused their legislation on prohibiting mass surveillance or limiting

90 John Villasenor, "Observations from Above: Unmanned Aircraft Systems and Privacy," *Harvard Journal of Law & Public Policy*, 36 (2013): 458–517, http://www.harvard-jlpp.com/wp-content/uploads/2013/04/36_2_457_Villasenor.pdf.

91 Miranda Green. "On the Home Front, Drones Are Quickly Shot Down by States," *Daily Beast*, March, 9, 2013, <http://www.thedailybeast.com/articles/2013/03/09/on-the-home-front-drones-are-quickly-shot-down-by-states.html>.

92 Allie Bohm, "Status of 2014 Domestic Drone Legislation in the States," *American Civil Liberties Union Blog*, April 22, 2014, <https://www.aclu.org/blog/technology-and-liberty/status-2014-domestic-drone-legislation-states>.

93 International Association of Chiefs of Police (IACP), *Recommended Guidelines for the Use of Unmanned Aircraft* (IACP: Alexandria, VA. August 2012), http://www.theiacp.org/portals/0/pdfs/iacp_uaguidelines.pdf.

surveillance to groups such as farmers and ranchers.⁹⁴ Advocates for privacy believe that most state legislation has fallen short on addressing privacy issues fully.⁹⁵ Independent public policy organizations have attempted to educate legislators to avoid passing legislation that too narrowly restricts or eliminates UAS use.⁹⁶ There is evidence that supports a position that broadly worded requirements for police to obtain warrants do not protect privacy and safety but instead, can allow for criminal behavior to flourish.⁹⁷ Legislation should be enacted that strikes the proper balance between individual property rights and the use of technology for surveillance when needed for a legitimate purpose. As Gregory McNeal describes in *Drones and Aerial Surveillance*, “the best way to achieve that goal is to follow a property-centric approach, coupled with limits on pervasive surveillance, enhanced transparency measures, and data protection procedures”⁹⁸ When confronted with related policy decisions, an elected body must debate the use of information collected incidental to a lawful arrest and determine the storage criteria for related data. Additionally, concerns surround how to handle government access to data collected by a UAS with a commercial purpose. There remains an argument that UAS are no more of an invasion of privacy than police helicopter surveillance. Many of the proposed state bills allow law enforcement to obtain information from “plain view” or open space without a warrant.

⁹⁴ National Conference of State Legislatures, “Current Unmanned Aircraft State Law Landscape,” September 14, 2015, <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx>.

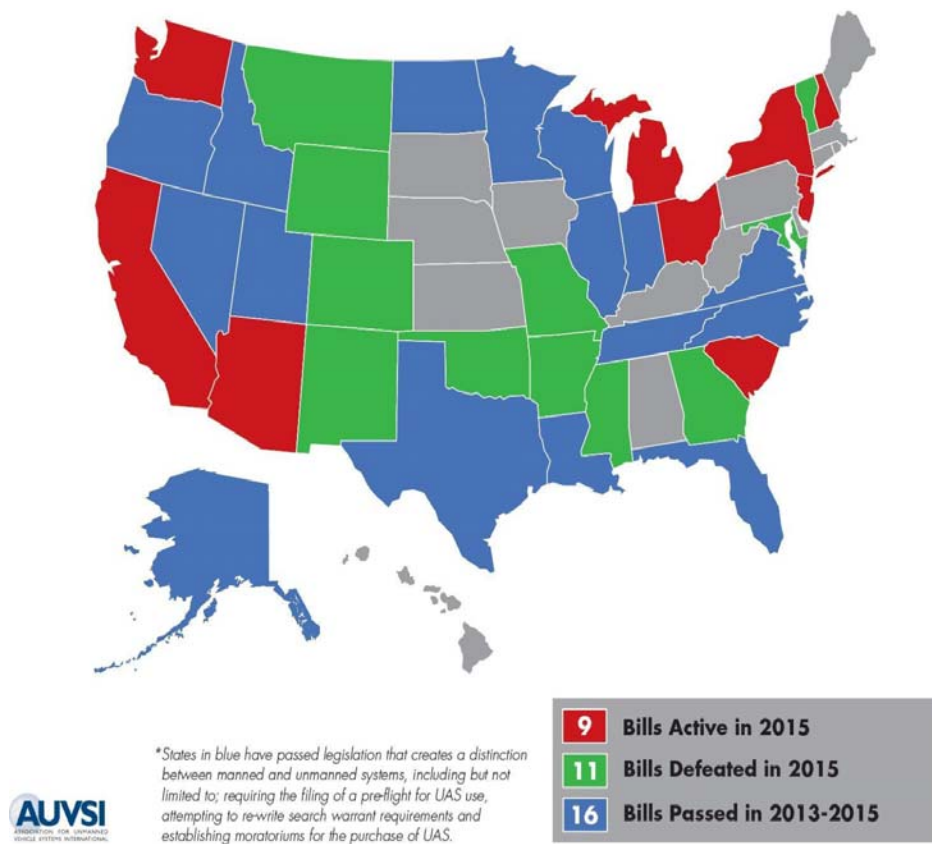
⁹⁵ Ronald B. Standler, “Privacy Law in the USA,” last modified in May 24, 1998, <http://www.rbs2.com/privacy.htm>.

⁹⁶ Gregory McNeal, *Drones and Aerial Surveillance: Considerations for Legislators* (Washington, DC: Brookings Institution, November 2014).

⁹⁷ Gregory McNeal, *Drones and Aerial Surveillance: Considerations for Legislators* (Washington, DC: Brookings Institution, November 2014).

⁹⁸ Gregory McNeal, *Drones and Aerial Surveillance: Considerations for Legislators* (Washington, DC: Brookings Institution, November 2014).

Figure 1. Restrictive UAS Legislation



From AUVSI, “Maryland Passes Pro-UAS Legislation; AUVSI Defeats 12th Anti-UAS Bill in 2015,” June 9, 2015 <http://www.auvsi.org/hamptonroads/blogs/auvsi-advocacy/2015/06/09/stateleg6915>

The most current piece of proposed federal legislation affecting UAS policy was released in the *Federal Register* on February 23, 2015, as a notice to proposed rule-making.⁹⁹ The proposed federal legislation outlines rules on operational limitations, operator certification and responsibilities, and aircraft requirements. The key policy changes from previous guidance require a UAS to weigh less than 55 lbs. and operate within line of sight at 500 ft. AGL or below.¹⁰⁰ The proposed regulations eliminate the

⁹⁹ Federal Aviation Administration, “Overview of Small UAS Notice of Proposed Rulemaking,” accessed September, 10, 2015, https://www.faa.gov/regulations_policies/rulemaking/media/021515_suas_summary.pdf.

¹⁰⁰ Federal Aviation Administration, “Overview of Small UAS Notice of Proposed Rulemaking,” accessed September, 10, 2015, https://www.faa.gov/regulations_policies/rulemaking/media/021515_suas_summary.pdf.

previous requirement of having a visual observer, but require the “pilot operator” to pass an aeronautical knowledge test and then obtain an unmanned aircraft operators certification described similar to an airman’s certificate. The proposed regulations do not require that a UAS have an airworthiness certificate and does not delineate UAS maintenance requirements: a subject advocated by air safety professionals.

Table 1. Current versus Proposed UAS Regulations

FAA UAS Regulations March 29, 2012	FAA Regulations (Proposed) February 23, 2015
<ul style="list-style-type: none"> • <i>Must weigh 4.4 lbs. or less, weight expansion allowable up to 25 lbs. under certain conditions</i> • <i>Visual Line of Sight (VLOS) required</i> • <i>Daylight Operations only</i> • <i>Restricted to Class G Airspace Only</i> • <i>Maximum altitude 400 AGL</i> • <i>Restricted from flying within 5 miles from any airport or other location with aviation activities</i> • <i>COA initially issued for training and performance evaluation only</i> • <i>Final COA approved for “defined perimeter” incidents only</i> • <i>Visual observer required</i> 	<ul style="list-style-type: none"> • <i>Must weigh less than 55 lbs.</i> • <i>Visual Line of Sight (VLOS) required</i> • <i>Restricted from operating over persons not involved with incident</i> • <i>Daylight operations only</i> • <i>Maximum airspeed 100 mph</i> • <i>Maximum altitude 500 AGL</i> • <i>Weather minimums - 3 miles visibility</i> • <i>Airspace Restrictions: Class A non-authorized</i> <p><i>Class B, C, D, E, F – ATC</i></p> <p><i>Class G -authorized</i></p> <ul style="list-style-type: none"> • <i>Preflight inspection requirement</i> • <i>Operators must pass knowledge test</i> • <i>Operators must be vetted by TSA</i> • <i>Visual observer may be used, but not required</i> • <i>Aircraft markings required (same rule as manned aircraft)</i>

After Federal Aviation Administration, “Small UAS Notice of Proposed Rulemaking (NPRM),” last modified June 1, 2015, <https://www.faa.gov/uas/nprm/>.

Some federal legislation is present that applies to specific UAS use such as the National Security and Federal Lands Protection Act. This legislation allows the National Park Service to prohibit or restrict the use of UAS at National Parks.¹⁰¹ The agricultural industry is also affected by specific federal legislation that restricts the ability for federal

¹⁰¹ Mark Berman, “National Park Service Bans Drone Use in All National Parks,” *Washington Post*, June 20, 2014, <http://www.washingtonpost.com/news/post-nation/wp/2014/06/20/national-park-service-bans-drone-use-in-all-national-parks/>.

authorities to conduct agricultural monitoring surveillance by UAS as outlined in the Farmers Privacy Act of 2012.¹⁰²

The ACLU is actively involved in the privacy debate surrounding UAS and has provided recommendations to states to enact legislation.¹⁰³ It recommends several core measures so that the privacy of Americans can be protected. It believes regulations should restrict usage to emergent situations and warrants must be obtained when use of a UAS could collect evidence of a crime.¹⁰⁴ The group also advocates restrictions on image retention and a requirement that police departments make public notice of their use. An effective auditing and tracking mechanism is also part of their core measures for implementation.

I. SAFE OPERATION OF UAS

The safe operation of UAS appears focused on the implementation of “sense & avoid” technology.¹⁰⁵ The potential for innovation in UAS is being driven by commercialization at both the national and international level in pursuit of regulatory and manufacturing standards. Additional analysis through simulation is necessary to further develop this technology.

The research suggests that new methods of ensuring collision avoidance as a way of improving integration efforts must continue to be studied.¹⁰⁶

Concerns over command and control latency, vehicle performance, reliability of autonomous functions, and interoperability of sense-and-

102 Farmer’s Privacy Act of 2012, Pub. L. No. 112–225 (2012), accessed September 10, 2015, <http://www.cbo.gov/publication/43583>.

103 American Civil Liberties Union (ACLU). *Protecting Privacy from Aerial Surveillance: Recommendations for Government Use of Drone Aircraft* (New York: ACLU, December 2011), <http://www.aclu.org/files/assets/protectingprivacyfromaerialsurveillance.pdf>.

104 American Civil Liberties Union (ACLU). *Protecting Privacy from Aerial Surveillance: Recommendations for Government Use of Drone Aircraft* (New York: ACLU, December 2011), <http://www.aclu.org/files/assets/protectingprivacyfromaerialsurveillance.pdf>.

105 Andrew Zeitlin et al., *Collision Avoidance for Unmanned Aircraft: Proving the Safety Case*. (McLean, VA: Mitre, October 2007).

106 Roland E Weibel and R. John Hansman, Jr., “An Integrated Approach to Evaluating Risk Mitigation Measures for UAV Operational Concepts in the NAS,” in *Proceedings of Infotech at Aerospace: Advancing Contemporary Aerospace Technologies and Their Integration 1* (2005): 509–519.

avoid systems with the Traffic Alert and Collision Avoidance System (TCAS) and Air Traffic Control must be resolved. [There is a] safety evaluation process that the international community has deemed necessary to certify such systems. The process focuses on statistically valid [estimates] of collision avoidance performance developed through a combination of airspace encounter modeling, simulation of the collision avoidance system scenarios, and system failure and event sensitivity analysis.¹⁰⁷

Numerous military UAS accidents have been attributed to communications structures that can easily be interrupted by EMI.¹⁰⁸ The disruption of a simple range omni-directional signal by a jammer is a concern of safe operation and their ease of use if sufficient power is available is equally as troubling. Cyber attacks to UAS need further exploration and are not the focus of this research.

J. LIABILITY OF UNMANNED SYSTEMS

Autonomous technology, such as UAS, has generated interesting debates in the insurance industry. It is possible that the autonomous features will lower collision rates and radically change the insurance industry landscape. It is possible that more of the burden of liability will be shifted to the UAS manufacturer than the owner and/or operator. Diverse academic research on the key policy issues related to UAS integration and UAS use by law enforcement enhances the ability of police executives to have available a growing body of knowledge necessary to develop UAS policy. The research conducted for this thesis is the most current literature, scoped to the issues of UAS privacy, safety and liability. The literature review provided the basis for the identification of knowledge gaps. Additional research on those knowledge gaps became the framework for the IRB-approved Delphi surveys distributed to subject matter experts.

¹⁰⁷ James Kuchar, *Safety Analysis Methodology for Unmanned Aerial Vehicle (UAV) Collision Avoidance Systems* (Lexington, MA: Massachusetts Institute of Technology, 2005), https://www.ll.mit.edu/mission/aviation/publications/publication-files/ms-papers/Kuchar_2005_ATM_MS-19102_WW-18698.pdf

¹⁰⁸ Jaysen A. Yochim, "The Vulnerabilities of Unmanned Aircraft System Common Data Links to Electronic Attack" (Master's thesis, U.S. Army Command and General Staff College, 2010).

III. RESEARCH METHOD—THE DELPHI METHOD

A. WHAT IS THE DELPHI METHOD?

The goal of conducting research using the Delphi method was to fill the knowledge gaps on UAS law enforcement policy with the most current analysis of the key policy issues. By surveying subject matter experts involved with UAS integration, a more comprehensive reference for police executives is created. This chapter provides an overview of the Delphi method, its historical context of application during war, and its application in this thesis. The collection of data from the Delphi panel established the framework for predictions and recommendations that are outlined in the concluding chapter of this thesis.

The Delphi Method is a social science research technique that was first developed to make an academic prediction on the impact technology would have during an in-theater conflict.¹⁰⁹ Its predictive features are closely linked to game theory. Frustrated by the shortcomings of traditional forecasting methods as he and several colleagues were attempting to decide the likely effects of a bombing strategy, Olaf Helmer argued that decisions in social science policy could be made with accuracy on the exercise of expert judgment and intuition.¹¹⁰ The Delphi Method uses a series of questionnaires to collect opinions from a panel of subject matter experts. It is well suited as a means and method to gain the most reliable consensus of a group.¹¹¹ Contrary to other data analysis techniques, The Delphi Method uses multiple iterations. During the iteration phase, questionnaires are returned to the researcher, who “codes” responses. Based on the analysis of responses, subsequent rounds of questions are developed with a statement of

¹⁰⁹ Olaf Helmer, *Analysis of the Future: The Delphi Method* (Santa Monica, CA: RAND, March 1967).

¹¹⁰ Norman Dalkey and Olaf Helmer, “An Experimental Application of the Delphi Method to the Use of Experts,” *Management Science* 9 (1963): 458–467.

¹¹¹ Chia-Chien Hsu and Brian Sandford, “The Delphi Technique,” *Practical Assessment, Research & Evaluation* 12 (2007). <http://pareonline.net/pdf/v12n10.pdf>.

the position of the whole group.¹¹² A primary advantage of the Delphi Method is the mutual anonymity of the respondents, which can reduce the influence of manipulation and coercion from dominant individuals that is often a problem with group-based processes. It also tends to encourage and increase candor in responses. Through secure online surveys to solicit and exchange information, confidentiality is facilitated by geographic dispersion of the respondents.

The Delphi Method has the potential of develop solutions for planning, policy and resource utilization. Historically, these are all areas in which effective application has been demonstrated in the academic setting. There are also several limitations to the Delphi Method that must be considered by a researcher that have the potential to affect survey candidate selection. A researcher must allow enough time to conduct and complete the research while facing the possibility of low response rates. In addition, a researcher must be aware of unintentional guidance to a respondent group that could steer a dialogue in a particular direction and call into question the integrity of the data.

B. THE EMPLOYMENT OF THE DELPHI METHOD IN THIS THESIS

The Delphi Method was employed to aggregate and code the knowledge and judgment of subject matter experts involved with UAS integration and law enforcement UAS policy development. The subject matter experts recruited as the Delphi respondents were identified by senior personnel at the Unmanned Aircraft Systems Integration Office, Federal Aviation Administration, and Department of Transportation. The literature review confirmed that these individuals were centrally involved in the development of UAS regulations and possessed experience with law enforcement UAS policy. Nine respondents were recruited for participation, and all nine participated in all three rounds of data collection. They were recruited from the following organizations:

- Department of Justice, National Institute of Justice
- Airborne Law Enforcement Association

¹¹² Murray Turoff and Harold Linstone, "The Delphi Method: Techniques and Applications," New Jersey Institute of Technology, accessed September 10, 2015, <http://is.njit.edu/pubs/delphibook/ch3b1.html>.

- International Association of Chiefs of Police
- University of North Dakota, John D. Odegard School of Aerospace Sciences, Center for Unmanned Aircraft Systems
- Michigan State Police
- Mesa County, Colorado Sheriff's Office
- Brookings Institute
- LeClairRyan
- TrueNorth Consulting LLC

To combine independent analysis with maximum feedback for building consensus and recognizing dissent among UAS integration experts, an IRB-approved sequence was established for Delphi panel participants.

1. Survey participants received an introductory phone call from the student researcher, explaining the research project and requesting consent to participate.
2. The student researcher forwarded a link to LimeSurvey Tool to each participant. LimeSurvey tool is a program approved by NPS for use in Human Subjects Research. The link directed each participant to a consent form. Once consent was received by the researcher, the first round of questions became available to the participant (Appendix A).
3. Following an analysis by the student researcher of the first round survey responses, a second round of survey questions was developed and forwarded to each participant (Appendix B).
4. Following an analysis by the student researcher of the second round survey responses, a third and final round of survey questions was developed and forwarded to each participant (Appendix C).

The risk of a breach of confidentiality was mitigated by keeping the personally identifiable information (PII) separate from the survey data being collected. It was necessary to collect PII on each participant as part of the identification and recruitment process. The survey responses have been de-identified and are not linked here to individual participants.

C. SURVEY GOALS AND A PRIOR ASSUMPTIONS

The overarching goal of applying the Delphi Method in this research project was to provide further investigation of the key issues prevalent in the literature related to public safety UAS implementation in a regulatory environment. The Delphi method exposes and explores areas of dissent, confusion, contradiction, ignorance and consensus.¹¹³ Academic research that aggregates, analyzes, and draws conclusions from the opinions of subject matter experts on key policy issues is a valuable resource for police executives or elected officials challenged by complex public policy decisions. When policy makers are able to review all sides of a debate, they have the best opportunity to avoid wasteful spending, mitigate risk and liability, and prevent public backlash. This transparency of the complex array of issues provides the most sustainable platform for a UAS to become a useful tool in public safety operations and crime-fighting strategies, and possibly become a model algorithm for how innovations in technology can transform policing.

Prior to administering the survey, this researcher predicted that the subject matter experts would agree that a law enforcement agency's successful development and execution of a sustainable UAS program would be directly linked to early community engagement to include civil liberty advocates, public messaging and transparency. This researcher also believed that a law enforcement agency, prior to operating a UAS, should establish protocols with well-defined training and operational requirements that complement the FAA's Interim Operational Approval Guidance 08-01.¹¹⁴

The first round of survey questions was drafted to establish a baseline from which to work forward on the key policy issues. First, the respondents were asked to describe the primary challenges with integrating UAS into the national airspace, based on the

113 Murray Turoff and Harold Linstone, "The Delphi Method: Techniques and Applications," New Jersey Institute of Technology, accessed September 10, 2015, <http://is.njit.edu/pubs/delphibook/ch3b1.html>.

114 sUAS News, "sUAS Regulations," accessed September 10, 2015, <http://www.suasnews.com/uas-regulations/>.

proposed regulations released by Federal Register on February 23, 2015.¹¹⁵ This description needed to include how the proposed regulations addressed the principles of safe operation, privacy, and liability at the federal level.

Second, because the literature suggests that technology will weigh heavily on safe operating standards in the future, garnering expert opinions of the adaptability of new regulations and policies to new technologies is a primary consideration for policy makers. As a result, three survey questions were compassed on the intuitive judgement of experts with a vision for UAS as a law enforcement technology in the future.

The third goal was to establish the viewpoints of the subject matter experts on law enforcement UAS policy and the related primary challenges of implementation within the culture of a police department. This set of questions addressed issues of safe operation, privacy, and liability issues specific to law enforcement UAS missions.

¹¹⁵ *Federal Register*, "Operation and Certification of Small Unmanned Aircraft Systems," February 23, 2015, <https://www.federalregister.gov/articles/2015/02/23/2015-03544/operation-and-certification-of-small-unmanned-aircraft-systems>.

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IV. RESULTS AND ANALYSIS OF DELPHI

A. UAS INTEGRATION

Respondents to the Delphi surveys identified a host of challenges with integrating UAS into a busy national airspace system. Among the primary challenges are the volume of anticipated UAS operators that could quickly overwhelm the air traffic control system and the inability for present-day radar infrastructure to track small UAS, creating an environment that prevents timely information to be passed to airman. With the entire national airspace system based on the see-and-avoid principle, it is challenging to introduce UAS that neither a pilot nor a radar operator can view. The primary challenge addressed in the proposed regulations is the establishment of strict guidelines on altitude and distance separation.

During round one of the Delphi survey, six out of nine respondents felt that requiring day operations within visual line of sight of the operator was the primary means by which the regulations attempted to address air safety. Restricting where UAS can fly and the requirement to identify a defined perimeter was felt to mitigate, but not eliminate the lack of UAS reliability and airworthiness standards. During the second round of survey questions, several respondents (5, 6, 9, and 8) further elaborated on sense and avoid technology. Five out of nine respondents concluded that until sense-and-avoid technology was available in civil aviation infrastructure, strict UAS policy and aggressive enforcement would be necessary to prevent mishaps.

An additional theme of concern voiced by all but one respondent was that the FAA did not have enough empirical data to develop the proposed UAS regulations. Respondent nine, who identified himself as a panel member on the FAA UAS Advisory and Rule Making Committee, whose recommendations formed the foundation for the proposed regulations, was in agreement that there was not enough empirical data. Respondent four wrote that divergent stakeholder groups with vested influence in building, selling and operating UAS played a role in the proposed rule-making. Round three, questions two and three explored the political pressure that influenced the speed at

which the proposed regulations received attention from the FAA. Five out of nine respondents felt the political pressure was significant and influenced the proposed regulations before they were well vetted.

Respondents were asked to provide recommendations on how UAS integration could have been proposed differently. Five out of nine respondents indicated that greater industry and public safety involvement would have been beneficial. Respondents 1, 3, and 5 identified that the advances of UAS technology and the demand for the technology did not allow for a well thought out implementation strategy based on the inputs the FAA was receiving.

When the proposed UAS regulations were published in February 2015, advocates for safe integration were surprised that mandatory airworthiness standards were not part of the guidance. Five out of nine respondents thought voluntary standards would not be effective. Respondent 4 stated that reasonable standards supported by rigorous testing and linked to funding mechanisms that require airworthiness standards may be an alternate method of ensuring agencies are operating reliable and effective UAS that mitigate liability. Legitimate manufacturers will emphasize the capabilities and technical standards that their devices meet. There was dissent among the respondent group about which component of airworthiness is the most important. While some respondents felt that software and control system security was the most vulnerable feature requiring standards, others felt that airframe, power plant, props and rotors were equally important.

Despite the disagreement over which component was most vulnerable, the respondents agreed that if airworthiness standards were developed in the future, they should follow the same general guidelines as manned aircraft and the industry could benefit from independent standard development organizations such as IEEE, ASTM and UL working in partnership with the FAA. Respondents envision minimum airworthiness standards on components, radio frequency, speed, payload, weight as well as mandates for maintenance intervals, inspections and lighting/markings.

Strong advocacy for the implementation of sense-and-avoid technology emerged in the responses. Three respondents (3, 5, 7) indicated that while sense-and-avoid

technology was several years away from full implementation and is aligned with ADS-B implementation. Companies such as Google and Amazon, who have strong profit-driven reasons to invest in UAS technology, are likely to boost the research timeline. Three respondents (2, 3, 7) indicated that sense-and-avoid technology may be both payload- and cost-prohibitive for operators of small UAS. Respondent 2 indicated that full implementation of sense-and-avoid technology would have the potential to allow the FAA to remove the line of sight restriction and allow safe long distance UAS operations expanding the mission profile of an approved law enforcement UAS program.

B. PRIVACY CONCERNS

One of the most debated topics within UAS integration surrounds privacy and the perception of potential intrusiveness. Six out of nine respondents of the survey group described this policy issue as overstated, misrepresented, a distracting force to general integration strategy, and a perceptual challenge for law enforcement. The survey group was unanimous in its opinion that the issue of privacy was not addressed in the integration strategy or the proposed regulations because it is not within the statutory authority of the FAA. Commercial UAS operator privacy enforcement has been delegated to the Department of Commerce, National Telecommunication and Information Administration (NTIA). The Department of Justice, Civil Rights Division, under the legal framework of the Fourth and First Amendments, will provide oversight of public operators. It is interesting to note that the FAA did compel the six FAA-approved UAS test sites to develop privacy policies as part of their operating authority.

There are two conceptual frameworks that emerged from the survey on how to manage the privacy issues surrounding a law enforcement UAS program appropriately. First, three out of seven respondents advocated for transparency measures, such as an independent advisory board and early public messaging, for a department considering implementing a UAS program. The second and collateral approach is to ensure appropriate digital evidence procedures are in place that adequately address image retention and storage. Respondents did not view this approach as new, but rather as

consistent with sound public policy formulation. Several respondents referenced IACP guidelines as a model template that adequately addresses these issues.

During the second round survey, respondents were asked whether they believed the Fourth Amendment case law that applied to manned aircraft and other technology used by the police was adequate and applicable to UAS. There was disagreement among the survey group on this topic. Four respondents (1, 3, 7, 9) believed that current case law would provide the appropriate legal framework for UAS. Five respondents (2, 4, 5, 6) felt that a new legal framework will likely be created as UAS search and seizure cases make their way to the Appellate and Supreme Court. It is interesting to note that two respondents in the survey group are practicing attorneys representing government clients in aviation-related matters including UAS, and they disagree on whether current case law is an adequate legal framework. Three respondents (1, 2, 9) felt that external factors derived by the modern electronic age, such as the NSA's controversial surveillance programs, Hollywood, and the general public mistrust of the government is likely to generate new and applicable case law.

C. UAS LIABILITY

UAS has the potential to transform certain characteristics of policing. Once the proposed regulations are in place, a liability framework will emerge that will lead to an increased need for insurance. Survey respondents agreed unanimously that the proposed regulations do not address liability, but the literature suggests that federal regulation may even require minimum liability coverage in the future.¹¹⁶ There was also consensus in the survey group that the ultimate liability for any government agency that chooses to operate a UAS in support of their public safety mission rests with the agency itself. Three respondents (5, 8, 9) believed that a portion of UAS liability from a police department could attach to a third party if culpable negligence is present through defective manufacturing and/or software glitches. Respondents drew a distinction between the autonomous car and a UAS. No clear path to taking human interface out of the decision

¹¹⁶ Jonathan S. Ziss, "Drone Regulation Would Create Need for Liability Insurance," *Business Insurance*, November 23, 2014, <http://www.businessinsurance.com/article/20141123/ISSUE0401/311239999>.

loop in civil UAS operations has been established. Respondent 4 equated the characteristics of true autonomy with the current debates on autonomous cars. Three respondents (4, 3, 7) view the liability framework as part of the evolution of the technology, yet reliant still on traditional principles of foreseeability, reasonableness, duty of care, assumption of risk, and intent.

D. SAFE OPERATIONS IN A LAW ENFORCEMENT UAS PROGRAM

A review of respondent answers to survey questions about maintaining safe operations reveals themes similar to those on model safety policies of manned airborne law enforcement operations. Implementing and enforcing comprehensive unit policies aligned with FAA regulations, adopting a mission profile and outlining a mission approval process, developing a minimum initial and recurrent training program, and implementing a risk assessment tool and comprehensive safety management system are included in respondent recommendations (1, 3, 7, 9).

There is dissent among the survey group in its assessment of whether the COA approval process for law enforcement creates a culture of safe operations. The perspective of survey respondents is that a safety culture must emerge from within the organization, must be consistent with manned aviation culture, and cannot be correlated with the COA (4, 6, 9). An opposing view was expressed by several respondents describing the FAA COA process as a comprehensive review that contributes to the establishment of safe operations (1, 2, 7, 9). Two respondents (3, 5) stated that it is difficult to assess the true impact on the COA on public safety UAS operations as the process is still in its infancy and no empirical data has been collected.

E. LAW ENFORCEMENT MISSION PROFILE

The survey group was unanimous that a law enforcement agency can operate a UAS and that both the number of agencies operating a UAS in support of their Department's mission and the mission profile of a law enforcement UAS program will expand under the proposed regulatory environment. The consensus of the respondents is that UAS could support about a third of the missions flown by manned police aircraft at a

significant cost savings and serve many roles that are not filled by more expensive assets or other tactics.

Respondents outlined three basic challenges to agencies implementing a UAS program. The primary challenge was education, assuring the public that the UAS will not be used to invade their privacy or to collect and store data that has no specific purpose other than broad sweeping of the jurisdiction fishing for evidence of criminal behavior. A second challenge is convincing the political arm of local government that the expense of owning and operating a UAS unit is a worthwhile expenditure of taxpayers' money, and that the technology can serve a useful purpose that cannot be readily achieved by other means. A third area of concern is safe operations of the UAS so that they do not interfere with manned air traffic or create an undue hazard to people and property on the ground.

The importance of safety resonated throughout all three iterations, among all respondents. The minimum training requirements recommended by the survey group went well beyond the requirements established by the proposed regulations:

- Review of applicable FAA regulations and guidance
- Current UAS Systems overview
- Pre-flight inspection requirements
- Instruction on airspace classification
- Instruction on aeronautical chart interpretation
- Comprehensive overview of aviation weather
- Interpreting notices to airmen (NOTAMS)
- Basic aviation radio communication terminology
- Practical exercises on visual scanning
- Instruction and practical training application of emergency procedures including loss of GPS; operation of sensor systems; incident and accident criteria and reporting.
- Review of flight documentation requirements (operator and aircraft logbooks)
- Instruction on Fourth Amendment case law

Because of the nature and number of these recommended minimum training requirements, there was consensus in the survey group that an agency with an existing aviation program would have a considerable advantage starting a UAS unit-based on its aviation knowledge and experience over agencies without one. Respondents supported a concept modeled on a professional flight department, scaled down to reflect the differences in size and complexities of the systems used. Respondents conceded that the knowledge gaps for a department with no aviation experience were not insurmountable.

Survey respondents were asked to identify the primary mission profile of a law enforcement UAS program (Appendix D). Respondents (4 and 6; or “7 respondents”) indicated that defining the mission profile and communicating that profile to the community was an important policy consideration to implement and sustain a UAS program.

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V. CONCLUSION

A. REVIEW

This thesis examined the impact of a new regulatory environment on law enforcement use of UAS in support of their mission to investigate crime and protect its citizens. The FAA and DOJ have had temporary procedures in place since March 2012 that issue limited operational guidelines to law enforcement to receive approval for UAS flight, but police executives and elected officials have been slow to adopt this technology because of concerns over safe operation, intrusiveness and liability.¹¹⁷ In February 2015, the FAA released new regulations for public comment after recommendations were provided by the UAS ARC. By performing a thorough literature review of the related policy issues and querying subject matter experts responsible for creating the architecture for the proposed regulations, this researcher was able to conduct an analysis of whether the issues of safety, privacy and liability are adequately addressed in the regulations. The author also identified their impact on a law enforcement UAS for policy makers to consider.

B. RECOMMENDATIONS

The FAA has proposed a new regulatory environment for both public and commercial UAS operations. After careful consideration of the policy issues and recommendations identified in this thesis, law enforcement executives and elected officials should be able to make informed decisions on UAS use in their community. This author supports UAS by a police department and other public safety agencies providing the following recommendations are implemented:

1. A police department should plan for early community engagement, prior to UAS program implementation. Early engagement and transparency on intended use will assist in building public trust. Educate the public on the dramatic differences between a large military predator drone reserved for combat operations and the small quad copters under evaluation as a tool for law enforcement similar to an RC flyer. Build a UAS mission profile

¹¹⁷ Federal Aviation Administration, "FAA Makes Progress with UAS Integration," accessed September 10, 2015, <https://www.faa.gov/news/updates/?newsId=68004>.

based on input from your community that allows the mission to drive the use of the technology and does not encroach on the fringe or outside the boundaries of public acceptance. Select an advisory board that will develop your concept of operations.

2. Mandate that operators follow established FAA regulations and receive approval through the COA process. Police executives and elected officials must know that the COA process does not equate to safe operations, and is only the minimal requirement threshold to operate a UAS in the NAS. Implementation of safety management system similar to those in manned aviation is recommended.
3. An agency must adopt a comprehensive policy framework that addresses safe operations and privacy—including data retention and storage—and that protects personally identifiable information and identifies a specific mission profile. *IACP—Guidelines for the Use of Unmanned Aircraft* is a model policy that can be used as a template for such policy development.
4. The lack of regulatory airworthiness standards remains a barrier to safe operations. Police departments should therefore model practices from manned aviation and develop standards for UAS procurement, maintenance and inspection intervals. Opening dialogue with approved UAS test sites may be helpful to policy development in this area.
5. The combined action of regulatory agencies, UAS industry professionals, academics, public safety professional and private sector interests is required to fully develop, implement and mandate sense-and-avoid technology to increase safe operations.
6. Police personnel who are assigned UAS must complete an agency-approved training program to ensure proper use and operations. The framework for a training program should be based on the following core competencies:
 - Applicable FAA regulations and guidance
 - UAS Systems overview
 - Pre-flight inspection
 - Airspace classification
 - Aeronautical chart interpretation
 - Aviation weather
 - Interpreting notices to airmen (NOTAMS)
 - Basic aviation radio communication terminology

- Visual scanning
- Emergency procedures including loss of GPS; operation of sensor systems; incident and accident criteria and reporting.
- Flight documentation (operator and aircraft logbooks)
- Fourth Amendment case law

A robust training program should be required at regular intervals to ensure the continued effective use and operation, and the proper calibration and performance, of the equipment. Commanding officers with the responsibility of approving UAS missions should be trained in local and federal laws related to UAS operations.

The UAS policy landscape is highly fluid at the time of this research. The scope of this thesis focused on whether a law enforcement agency should operate a UAS. Our conclusion is that with the acquisition and maintenance of technical, legal, and policy expertise, law enforcement agencies can and should take advantage of the cost savings, technical capabilities, and mission performance offered by this technology. Lateral issues outside the scope of this research are the privacy and security risks of UAS operated by private citizens and commercial operators, which themselves will shift the debate, the response or engagement of law enforcement, and the policy landscape.

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APPENDIX A. FIRST ROUND DELPHI SURVEY QUESTIONS

Project Title: Considerations for Domestic Law Enforcement Implementation of a UAS Program in the Proposed FAA Regulatory Environment of Integration into the National Airspace System 1st Round Delphi Survey Questions <i>Released April 24, 2015</i>	
Section I – UAS Airspace Integration	1. What are the primary challenges with UAS integration into the National Airspace System?
	2. How are the principles of safe operation addressed in the UAS integration plan?
	3. How are the issues surrounding privacy addressed in the UAS integration plans?
	4. How are the issues surrounding liability addressed in the UAS integration plans?
	5. How do you think proposed or current regulations will adapt to new UAS technologies?
Section II - Law Enforcement UAS Policy	6. Do you believe a law enforcement agency should operate a UAS? If yes, why? If no, why not?
	7. If you believe a law enforcement agency should operate a UAS, what are the primary Challenges that a department would face with implementation of a UAS program?
	8. How should a Law Enforcement UAS program address safe operations issues
	9. What should Law Enforcement UAS program training include?
	10. How should a Law Enforcement UAS program address privacy issues?
	11. How should a Law Enforcement UAS program address liability issues?
	12. What do you believe will be the primary mission profile for a law enforcement UAS program?
	13. Do you believe that the new regulations will allow for a more routine use of UAS by a police department?
	14. What would a law enforcement UAS deployment protocol look like after new regulations are implemented?

Following a period of collation and analysis of the first round survey data, a second round of survey questions was drafted with the goal of giving a closer examination to some of the themes identified from the expert responses in the first round.

Themes identified in the first round survey data included:

- Cost benefit analysis of the initial and maintenance cost of UAS
- Empirical data used by the FAA to develop the proposed UAS regulations
- The use of “sense and avoid” technology
- Standards for reliability and airworthiness
- Data management
- The importance of privacy related issues and public perception
- The legal communities interpretation of UAS liability
- Creating a culture of safe UAS operations within a police department
- Model UAS policy review and development
- Law Enforcement UAS mission profile

APPENDIX B. SECOND ROUND DELPHI SURVEY QUESTIONS

Project Title: Considerations for Domestic Law Enforcement Implementation of a UAS Program in the Proposed FAA Regulatory Environment of Integration into the National Airspace System 2nd Round Delphi Survey Questions <i>Released May 28, 2015</i>	
Section I – UAS Airspace Integration	1. What are the biggest costs associated with implementation and maintenance of a UAS program?
	2. Do those costs—either individually or in the aggregate—outweigh the benefits of the program?
	3. Do you agree with this assertion that the FAA did not have enough empirical data when proposing new UAS regulations? If not, please make the counterargument.
	4. If so, how specifically should UAS integration have been proposed differently? What additional or different considerations or information should they have been based on?
	5. How far away is sense and avoid technology?
	6. What are the current obstacles to developing, launching, acquiring or using sense and avoid technology?
	7. Which regulations would need to change once sense and avoid technology is available?
	8. How will sense and avoid technology effect law enforcement UAS policy?
Section II – UAS Safety	9. How “smart” are the UAS regulations on the point of air safety and how specifically should law enforcement policy address it?
	10. What steps does the UAS industry need to take to improve the reliability of UAS?
	11. What should airworthiness standards look like for UAS?
	12. Would establishing standards of data management, perhaps in “blackbox” fashion, for examination in the event of a collision be helpful to UAS integration? Please respond to and discuss this idea.
Section III – UAS Privacy	13. Do you believe that existing privacy/4 th Amendment case law as it pertains to <u>manned</u> police aircraft is adequate and/or applicable to UAS? Please discuss.
	14. What NEW policy, practice or protocol could a law enforcement agency use to allay fears, change perceptions, or address real privacy violations?
	15. UAS operators would assume all liability. Do you agree or disagree with this assessment?
	16. In what scenarios would liability attach to other parties, e.g., manufacturer, software companies, maintenance personnel, third parties, etc.

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2nd Round Delphi Survey Questions
Released May 28, 2015

Section IV – UAS Liability	17. To what extent are liability issues in the use of UAS going to resemble existing liability laws and decisions as they pertain to similar technologies or circumstances? What liability issues or practices might evolve differently from existing liability laws?
	18. How will the legal community define negligence in the use of a UAS?
	19. Companies and insurers involved with driverless cars and the concept of being a “systems supervisor” has brought the need for additional legal clarification about liability. How do you believe the concept of “system supervisor” changes the liability landscape of UAS?
Section V – UAS for Law Enforcement	20. Two respondents argued that any police department without a current aviation program would lack sufficient expertise in aviation to safely implement a UAS program. Do you agree or disagree with this assertion?
	21. What type and amount of training or certification constitutes minimum required competence to implement a UAS program? Please address this at the individual and agency level.
	22. How might a police department garner public support for its use of a UAS?
	23. Is the current FAA program that allows a police department to operate a UAS after obtaining a COA adequate enough to create a culture of safe operation? Please explain your answer.
	24. Should a police department operating a UAS for a specific incident notify the public of its use prior to or during the incident? Please explain your answer
	25. Should a Temporary Flight Restriction or Notice to Airmen be required during UAS use by a police department? Please explain your answer.
	26. Where does the IACP Unmanned Systems policy need customization or expansion to accommodate the specific requirements of UAS technology?
	27. There was no consensus among respondents on the primary UAS law enforcement missions. Which of the missions now flown by manned police aircraft could be executed just as effectively by unmanned aircraft? Which would be BETTER executed by a UAS?
28. One respondent recommended the use of an external advisory board for LE UAS policies and programs. What would be the advantages and disadvantages of an external advisory board?	

The second round of survey questions identified several themes from survey respondents.

- UAS effectiveness during mobile incident scenes
- Political influence of proposed UAS regulations

- Privacy influence of proposed UAS regulations
- Concept and focus of voluntary airworthiness standards
- Impact of future case law on UAS operations and other technology

The third and final round of survey questions was drafted with the goal of finalize the most appropriate mission profile of a law enforcement UAS program, explore the impact of airworthiness standards and further explain the potential impact that UAS will have on manned aircraft technology and policy.

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APPENDIX C. THIRD ROUND DELPHI SURVEY QUESTIONS

Project Title: Considerations for Domestic Law Enforcement Implementation of a UAS Program in the Proposed FAA Regulatory Environment of Integration into the National Airspace System 3rd Round Delphi Survey Questions <i>Released June 21, 2015</i>	
Section I – UAS Law Enforcement Mission Profile	1. What changes to UAS would need to take place to make them more effective during a mobile situation, such as a search and rescue incident?
Section II – UAS Integration	2. How do you believe politics either positively or negatively influenced the proposed regulations?
	3. Do you believe the FAA was distracted by privacy related concerns when they drafted the new regulations? Please explain your answer.
	4. What do you believe the impact on the industry will be if the standards are voluntary?
	5. Should airworthiness standards focus mainly on software and control system security? What should standards with this focus look like?
	6. Do you believe that the perception of privacy concerns will drive whether or not a police executive will implement a UAS program? If yes, how does a police department get beyond the perception?
	7. Do you believe new case law generated by the use of UAS will be unfavorable to both manned and unmanned aircraft in the future? Please explain your answer.

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APPENDIX D. FUTURE LAW ENFORCEMENT UAS MISSION PROFILE

Law Enforcement UAS Mission Profile

Delphi Survey Results

- Crime and traffic scene documentation
- Searches for victims and suspects within a defined perimeter
- Roof checks on alarm calls or suspicious circumstances
- Monitoring large crowds when specific criminal activity and/or riotous behavior is occurring
- Disaster response and recovery
- Radiation, biological and toxic smoke plumes sensing
- Public safety life preservation mission to include SWAT Operations and active shooter situations
- Support for fire department operations to assess fire progression and identify hot spots using infrared technology
- Hazardous material incidents
- Marijuana eradication

There was a range of opinion among the group on whether a mobile search and rescue situation could be effectively supported by a UAS for reasons described by a respondent with significant operational experience. Respondents 1, 5 and 9 felt that a UAS operator conducting a search of an area too big could violate the requirement to operate the unmanned vehicle within line of sight of the operator; a requirement in the COA and proposed regulations. Two respondents (4, 5) focused on the technical limitations of a UAS. Both argued that UAS camera systems have a 10-degree field of view, while human eyes from a manned aircraft can view 180 degrees. This technical limitation makes a manned aircraft a more effective option during mobile search and rescue mission not contained within a small defined perimeter.

The literature suggests that law enforcement policy makers have recognized the potential for UAS technology to be leveraged in support of their goals and objectives and that guidelines specific to law enforcement are needed on how a police executive would implement this technology after considering the police issues. Survey respondents were asked to evaluate the IACP – Recommended Guidelines for Use of Unmanned

Aircraft.¹¹⁸ It should be noted that survey participants were asked to review the model policy published in 2012. Several survey respondents indicated they had knowledge that an updated policy was in the process of being drafted by IACP. While the majority of the respondents indicated that they did not see significant policy gaps or areas for improvement, two respondents indicated that the policy was deficient in addressing issues of medical and written examination requirement for UAS operators and operator proficiency. One respondent also recommended that flight over a densely populated urban area should be specially addressed.

118 International Association of Chiefs of Police (IACP), *Recommended Guidelines for the Use of Unmanned Aircraft* (Alexandria, VA: IACP, August 2012)
http://www.theiacp.org/portals/0/pdfs/iacp_uaguidelines.pdf.

LIST OF REFERENCES

- American Civil Liberties Union (ACLU). *Protecting Privacy from Aerial Surveillance: Recommendations for Government Use of Drone Aircraft*. New York: ACLU, December 2011. <http://www.aclu.org/files/assets/protectingprivacyfromaerialsurveillance.pdf>.
- Anand, Saurabh. "Domestic Use of Unmanned Aircraft Systems: An Evaluation of Policy Constraints and the Role of Industry Consensus Standards." Internship paper, Washington University in St. Louis, August 2, 2007.
- Baron, Gerald. "UAVs and Emergency Management: Progress and Regress." *Emergency Management*, June 26, 2014. <http://www.emergencymgmt.com/emergency-blogs/crisis-comm/UAVs-and-Emergency-Managementprogress-and-regress.html>.
- Barry, Tom. *Drones Over the Homeland: How Politics, Money and Lack of Oversight Have Sparked Drone Proliferation, and What We Can Do*. Washington, DC: Center for International Policy, April 2013. http://www.ciponline.org/images/uploads/publications/IPR_Drones_over_Homeland_Final.pdf.
- Bennett, Wells C. "*Civilian Drones: Privacy and the Federal-State Balance*." Washington, DC: Brookings Institution, 2014.
- Bracken-Roche, Ciara, David Lyon, Mark James Mansour, Adam Molnar, Alana Saulnier, and Scott Thompson. *Surveillance Drones: Privacy Implications of the Spread of UAVs in Canada*. Kingston, ON, Canada: Surveillance Studies Centre, April 30, 2014. http://www.sscqueens.org/sites/default/files/Surveillance_Drones_Report.pdf.
- Bowman, M.E. "National Security and the Fourth and Fifth Amendments." In *National Security Law*, edited by John Norton Moore and Robert F. Turner, 1059–1087. 2d ed. Durham, NC: Carolina Academic Press, 2005.
- Dalkey, Norman, and Olaf Helmer. "An Experimental Application of the Delphi Method to the Use of Experts." *Management Science* 9 (1963): 458–467.
- Daniel, Kai, and Christian Wietfeld. "Using Public Network Infrastructures for UAV Remote Sensing in Civilian Security Operations." *Homeland Security Affairs Best Papers from the IEEE Conference on Technologies for Homeland Security*, 7 (2011): <https://www.hsaj.org/articles/71>
- Darnell, Bart W. "Unmanned Aircraft Systems: A Logical Choice for Homeland Security Support." Master's thesis, Naval Postgraduate School, 2011.

- DeBusk, Wesley M. “Unmanned Aerial Vehicle Systems for Disaster Relief: Tornado Alley.” Reston, VA: American Institute of Aeronautics and Astronautics, April 22, 2010.
- DeGarmo, Matthew T. *Issues Concerning Integration of Unmanned Aerial Vehicles in Civil Airspace*. McLean, VA: MITRE Center for Advanced Aviation System Development, November 2004.
- Department of Defense (DOD), *Unmanned Systems Integrated Roadmap FY2011–2036*, (n.p.: Progressive Management, 2012).
- Department of Homeland Security (DHS). *CBP’s Use of Unmanned Aircraft Systems in the Nation’s Border Security, Office of Inspector General*. Washington, DC: DHS, May 2012.
- Department of Homeland Security Office of the Inspector General (DHS OIG), *Use of Unmanned Aircraft Systems in the Nation’s Border Security*.(Washington, DC: DHS OIG). http://www.oig.dhs.gov/assets/Mgmt/2012/OIG_12-85_May12.pdf.
- Department of Justice, Office of the Inspector General, Audit Division. *Interim Report on the Department of Justice’s Use and Support of Unmanned Aircraft Systems*. Washington, DC: Department of Justice, Office of the Inspector General, Audit Division, September 2013. <http://www.justice.gov/oig/reports/2013/a1337.pdf>.
- Department of Transportation. *Unmanned Aircraft Systems (UAS) Operational Approval* (N 8900.227) Washington, DC: FAA, July 30, 2013. http://fsims.faa.gov/wdocs/notices/n8900_227.htm.
- Department of Transportation, and Federal Aviation Administration. *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. Washington, DC: FAA, 2013.
- DeVane, John C. “Applicability of Unmanned Aerial Systems to Homeland Defense Missions.” Master’s thesis, Naval Postgraduate School, 2012.
- Dolan, Alissa M., and Richard M. Thompson. *Integration of Drones into Domestic Airspace: Selected Legal Issues*. (CRS Report No. R42940) Washington, DC: Congressional Research Service, 2013.
- Engele, Jerome, Marc Sharpe, and John Evans. *Guidebook for Integrating a Micro Unmanned Aerial System* (DRDC CSSCR 2012–012). Ottawa, ON, Canada: Defense R&D Canada. <http://lgdata.s3-website-us-east-1.amazonaws.com/docs/1314/785668/micro.pdf>.
- Finn, Rachael, and David Wright. “Unmanned Aircraft Systems: Surveillance, Ethics and Privacy in Civil Applications.” *Computer Law and Security Review* 28 (2012): 184.

- Gertler, Jeremiah. *U.S. Unmanned Aerial Systems*. (CRS Report No. R42136). Washington, DC: Congressional Research Service, 2012. <https://www.fas.org/sgp/crs/natsec/R42136.pdf>.
- Government Accountability Office (GAO). *Unmanned Aircraft Systems: Federal Actions* (GAO-08-511). Washington, DC: GAO, 2008. <http://www.gao.gov/new.items/d08511.pdf>
- . *Unmanned Aircraft Systems: Measuring Progress and Addressing Potential Privacy Concerns Would Facilitate Integration into the National Airspace System-* (GAO-12-981) Washington, DC: GAO. <http://www.gao.gov/assets/650/648348.pdf>.
- Haddon, D.R., and C.J. Whittaker. *UK-CAA Policy for Light UAV Systems*. London: UK Civil Aviation Authority, 2004. <http://www.caa.co.uk/default.aspx?catid=1416&pageid=8547>.
- Hardee, Sarilyn, E. “Why the United States Supreme Court’s Rule in *Kyllo v. United States* Is Not the Final Word on the Constitutionality of Thermal Imaging,” *Campbell Law Review* 24 (2001): 53–70.
- Helmer, Olaf. *Analysis of the Future: The Delphi Method*. Santa Monica, CA: RAND, March 1967.
- Hsu, Chia-Chien, and Brian Sandford. “The Delphi Technique,” *Practical Assessment, Research & Evaluation* 12 (2007). <http://pareonline.net/pdf/v12n10.pdf>.
- International Association of Chiefs of Police (IACP). *Recommended Guidelines for the Use of Unmanned Aircraft*. Alexandria, VA.: IACP, August 2011. http://www.theiacp.org/portals/0/pdfs/iacp_uaguidelines.pdf.
- Jenkins, Darryl, and Bijan Vasigh. *The Economic Impact of Unmanned Aircraft Systems Integration in the United States*. Arlington, VA: Association for Unmanned Vehicle Systems International, March 2013.
- Joint Planning and Development Office, The (JPDO). *Unmanned Aircraft Systems (UAS) Comprehensive Plan, A Report on the Nation’s UAS Path Forward*. Washington, DC: JPDO, September 2013. http://www.faa.gov/about/office_org/headquarters_offices/agi/reports/media/uas_comprehensive_plan.pdf
- Kuchar, James. *Safety Analysis Methodology for Unmanned Aerial Vehicle (UAV) Collision Avoidance Systems*. Lexington, MA: Massachusetts Institute of Technology, 2005.
- Kuchar, James, and Ann Drumm. *Collision Avoidance for Unmanned Aircraft: Proving the Safety Case*. Bedford, MA: MITRE - Center for Advanced Aviation System Development, 2006.

- Langton, Lynn. *Bureau of Justice Statistics Special Report: Aviation Units in Large Law Enforcement Agencies*, Washington, DC: U.S. Department of Justice, July 2007. <http://www.bjs.gov/content/pub/pdf/aullea07.pdf>.
- Maddox, Stephen, and David Stuckenberg. "Drones in the U.S. National Airspace System: A Safety and Security Assessment," *Harvard Law School National Security Journal*, February 24, 2015. http://harvardnsj.org/2015/02/drones-in-the-u-s-national-airspace-system-a-safety-and-security-assessment/#_edn12.
- McKelvey, Tara. *Media Coverage of the Drone Program*. Cambridge, MA: Joan Shorenstein Center on the Press, Politics and Public Policy. <http://journalistsresource.org/wp-content/uploads/2013/02/D-77-McKelvey.pdf>.
- McNeal, Gregory. *Drones and Aerial Surveillance: Considerations for Legislators* (Washington, DC: Brookings Institution, November 2014).
- Means, Kevin P. *Tactical Helicopter Missions How to Fly Safe, Effective Airborne Law Enforcement Missions*. Springfield, IL: Charles C Thomas, 2007.
- Monnat, Daniel E., and Anne L. Ethen. "A Primer on the Federal Wiretap Act and Its Fourth Amendment Framework." *Kansas Trial Lawyers Association Journal* (March 2004): 12–15.
- Moore, Jeanie. "DaVinci's Children Take Flight: Unmanned Aircraft System in the Homeland." Master's thesis, Naval Postgraduate School, 2014.
- National Conference of State Legislatures. "Current Unmanned Aircraft State Law Landscape," September 14, 2015, <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx>.
- Office of the Privacy Commissioner of Canada (OPC). *Drones in Canada: Will the Proliferation of Domestic Drone Use in Canada Raise New Concerns for Privacy?* Quebec, Canada: OPC.
- Radler, Matthew. "Privacy is the Problem: United States v. Maynard and a Case for a New Regulatory Model for Police Surveillance." *George Washington Law Review* 80, (2011): 1209.
- Ravich, Timothy M. "The Integration of Unmanned Aerial Vehicles into the National Airspace." *North Dakota Law Review* 85 (2010): 597.
- Schlag, Craig. "The New Privacy Battle: How the Expanding use of Drones Continues to Erode our Concept of Privacy and Privacy Rights." *Journal of Technology, Law and Policy* 13, (2013).
- Schneider, Harvey A. "Katz v. United States: The Untold Story." *McGeorge Law Review* 40, no. 13 (2009): 13–23.

- Stanley, Jay, and Catherine Crump. *Protecting Privacy from Aerial Surveillance: Recommendations for Government Use of Drone Aircraft*. New York: American Civil Liberties Union, December 2011.
- Turoff, Murray, and Harold Linstone. "NJIT The Delphi Method: Techniques and Applications," New Jersey Institute of Technology, accessed September 10, 2015, <http://is.njit.edu/pubs/delphibook/ch3b1.html>.
- Villasenor, John. "Observations from Above: Unmanned Systems and Privacy." *Harvard Journal of Law and Public Policy* 36 (2013): 458–517.
- . *Products Liability and Driverless Car: Issues and Guiding Principles for Legislation*. Washington, DC: Brookings Institute, April 2014.
- Wallace, John. "Integrating Unmanned Aircraft Systems into Modern Policing in an Urban Environment." Master's thesis, Naval Postgraduate School, 2012.
- Warwick, Graham. "Sky Patrol." *Aviation Week & Space Technology* 174 (2012): 55–55.
- Weibel, Roland E., and R. John Hansman, Jr. "An Integrated Approach to Evaluating Risk Mitigation Measures for UAV Operational Concepts in the NAS," in *Proceedings of Infotech at Aerospace: Advancing Contemporary Aerospace Technologies and Their Integration* 1 (2005): 509–519
- Wright, David. "Should Privacy Impact Assessments Be Mandatory?," *Communications of the ACM* 54 (2011): 121–131.
- Yeomans, Gillian. *Autonomous Vehicles: Handing Over Control, Opportunities and Risks for Insurance*. London: Lloyds of London, 2014.
- Yochim, Jaysen A. "The Vulnerabilities of Unmanned Aircraft System Common Data Links to Electronic Attack." Master's thesis, U.S. Army Command and General Staff College, 2010.
- Zeitlin, Andrew, Andrew Lacher, James Kuchar, and Ann Drumm. *Collision Avoidance for Unmanned Aircraft: Proving the Safety Case*. McLean, VA: Mitre, October 2007.

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