

A Report by a Panel of the
NATIONAL ACADEMY OF PUBLIC ADMINISTRATION

*Fulfilling the Promise of
Small Unmanned Aircraft Registration:
An Action Plan for the FAA*



May 2020

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*Fulfilling the Promise of Small Unmanned
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An Action Plan for FAA*

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Foreword

Since 1958, the Federal Aviation Administration (FAA) has pursued its mission to “provide the safest, most efficient aerospace system in the world”. The safety aspect of that statement is especially important for a country that takes millions of flights every year. The FAA confronts both challenges and opportunities as it incorporates new technologies into an efficient aerospace system, including leveraging new aviation technology for recreation, welfare, and commerce.

The recent widespread availability of small Unmanned Aircraft Systems (sUAS) through online marketplaces and traditional retailers has posed a new challenge to the FAA’s dual-purpose mission. Over the span of several months approaching the holiday season of 2015, the FAA responded with a regulation requiring sUAS owners to register. This registration system is intended to identify who is operating in the nation’s airspace and to provide educational materials to this group of fliers, many of whom have little familiarity with basic aviation safety rules.

Congress directed the FAA to engage the National Academy of Public Administration (the Academy) to review the effectiveness of the registration rule and public compliance with it. The Academy formed a Panel of five Fellows with relevant industry, academic, and government backgrounds, to examine the program’s key objectives, effective practices, and information collected to track progress, enforcement, and communications. The Panel’s research combined many interviews with detailed reviews of FAA sUAS regulations and such key documents as General Accounting Office (GAO) reports. The FAA’s sUAS registration system was also compared with similar product registration systems of other federal agencies and international partners. It became quite clear that effective operation and management of the sUAS registration is essential for broader aviation safety.

The Academy, with over 950 distinguished Fellows, is uniquely positioned to help government agencies solve complicated challenges. We have appreciated the openness and cooperation of the FAA and other key stakeholders, like model aircraft associations, sUAS manufacturers, and law enforcement organizations. I am grateful for the thoughtfulness, expertise, and leadership of the five-member Panel of Academy Fellows and the professional Academy study team.

I anticipate that the Panel’s report, a practical action plan with concrete and achievable recommendations, will greatly assist the FAA in its ongoing efforts to integrate sUAS into the nation’s airspace to ensure that our skies remain the safest in the world.

Teresa W. Gerton
President and Chief Executive Officer
National Academy of Public Administration

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Acronym List

Acronym or Abbreviation	Definition
ABC	Activity-Based Costing
AFB-700	Civil Aviation Registry Division of the Office of Foundational Business
AFG-300	General Aviation C Division
AFS-800	General Aviation and Commercial Division
AMA	Academy of Model Aeronautics
APO-100	Forecast and Performance Analysis Division of the Office of Aviation Policy and Plans
ASH	Security and Hazardous Materials Safety
BVLOS	Beyond Visual Line-of-Sight
CES	Consumer Electronics Show
CTA	Consumer Technology Association
DAC	Drone Advisory Committee
DoD	Department of Defense
FAA	Federal Aviation Administration
FAAST	FAA Safety Team
FACA	Federal Advisory Committee Act
FMCSA	Federal Motor Carrier Safety Administration
FSDO	Flight Standards District Offices
FY	Fiscal Year
GAO	Government Accountability Office
IFR	Interim Final Rule

LEAP	Law Enforcement and Assistance Program
NAPA	The National Academy of Public Administration
NAS	National Airspace System
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
OMB	Office of Management and Budget
PHMSA	Pipeline and Hazardous Materials Safety Administration
PTRS	Program Tracking and Reporting Subsystem
REMOTE ID	Remote Identification of Unmanned Aircraft Systems
SXSW	South by Southwest
TFR	Temporary Flight Restriction
sUAS	Small Unmanned Aircraft System
UAS	Unmanned Aircraft System
UAV	Unmanned Aircraft Vehicle
UTM	Unmanned Aircraft System Traffic Management (UTM)

Executive Summary

Background

All small Unmanned Aircraft Systems (sUAS) weighing over .55 and under 55 pounds must be registered with the Federal Aviation Administration (FAA), which is responsible for maintaining the safety of the nation's airspace. The registry requirement went into effect in late 2015 after manufacturers released a range of affordable and appealing aircraft for the holiday season. The FAA faced the prospect of thousands of aircraft operating across the country without knowing their owner-operators, nor whether those individuals possessed even the most basic information on how to fly safely.¹

The FAA quickly established a task force that drew from the agency and such key stakeholders as associations and manufacturers. The FAA used those recommendations to create the "Registration and Marking Requirements for Small Unmanned Aircraft" Interim Final Rule (IFR) issued on December 16, 2015 (80 Fed. Reg. 78593). This rule required that, in addition to providing names, addresses, and email addresses, all registrants would directly display their registration number received on their aircraft. All commercial users would go further and register each individual aircraft. There would be a \$5 fee for the online registration. As of March 2020, more than 1.5 million people had registered. The FAA took key steps to implement the registry, assigning parts of its organization to, among many lines of effort, operate the database and enforce its provisions.

Section 371 of the FAA Reauthorization Act of 2018 directed the Secretary of Transportation to enter into an agreement with the National Academy of Public Administration (the Academy) to conduct an assessment of the compliance with, and the effectiveness of, the FAA's sUAS registration program.² The scope of work included an examination of the goals of the registration program, the types of information collected through the registration system, the processes by which the FAA determines compliance, and the regulatory environment as seen by such interested groups as local law enforcement, associations of recreational flyers, and industry.

Findings

The FAA established a registration system for sUAS that takes the first steps towards creating a means to notify and educate users, while setting in place a system of accountability to tie aircraft to owner-operators. Registration is a key foundation for safe integration of sUAS into the nation's airspace, and the agency has many of the key requirements needed for a successful registration system, when compared to other federal registration programs and international partners.

¹ See pages 5 and 13 of this report for explanation of the owner-operator terminology.

² "Public Law 115-254 - FAA Reauthorization Act of 2018". 2018. Washington, DC: U.S. Government Publishing Office. <https://www.govinfo.gov/app/details/PLAW-115publ254>.

The FAA has a great deal of work remaining to ensure a fully effective registration system with a high level of compliance. The review of elements of the registration system reveals mixed results. While there are many bright spots, significant accountability and enforcement challenges remain. The agency has not taken adequate steps to educate and inform sUAS owner-operators, especially recreational users, of the intricacies of flight rules and national airspace restrictions.

While the agency is actively focused on sUAS integration matters, more active management of the sUAS registration effort is required. The registration effort would be more likely to accomplish its policy goals if the FAA directed more of its attention to strategic communications, oversight, program implementation, and ongoing activities.

The number of registrations has grown steadily since 2016, and, as of March 2020, more than 1.5 million owner-operators have registered. The FAA does not track non-compliance, which means the agency does not know with certainty the specific number of owner-operators who should register, but have not. The FAA neither formally tracks nor adequately addresses the rate of compliance as part of its management of the registration system. The Panel estimates that owner-operators are failing to register as many as 200,000 unmanned aircraft.

While the FAA has taken many essential steps to provide public notice of the need to register, many owner-operators are still not consistently and directly receiving the message. The FAA has taken few compliance actions against those not registered. Many manufacturers do not include outside labeling or inside notification slips of the need to register in the packaging of sUAS. Online marketplaces fail to make prominent mention of registration requirements in their web presence.

The system as currently designed is ineffective in achieving the FAA's ability to tie an unmanned aircraft to its owner-operator. The agency acknowledged that registration is a necessary, but not sufficient step, for owner-operator accountability in its December 2019 Notice of Proposed Rulemaking (NPRM) on Remote Identification of Unmanned Aircraft. This new rulemaking, also referred to as Remote ID, seeks to create an "electronic license plate" on sUAS and allow pinpoint accuracy on the location of both aircraft and operator.

The FAA is leveraging its existing organizational structure and staffing to develop, monitor, investigate, and enforce the current "untested" inspection and enforcement system. The Academy Panel guiding this study is concerned that the Remote Identification NPRM – designed to connect the operator to the aircraft every time – will likely result in a significant increase in the investigation and enforcement caseload. Remote ID will enhance the FAA's ability to hold sUAS operators accountable for violations of safety and flight rules. This increase in work will further stress the current organization and staffing levels.

The FAA is successfully using the registration database to communicate with owner-operators about key safety and flight warning information, e.g., during wildfires or major sporting events. Owner-operators who are not registered do not receive these alerts and warnings.

The FAA's registration website, DroneZone, provides basic educational information. However, the site is challenging to navigate and makes a visitor labor to find critical resources.

The FAA has opted not to offer a knowledge test as part of the online registration experience. A test available during the registration process would be convenient for owner-operators, as well as a best practice internationally. Offering the test on the DroneZone, if not formally requiring test completion for registration and allowing individuals to take a test from other sources, would help ensure the as many owner-operators as possible receive critical information and pointers before flying.

After tentative efforts in the first few years after the IFR release, the FAA is making significant strides in reaching out through its communications to unmanned aircraft operators. Recreational operators may view these aircraft as toys rather than aircraft, and they may have modest to no understanding of the national airspace system (NAS).

Several of the issues identified in the course of this study stem from what emerged as a narrow view within the FAA of registration as strictly a process that deals with ownership, not usage and operations. That distinction is compelling when one considers the high expense of traditional manned aircraft that the agency has regulated over the decades. However, the costs of sUAS ownership are significantly lower than traditional aircraft and far more owners are also the operators of the sUAS. Registration of sUAS – as key stakeholders and as the IFR itself underscored – deals at once with ownership and operations. Hence, this report uses the term “owner-operator” throughout. The limited view is likely causing the agency to miss opportunities to engage and educate users on how to fly safely.

Registration is a critical step for safely integrating sUAS into the nation's airspace, the safest skies in the world. The FAA achieved a well-designed registration system that is the model for the world and has allowed the agency to focus on other crucial steps to safely bring in sUAS into the nation's skies. As it moves ahead, the agency must put renewed emphasis on registration to ensure higher compliance and effectiveness.

Recommendations

Strategic Leadership

The Secretary of Transportation, the FAA Administrator, and the agency's senior leadership should lead a renewed focus on the importance of the registration program, informing Congress

and the public more frequently of the critical role of registration in protecting the national airspace. Leadership should intensify its efforts to make the current system more effective.

1. Prioritize Registration

The FAA should ensure registration remains a top priority in its sUAS integration efforts, especially considering the statutes that require registration of all aircraft and the central role of safety in the FAA's mission.

2. Reinforce the Vision

The FAA should continue to underscore its broader vision of integrated operations of manned and unmanned systems to help stakeholders understand the need for registration and other operating restrictions.

Organizational Enhancements

While the Panel does not believe there is a need to substantially change the existing organizational structure that the FAA has put in place to oversee and manage sUAS registration, the existing UAS Integration Office should be provided significantly expanded authority and resources to have increased oversight on implementation and operations of the registration program.

3. Empower the Existing Integration Office

FAA should give greater responsibility and new authorities to the UAS Integration Office, including oversight authority of program implementation and ensuring that the registration system is operating effectively on a daily basis. A clearly designated program overseer-manager within the office would have responsibility to develop policy, coordinate on staffing levels, and set program finances and review costs and fees, as discussed further in recommendation 5 below. That overseer would coordinate closely with other divisions and offices with responsibilities for day-to-day execution of the registration program, like enforcement or database operations. The Office should also be responsible for the development of a quarterly performance metric dashboard and use this management tool to drive future decision making.

4. Expand and Intensify Intra-Agency and Interagency Coordination

The FAA should elevate one of its interagency committees, the UAS Executive Work Group for example, to create a high-level sUAS management council that brings together responsible agency officials to discuss cross-cutting issues and coordinate on a common agenda. The FAA should also expand its work with other federal agencies to ensure its UAS Executive Committee, which brings together senior officials from the FAA, the Department of Defense, the Department of Homeland Security, and NASA covers all the key federal stakeholders and continues to meet regularly to discuss common and cross-cutting issues. It is critical for the FAA to learn the lessons of other agencies and exchange best practices.

Financial Management

The FAA should ensure that the registration fee is correctly set to cover the costs of providing the public service. The agency must ensure it has clarity on program costs and plans for enhancements, along with the necessary financial reporting systems in place.

5. Financial Accountability

The designated program overseer-manager within the empowered UAS Integration Office discussed in recommendation 3 above, should also have responsibility for managing finances and be accountable for results in this realm. A program office with an overseer in charge of reviewing program costs, fees revenue, and maintaining a balanced budget would create greater accountability, ensuring officials have clear responsibilities and performance expectations.

6. Evaluate Fees and Costs

The FAA should reexamine its fees structure for the registration program. The FAA must be clear why it charges the current fee rate, and whether the current total revenue covers all program costs, allowing for full cost-recovery. The FAA should update its existing cost accounting system to provide greater visibility into the cost of registration, potential knowledge test-taking, law enforcement support, and other related functions. The FAA should accelerate its efforts to comply with U.S. Office of Management and Budget (OMB) guidance and U.S. Government Accountability Office (GAO) recommendations on financial reporting to ensure the financial management enhancements are in place prior to the Remote ID rulemaking and the registration final rule.

7. Conduct an ABC Study

The FAA should conduct an Activity-Based Costing (ABC) study to ensure it is setting the fee, currently \$5, at the right level.

Accelerate Planned Rulemakings

To address the compliance challenges and enhance its ability to notify users of flight restrictions, the FAA should consider pursuing a range of additional regulations.

8. Accelerate Remote Identification

The FAA should support the timely implementation of its rulemaking on remote identification to address the gap between the number of sUAS units owned and registration-compliant recreational owners. The final rule should include aircraft serial numbers and make and model information, as well as obtain registrant mobile numbers to facilitate timely flood-warning-style messages.

9. Enhance Package Labeling

The FAA should provide specific guidelines and require manufacturers to inform new owner-operators of the requirement to register their aircraft by requiring a statement on the inside and outside of the box.

10. Consider Adoption of Software Locks

To ensure the owner-operator of any given sUAS has registered with the FAA and taken a flight knowledge test, the FAA should explore the requirement that manufacturers implement a software lock on sUAS units. These locks can prevent operation of the sUAS before the owner-operator indicates that both legislative requirements – aircraft is registered and the operator takes a test – have been satisfied.

11. Finalize the IFR

In order to follow proper administrative procedure, learn the lessons from implementation of its registration regulation, and to consider feedback during the public comment period for the Remote Identification NPRM, the FAA should finalize and publish the Registration IFR.

Require Performance Management

FAA leadership should routinely monitor new registration trends and make regular program adjustments to enhance its existing efforts to meet the registration goals of owner-operator education, accountability, and notification.

12. Publish Compliance Trends Regularly

In line with recommendation number 1 to ensure registration is an agency priority, the FAA should track and report compliance metrics to the public.

13. Fully Understand Market Trends

The FAA should enhance its on-going efforts to understand the unmanned aircraft market more comprehensively and act on the data it collects from manufacturers and forecasters.

14. Report Enforcement Actions

The FAA should ensure that decision-makers, such as the Executive Director of the Flight Standards Service, the Executive Director of the UAS Integration Office, the Associate Administrator for Aviation Safety, and the FAA Administrator, receive regular reports on unmanned aircraft events, investigations, enforcement, and education actions.

15. Publish Metrics

Section 371 of the FAA Reauthorization Act of 2018 requires the FAA Administrator and the Secretary of Transportation to monitor and report on compliance, enforcement actions and fees. FAA should add the following additional areas to the performance metric dashboard referred to earlier, including social media and website contacts with sUAS owner-operators, the number and geographical spread of warnings sent to owner-operators through the registry, and pilot education and testing.

Enhance Enforcement Program

The FAA should take steps to improve its ability to enforce the IFR, especially as Remote Identification, if implemented with key provisions like serial numbers, increases caseloads. A strong relationship with state and local law enforcement, which has already begun, will be a key ingredient to becoming better postured for accountability and enforcement.

16. Perform Business Process Review on Enforcement Functions

The FAA should conduct an end-to-end business process and staffing review to understand how an anticipated increase in caseload would impact the overall enforcement system. FAA should engage an independent research center to map the enforcement process and “test” that system against low, medium, and high caseloads to identify weak points and structural flaws.

17. Strengthen Local & State Law Enforcement Cooperation

The FAA should strengthen cooperation and collaboration with state and local law enforcement with the adoption of formal communications protocols, including a common incident form. The FAA should step up its outreach efforts, reaching out to additional local and state law enforcement associations. The FAA should provide the law enforcement community a means for more direct, expedient, and timely access to the registry, possibly through operations/fusion centers.

Notification, Education, and Communications

To meet the unique and significant challenge of outreach to a very large number of sUAS users who may be unfamiliar with the FAA, flight rules and restrictions, and the national airspace, the FAA should take a number of steps.

18. Reorganize and Release a New Version of the DroneZone

As the FAA continues to rely heavily on its website for user education, training, and registration, the FAA should enhance the DroneZone websites’ visibility, navigation, loading, and archiving features. The website should be intuitive and have a logical navigation roadmap, and search engine optimization.

19. Get More Creative with Outreach

The FAA should enhance creative methods of engagement with the non-traditional owner-operator of unmanned aircraft, including better collaboration of “individuals and centers of influence” to encourage compliance with registration and flight restrictions. The FAA should develop and implement a content management system to manage its communications strategy at an enterprise level.

Chapter 1: Introduction

The recent widespread availability of affordable small Unmanned Aircraft Systems (sUAS) in the global marketplace has opened up new realms for commerce and recreation.³ The global market for civil unmanned aircraft systems is predicted to quadruple by 2026 from its 2018 levels, constituting a 15.5 percent compound annual growth rate in constant dollars.⁴ The rise of all new technologies, but especially one operating within the nation's skies known as the safest in the world, poses numerous policy, regulatory, and public administration challenges. The United States, like other countries, is continuing to lay the regulatory foundations that will allow for the rapid proliferation of Unmanned Aircraft Systems (UAS).⁵

As the December holiday season approached in 2015, the U.S. faced a daunting challenge as new sUAS were released to consumers. The U.S. Government agency responsible for aviation safety, the Federal Aviation Administration (FAA), faced the prospect of tens of thousands of sUAS flying without knowing their owners, let alone whether those operators knew anything about how to fly safely. Over the course of three months, the FAA promulgated an Interim Final Rule. Under the rule, sUAS above the weight of .55 pounds and below 55 pounds would have to register through an online process. Owners of sUAS for recreational purposes would not have to register each individual aircraft, but instead register themselves and display their individual registration number on each aircraft.⁶ There would be a \$5 fee for registration.⁷

As of March 10, 2020, more than 1.5 million individuals have registered through the FAA's Unmanned Aircraft Registry. Recreational and commercial users accounted for 1,117,900 and 441,709 of the total number of registrations, respectively. The current number of unmanned aircraft registered with the FAA is about five times the approximately 316,000 manned aircraft registered with the FAA as of October 31, 2017.

³ This report makes reference to both the terms "sUAS" and "UAS". "UAS" are the larger category, without specifications regarding weight, while "sUAS" refers to the type of aircraft described in the reports scope of work.

⁴ Finnegan, Philip. 2018. *World Civil Unmanned Aerial Systems Market Profile and Forecast*. Fairfax, Virginia: The Teal Group Corporation.

⁵ Unmanned Aircraft Systems (UAS) refers to all unmanned aircraft systems, while the term small Unmanned Aircraft Systems (sUAS) refers to those between .55 and 55 pounds, the subject of this report.

⁶ The use of the term "recreational" refers to aircraft operating under the authority of Title 49 U.S.C. 44809, which allows for sUAS operations when, among other requirements, users fly within line-of-site for recreational purposes. "Commercial" refers to sUAS operations under 14 CFR Part 107 that defines operations for other than hobby or recreational purposes, including for-profit commerce.

⁷ Appendix C provides a fuller description of the IFR.

Project Origin and Scope

Section 371 of the Federal Aviation Administration Reauthorization Act of 2018 directed the Secretary of Transportation to enter into an agreement with the National Academy of Public Administration to conduct an assessment of the compliance with, and the effectiveness of, the FAA's registration program for small Unmanned Aircraft Systems.⁸ The specific focus of the assessment was the Interim Final Rule on "Registration and Marking Requirements for Small Unmanned Aircraft" issued on December 16, 2015 (80 Fed. Reg. 78593).⁹

The Academy formed a Panel of experts with support from a professional study team to analyze both (1) compliance with the FAA's registration requirements and (2) evidence on the effectiveness of those requirements on meeting the underlying purpose of the registration, which is to promote the safety of the national airspace through education of users and identification of the aircraft in the event of an incident or accident.

The study included several lines of inquiry, including:

- Summarizing regulatory goals, based on discussions with the FAA and review of congressional hearings and other relevant reports;
- Assessing whether the types and quality of information currently collected by the FAA under the registration program for small unmanned aircraft are well-suited for monitoring performance, and strategies for addressing any potential data gaps;
- Examining information collected through the regulatory system and other sources, such as industry data on UAS sales, usage and incidents, to help validate or augment the agency's data on compliance and effectiveness;
- Examining how non-compliance is determined, including reporting processes to the FAA from state and local law enforcement and other officials, and whether there are challenges in collecting these data as well as steps to mitigate any gaps identified;
- Discussing the regulatory environment with stakeholders, including manufacturers of small unmanned aircraft, current and potential commercial users, representatives of non-commercial users, airlines and general aviation, airport authorities, and privacy advocates; and
- Assessing the organizational aspects of the FAA's program, and whether information is effectively shared, and responsibilities are clearly assigned across offices within FAA.

⁸ U.S. Congress. 2018. "Public Law 115-254 - FAA Reauthorization Act of 2018." Washington, DC: U.S. Government Publishing Office. <https://www.govinfo.gov/app/details/PLAW-115publ254>.

⁹ U.S. Federal Aviation Administration. 2015. *80 Fed. Reg. 78593: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

Study Approach and Methodology

The Academy study team adopted a research methodology that focused on both compliance and the regulation's effectiveness in achieving the requirements for aviation safety.

The research methodology included both documentary review and interviews. With respect to documentary review, the study team reviewed written materials on relevant topics prepared by the FAA and other research organizations, academic journal articles, and research completed by auditors, such as the U.S. Government Accountability Office (GAO). Specific sources are cited in footnotes in this report, and a combined bibliography is found in Appendix D.

The study team conducted interviews with more than 40 individuals (see Appendix B for the list of interviewees during the Academy's assessment on the FAA's IFR). The study team met with current and former FAA employees who are assigned to headquarters, and the field. In addition, the study team met with Congressional Committee Staff, as well as representatives from GAO, other federal agencies, trade associations, and external experts who focus on aviation and unmanned systems.

Owner-Operator Terminology

The term "owner-operator" is used throughout the report, instead of simply "owner". The registration process for aircraft regulated by the FAA has historically centered around specifying owners who hold title to the craft itself. That approach is compelling when one considers the high expense of traditional manned aircraft ownership. However, the costs of sUAS ownership are significantly lower than traditional aircraft and far more owners are also the operators of the sUAS. Key stakeholders and FAA officials interviewed in the course of this study used the terms interchangeably. The IFR itself highlighted one of the key purposes was to engage not just with owners, but to connect with users. Registration as applied to sUAS deals at once with ownership and operations.

Organization of the Report

Chapter 1 serves as an introduction and reviews the project scope and methodology;

Chapter 2 provides the specific goals and objectives of the registration program to contribute to aviation safety, reviews the organization the FAA created to implement the registration system, and the role of fees to meet program costs;

Chapter 3 reviews compliance, looking at compliance rates, the FAA's efforts to track these rates and broader sUAS market trends, and whether sUAS owner-operators are receiving communications about the requirement to register;

Chapter 4 begins the review of the IFR's effectiveness to date, looking at the IFR's foundational role in enabling future regulations and operation of sUAS in the United States national airspace, as well as comparing the FAA's sUAS registration system against best practices of other federal registration systems and other international sUAS registration approaches;

Chapter 5 details the FAA's efforts to enforce the regulation, examining the broad approach and the role of local of law enforcement in registration enforcement;

Chapter 6 details the FAA's strategy and current efforts to communicate, educate, and notify owner-operators on the requirements set forth in the IFR; and

Chapter 7 provides recommendations to enhance the FAA's organization for implementation of the IFR and subsequent rulemaking and regulations.

Chapter 2: The IFR and Goals of Registration

The FAA had the right goals in mind as it constructed the sUAS regulation consistent with the strong governmental interest in ensuring accountability, educating and notifying flyers, and ensuring security, all of which contribute to the goal of safe skies. By taking a decentralized approach to implementing the IFR consistent with its approach to manned aircraft, the FAA does not have a coherent focus on strategy, oversight, or the big picture on sUAS across the organization. It is unclear whether the agency is setting the fee for registration correctly to optimally manage the registration system and recover the associated costs of providing this public service.

This chapter articulates what the FAA is hoping to accomplish with the IFR. These objectives are either stated directly in the regulation or derived from the study's research.¹⁰ This chapter also assesses how the FAA implemented the IFR, including the program it set up to carry out the registration and how it assigned functions across the organization. This chapter also examines program costs and fee-structure.

Goals and Objectives

Underlying the IFR, its various modifications, and the recent Notice of Proposed Rulemaking on Remote Identification are a set of goals that the FAA hopes will allow it to achieve safe integration of sUAS into the nation's airspace. These goals helped drive the pace and shape of its broader regulatory efforts, as well as the Administration's specific actions during implementation. It is necessary to understand the key drivers of the regulation in order to assess its effectiveness. This section lays out the primary and secondary goals FAA hopes to achieve with the registration regulation as described earlier. With a description of each area, parts of the IFR and regulation most relevant to this goal are discussed.

¹⁰ The term "IFR" is used interchangeably with "Registration Rule" and "Part 48," the portion of Code of Federal Regulations, Title 14. While the regulation was promulgated through an interim rule and now resides in the federal code, the Congress' basic charge to the FAA and the Panel's study was to assess the effectiveness of the IFR.

Primary Goals

Fulfilling Statutory Requirements and FAA's Core Mission

The IFR's primary and explicit goal is to ensure that the FAA follows the most basic statutory requirement for ensuring aviation safety. Numerous statutes enacted over decades underscore the need for registration.¹¹ In releasing the IFR for immediate adoption, the FAA Administrator affirmed that "all unmanned aircraft, including model aircraft" must be registered, which was consistent with congressional direction in 2012 legislation.^{12,13} The FAA's central mission as set forth in its basic charge is safety of the nation's skies, which drives much of the agency's work. The statute advances the core goal of creating a safe, effective, and efficiently managed national airspace.

As the FAA released the IFR, questions arose as to whether all UAS met the definition of an aircraft, and whether owner-operators would have to register. Several recreational sUAS flyers filed lawsuits, claiming that the registration was unnecessary. On May 19, 2017, the U.S. Court of Appeals for the District of Columbia Circuit vacated the FAA's registration rule as it applied to model aircraft.¹⁴ The Court held that, subject to the FAA Modernization and Reform Act, the FAA "may not promulgate any rule or regulation regarding a model aircraft".¹⁵ In December 2017, the President signed the 2018 National Defense Reauthorization Act, reinstating the registration requirement for model aircraft.¹⁶ This specific statutory obligation settled the legal question. Stakeholders interviewed in the course of the study agreed that registration is critical for aviation safety.

Accountability

The second main objective of the registration regulation is accountability. Tying an aircraft to its owner-operator is the starting point for any aviation safety regime. If an incident occurs, a craft can be tied to the owner-operator involved, leading to investigation and remediation. To meet

¹¹ U.S. Code, U.S. Federal Aviation Administration. 1994. *U.S. Code of Federal Regulation: Title 14 Part 49 Section 44101.a*. Washington, DC: U.S. Department of Transportation. <https://www.law.cornell.edu/uscode/text/14/44101>.

¹² U.S. Federal Aviation Administration. 2015. *80 Fed. Reg. 78596: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

¹³ U.S. Congress. 2018. "Public Law 115-254 - FAA Reauthorization Act of 2018." Washington, DC: U.S. Government Publishing Office. <https://www.govinfo.gov/app/details/PLAW-115publ254>.

¹⁴ *Taylor v. Huerta*. 2017. 15-1495 (United States Court of Appeals for the District of Columbia Circuit, May 19).

¹⁵ U.S. Congress. 2012. *Public Law 112-95: FAA Modernization and Reform Act of 2012*. Washington, DC.

¹⁶ Federal Aviation Administration. 2018. *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap: A Five-year roadmap for the introduction of civil UAS into the NAS*. United States Department of Transportation.

this goal, the IFR includes provisions to obtain the names, physical addresses, and email addresses of owner-operators. The registration is designed with what the FAA characterizes as a low fee to get as many people to register as possible. The IFR prominently mentions accountability, and in their testimony before Congress on sUAS matters, senior FAA officials frequently highlight the registration system as a way to provide accountability.¹⁷

Education and Notification

With the IFR and its associated changes, the FAA intends to provide a means to educate and notify users. In this report, education refers to providing information to owner-operators on how to fly their craft safely within the rules, as well as providing additional materials on the FAA or how to obtain waivers for regulatory relief to conduct certain operations not permitted under the FAA's part 107 rule that govern sUAS operations. The registration process, particularly when an owner-operator actually registers on its website, known as the DroneZone, helps to serve this goal, especially to provide users with safe-to-fly information. The IFR highlights that "many owners of these new UAS may have had no prior aviation experience and have limited understanding of the NAS, let alone safe operating requirements and additional authorizations required to conduct certain operations".¹⁸

Notification refers to immediate communications to owner-operators already in the registry. The goal is to have the ability to quickly contact flyers of emergency situations or other upcoming events to warn against flying. The names and contact information collected provide a means for the FAA to pass along warnings of no-fly areas, additional pointers, rule-changes, and tips on safe flying.

Secondary Goals

Congruity and Expediency

One lower-level, but nonetheless critical goal is to have a registration system in line with the basic characteristics of UAS, which differ quite substantially from manned aircraft. The FAA sought a registration system more in line with sUAS, which are small, low cost, and possess unique operational capabilities when compared to full-scale aircraft.¹⁹

¹⁷ U.S. Federal Aviation Administration. 2015. *80 Fed. Reg.: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

¹⁸ U.S. Federal Aviation Administration. 2015. *80 Fed. Reg. 78598*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

¹⁹ Ibid

The FAA decision to release an interim rule, which provides a more immediate way to implement a binding regulation, points toward an important goal of a fundamentally easier registration process. In 2015, the agency faced a scenario where many consumers who purchased and received sUAS around the holiday season would have to register. The paper-based registration process in place at the time could not accommodate such an influx of applications. The goal of the IFR and the web-based registration approach is to make it possible for the FAA to handle all incoming registration requests and quickly provide a registration number that would allow registrants to fly their craft legally.

Security

A close corollary to accountability is the goal of security, which is an important, though often unstated, focus of the IFR. Tied closely to accountability, possessing the registration information provides a means to counter possible sUAS threats. The ability of the various government agencies charged with security, including the Departments of Homeland Security (DHS) and Defense (DoD), as well as state and local enforcement organizations that encounter sUAS on a daily basis, to deal with threats is assisted by being able to determine who owns and operates a particular UAS. While registration can be a means to identify bad actors, someone looking to use an sUAS for nefarious purposes can submit misleading registration information or simply not register in the first place. The ability of registration to contribute to security efforts is limited and not an overarching driver of the effort.

Privacy

The FAA seeks to deal with privacy in two senses. First, the agency seeks to avoid the release of private information of registrants, including protecting children from exploitation. A secure database, safe from intrusion and theft, remains a strong goal. The FAA designed and administered the system in compliance with federal information technology requirements including the Federal Information Security Management Act, Federal Information Security Modernization Act, and National Institute of Standards and Technology Guidelines. The database is encrypted, the server is secure, and access is highly controlled.

Access to the registry depends on a validated email address and a password created by the user. Further, the system is identified by a digital certificate so that the public has confidence that they are interacting with the authentic registration site. The system encrypts the information provided by the users while they use the system as well as user information stored within the system. The system has also been designed to protect information based on the potential for serious impact from a security compromise. In addition, the system protects credit card information in accordance with relevant security standards.

A second privacy issue is also important to some stakeholders. The use of sUAS for illegal surveillance and gathering of personal information is a concern of the IFR, though not a major focus. The FAA avoided addressing the issue in-depth in the IFR, instead opting to refer the matter for further discussion and guidance. The National Telecommunications and Information Administration (NTIA) convened a multi-stakeholder effort to develop best practices regarding the privacy, accountability, and transparency framework for commercial and private UAS use. The report was published on May 18, 2016 without any additional recommendations for action by the FAA.²⁰

The FAA had the right goals in mind as it constructed the regulation on small UAS registration. It is essential that there be clear and understandable reasons for the government to compel citizens to pay to fly their aircraft, whether for recreation or for profit. There is a very reasonable government interest in ensuring accountability, educating and notifying flyers, and ensuring security, all of which contribute to the ultimate goal of safe skies.

However, there is a tension among these goals, as emphasis in one area can obstruct the other's goals. Organizations often find tensions between profitability and growth in the short-term and long-term, in parts or enterprise-wide.²¹ For the FAA, the focus on areas like accountability and security and the associated investigations or incident-prevention actions, raises concern over the release of private information. There are inherent difficulties in implementing a complex system, weaving together a series of goals and implementing the resulting policies, programs, and procedures. The FAA has done a skillful job in balancing these varied program objectives.

The privacy issues raised by the widespread availability of these systems must be addressed. The FAA says that there are several task forces and working groups in this area. The FAA has taken steps to address the online privacy of sUAS owner-operators, though concerns remain about vulnerabilities in security controls.²² The FAA has not yet addressed the use of sUAS for unauthorized surveillance, particularly for bystanders who may not have given permission for their images to be taken by an overhead sUAS. The U.S. GAO is currently examining issues of privacy and UAS. Though not the IFR's major focus, it is critical that the FAA find a way to

²⁰ U.S. National Telecommunications and Information Administration. 2016. "Voluntary Best Practices for UAS Privacy, Transparency, and Accountability."

https://www.ntia.doc.gov/files/ntia/publications/uas_privacy_best_practices_6-21-16.pdf.

²¹ Dodd, Dominic, and Ken Favaro. 2006. *Managing the Right Tension*. December. <https://hbr.org/2006/12/managing-the-right-tension>.

²² Office of the Inspector General, Department of Transportation, "FAA Lacks Sufficient Security Controls and Contingency Planning for Its DroneZone System," Report No. IT2020027, April 15, 2020.

<https://www.oig.dot.gov/sites/default/files/FAA%20DroneZone%20Security%20Controls%20Final%20Report.pdf>

address this topic in conjunction with other Federal agencies, like the Department of Justice, that also have responsibilities over these critical privacy issues.

Organization

The FAA has taken a decentralized approach to implementing the IFR across the organization. The various functions, whether managing the database, operating the registration site, overseeing policy, or conducting enforcement, each fall into several offices within the FAA. This approach to policy-making and program administration largely follows a similar approach to that deployed for manned aircraft. The FAA has maintained its basic organizational structure and added responsibilities related to sUAS on top of its work on traditional aircraft. The key players within the FAA dealing with sUAS registration include the following offices.²³

Offices within FAA with responsibilities for aspects of sUAS registration regularly meet and hold informal committee sessions. FAA officials said, during the course of the study, that there is close cooperation among various sUAS offices in the agency, including regular meetings of such interagency groups as the UAS “Hot Topics” team and the UAS Executive Work Group.

Aviation Safety, Flight Standards Service

The Flight Standards Service carries the responsibilities for the registration IFR. Figure 1 below highlights how responsibility is divided between Flight Standards. The General Aviation and Commercial Division (known internally as AFS-800) has responsibility for policy, as well as ensuring that the relevant regulations and implementing directives are up to date. The Civil Aviation Registry Division of the Office of Foundational Business (AFB-700) maintains and operates the database and registry. Several FAA officials dealing with liaison, advisory, and some coordination activities report directly to the head of the Flight Standards Service. The Flight Standards District Offices (FSDOs), tied to AFG-300, include the inspectors who conduct investigations of incidents. Within Flight Standards, the FAA has established a corps of volunteers, so-called DronePros, who assist in education, modeled off its FAA Safety Team (FAAST) volunteer program in manned aviation.

²³ The FAA has established a Federal Advisory Committee (FACA) known as the Drone Advisory Committee (DAC) to provide advice, thoughts, and ideas to the FAA on UAS integration matters. The DAC holds quarterly meetings open to the public, broadcast online. The group helps to “identify challenges and prioritize improvements.” Membership includes top executives and officials from a broad group of stakeholders, including industry, research and academia, and retail manufacturers.

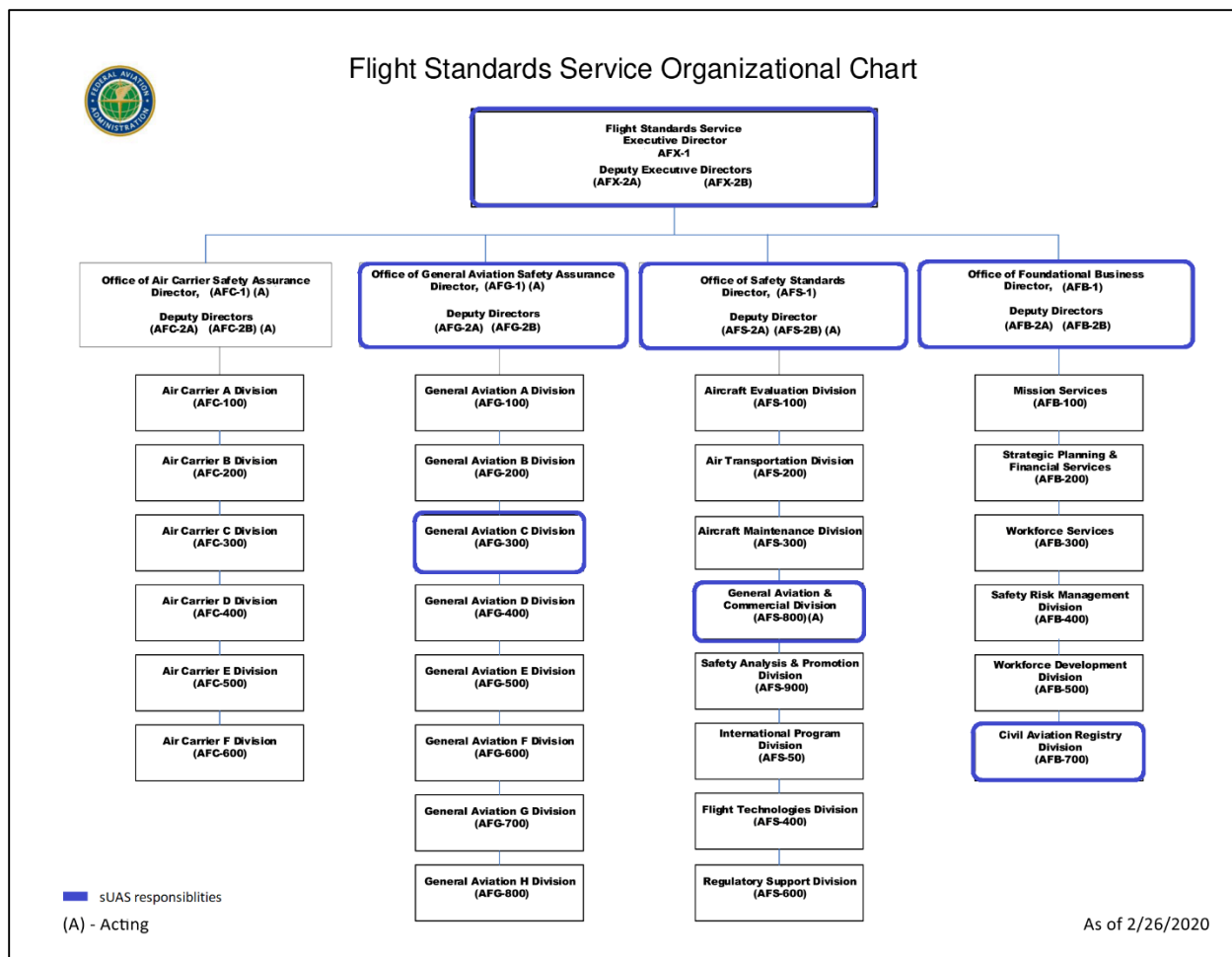


Figure 1: FAA Flight Standards Service Organizational Chart. (Source: U.S. Federal Aviation Administration - https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afx/)

UAS Integration Office

The FAA has established a UAS Integration Office, which advocates and coordinates on UAS matters. This office is not formally tasked under FAA directives with responsibility for policy formulation, execution, or oversight. The UAS Integration Office had a budget over \$15 million, with nearly 40 positions in Fiscal Year 2018. Like the Executive Director of the Flight Standards Service, the Executive Director of the UAS Integration Office reports directly to the Associate Administrator for Aviation Safety.

Security & Hazardous Materials Safety, Office of National Security Programs & Incident Response

This organization, known within FAA by its acronym as ASH, is responsible for some of the key enforcement functions, including the Law Enforcement Assistance Program (LEAP) agents who serve as liaisons to local law enforcement agencies. The organization would also handle any hazardous materials issues related to sUAS.

Office of the Chief Counsel

The Office of the Chief Counsel provides legal review of all sUAS regulations and policies, including those related to registration. The organization is also charged with reviewing potential disciplinary action related to sUAS cases, after the Flight Standards Service inspectors complete necessary investigations and dispositions.

Interagency Coordinating Body

The FAA is a key member of the UAS Executive Committee (ExCom) that brings together senior leaders from the agency, DoD, DHS, the Department of the Interior, the Department of Justice, the Department of Commerce and NASA, joined periodically by other key federal stakeholders. This group provides strategic focus on UAS matters across the Government and ensures coordination and cooperation among federal agencies.²⁴

The FAA took a sensible approach in assigning functions and structuring its sUAS registry work through the organization. It has leveraged the expertise, policies and procedures, and business processes already in place. The FAA's primary goal is to safely integrate manned and unmanned aircraft. Relying on a similar organizational arrangement to manned aircraft contributes to that goal. Creation of new offices that involve transfer of personnel to new offices can be disruptive, creating turbulence and confusion during difficult situations, when clarity and expertise might be especially valuable.

There are, however, downsides to the FAA's organizational approach. The proverbial bureaucratic stovepipes of each office remains too narrowly concerned with specific roles and responsibilities. While the FAA covered every functional area and ensured that no gaps exist, there is a lack of oversight or an enterprise-wide strategy across the organization. The divided

²⁴ FAA, "Civil Unmanned Aircraft Systems (UAS) Integration Roadmap of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap", Washington, DC, July 2018, p. 19. https://www.faa.gov/uas/resources/policy_library/media/Second_Edition_Integration_of_Civil_UAS_NAS_Roadmap_July%202018.pdf.

nature of sUAS registry matters made research for this study difficult, including finding an FAA point of contact conversant on the full range of sUAS matters. This difficulty arose despite the strong support within the FAA for the study.

The biggest concern regarding the FAA's organization is the lack of ownership and leadership on these matters. The FAA has not designated an office with authority to look across the organization on sUAS matters. In the specific case of registration, this lack of a singular focus means there is not a function or office to oversee implementation or make program adjustments based on compliance and enforcement data. When it comes to the sUAS registration program, there is not a specifically designated official that has clear responsibilities and expectations to oversee the system.

Program Costs and Fees

The charging of a registration fee, as highlighted in the IFR, is required by law and based on an estimate of the costs of the system and services associated with aircraft registration. Title 49, Section 45305 of the U.S. Code, directs the FAA to set and collect a fee for aircraft registration that covers the costs for providing the registration service. The FAA should adjust the amount of this fee when the FAA determines that the cost of the service has changed.

The FAA assesses a fee of \$5 for a registration certificate for each aircraft.²⁵ This is the same fee charged for manned aircraft. The FAA has not updated this fee since it was initially established in 1966.²⁶ The agency holds collected revenue as offsetting collection in its operations account. Collections, including the Unmanned Aircraft Systems Registry Fees, are recorded in the annual President's budget and are public information. In Fiscal Year 2019, the FAA took in \$1.25 million in fees for sUAS registration.²⁷ The FAA has collected \$5,794,818 in fees since the inception of the registration system.

While not providing a detailed breakdown, the FAA reported that the primary program costs include the design, operations, and security of the database, and the personnel involved in operating the program, including its enforcement. A recent GAO report on FAA's sUAS cost information revealed \$725,000 in obligations for information technology services related to registration.²⁸ The DroneZone website is funded through appropriated funds.

²⁵ See 14 CFR 47.17(a).

²⁶ See 31 FR 4495 (Mar. 17, 1966).

²⁷ FAA, Fiscal Year 2021 President's Budget Submission, Exhibit II-10, p. 17.

<https://www.transportation.gov/sites/dot.gov/files/2020-02/FY%202021%20FAA%20President%27s%20Budget.pdf>.

²⁸ U.S. Government Accountability Office, "Report pg. 29, UNMANNED AIRCRAFT SYSTEMS, FAA Should Improve Drone-Related Cost Information and Consider Options to Recover Costs," December 17, 2019.

<https://www.gao.gov/products/GAO-20-136>.

The agency says it continues to evaluate the expenses of running the registration system and its fees based on subsequent implementation of the final rule, especially in light of the potential changes to registration that will likely come as a result of the Remote Identification NPRM.

Similar to the lack of any clearly designated office or individual to oversee ongoing implementation, as discussed in the section immediately above, the FAA has not assigned an official to have responsibility for managing the registration system finances and be accountable for associated results and performance. There is not a responsible individual closely monitoring program expenditures, costs, and revenue, ensuring a balanced budget. A program manager in charge of an effective governmental program would typically have responsibilities for both ongoing activities and financial management.

While none of those interviewed believed that the \$5 fee is a barrier to registration, the Panel was unable to validate whether the \$5 fee is appropriate to cover the actual program costs. It is likely that the \$5 fee level will have to change whenever the FAA carries out its evaluation to align total program costs to total revenue collected. Assessing the same fee for sUAS registration as manned aircraft, whether a small single-engine or large jumbo-jet aircraft, does not make sense, as there is a significant difference between the associated registration programs necessary for each category (e.g., education and notification requirements). There is little likelihood that costs of the sUAS registration program are exactly equivalent to \$5 per registration.

One way to determine specifically the true costs and fees of a program to conduct an activity-based costing (ABC) calculation. The ABC calculation would help assess how much each step of the service costs and the expected amount of fees to be collected.

An ABC calculation would provide the FAA the opportunity to consider program enhancements, like increased staffing support, enhancements to the registration website, adoption of a content management system, and coordination with law enforcement. If, after performing an ABC, it turns out the agency is over-charging, the agency could spend more money to “break even” and not augment their appropriation to improve and enhance the program. If the result of the study is that the agency did collect enough and the costs of the enhancements are higher than that revenue, it could raise the fee accordingly.

According to a recent GAO Report, while the FAA is complying with recent OMB guidance on financial report requirements, it does not appear that all FAA divisions/offices are adhering to FAA policy and the use of charge codes to track costs.²⁹ The GAO report concluded that FAA

²⁹ Ibid, pg. 20, 22-24; Office of Management and Budget, “Circular A-136, Financial Reporting Requirements,” June 28, 2019. <https://www.whitehouse.gov/wp-content/uploads/2019/06/OMB-Circular-A-136.pdf>.

does not have the information needed at this time to determine whether the fee is appropriate, or whether the fee should be adjusted to better address the full cost recovery requirements of unmanned registration services.

As the FAA must improve cost tracking and carry out an ABC study, the FAA has a great deal of work to accomplish in this realm.

Chapter 3: Compliance

The FAA does not formally track or monitor compliance with the sUAS registration requirement. Currently, the agency is not undertaking systematic efforts to improve future estimates that inform operations and promote increased compliance. Based on the available data, the study estimates a substantial compliance gap for both recreational and commercial sUAS. The recently published Notice of Proposed Rulemaking on Remote Identification will assist the FAA with tracking compliance.

The primary purpose of this study is to assess the compliance of sUAS registration with the IFR. This chapter assesses the compliance level by examining the extent the FAA is tracking compliance along with broader sUAS trends. It also explores some of the issues the agency has faced in ensuring sUAS users understand the need to register.

Compliance

The FAA could not report to the study team the specific metrics on the level of compliance, as the FAA does not regularly or formally calculate this figure. Currently, no office is assigned to formally track or monitor compliance.

The Forecasting and Performance Analysis Division provided a forecast analysis that quantified that sUAS ownership levels were 40 percent greater than the registration among recreational users.³⁰ To construct this recreational estimate, the FAA used reports on consumer technology ownership published by the Consumer Technology Association (CTA), the Teal Group Corporation, and the Academy of Model Aeronautics.³¹ While such reports provide estimates of ownership per household in the U.S., there is not a consensus figure.³² The FAA assumes 100 percent compliance among commercial sUAS.

³⁰ U.S. Federal Aviation Administration. 2019. *FAA Aerospace Forecast: Fiscal Years 2019-2039*. Washington, DC: U.S. Department of Transportation.

³¹ Consumer Technology Association. 2019. "20th Annual Consumer Technology Ownership and Market Potential Study." Arlington, Virginia.; Finnegan, Phillip. 2018. *World Civil Unmanned Aerial Systems: 2018 market Profile & Forecast*. Fairfax, Virginia: TEAL Group Corporation. http://tealgroup.com/images/TGCTOC/WCUAS2018TOC_EO.pdf; Academy of Model Aeronautics. 2014. "sUAS Survey Results." Muncie, Indiana. <https://www.modelaircraft.org/suas-survey-results>.

³² Some of these estimates may be prone to selection bias in the sample. For instance, the AMA bases its per household ownership estimate on a survey of its members. Furthermore, these data do not differentiate between sUAS and UAS by the FAA's mass-based definitions of the terms. While CTA's estimates are based on the number of UAS sold by manufacturers in its membership, data on the number of drones manufactured and sold in the U.S. have not been furnished to the FAA by the industry at large. To determine what level of ownership is accounted for by

The aforementioned registration gap stated by the FAA is due to both owners operating multiple aircraft and simple non-compliance. Recreational sUAS owners who register under Part 48 that the IFR put in place are currently required to register themselves, not each individual sUAS they own. There is not a one-to-one relationship between the number of registered limited recreational owners and the number of sUAS that they own.³³ Therefore, it is probable that the number of sUAS owned by compliant users is greater than the sum total of compliant owners themselves.

As mentioned previously, the FAA estimated that recreational sUAS ownership is 40 percent greater than registration. The FAA stated that half, or 50 percent, of that gap can be credited to this trend in multiple ownership. The FAA stated that 25 to 50 percent of this gap can be attributed to simple non-compliance. The figure below illustrates these findings.

Unmanned Aircraft Registry	
Recreational Registrations	1,100,000
Commercial Registrations	400,000
Total Registrations	1,540,000

Unmanned Aircraft Registry and Registration Gap	
Recreational Registrations	1,100,000
Registration Gap	440,000
<i>Multiple Ownership</i>	220,000
<i>Non-Compliance</i>	110,000 to 220,000
Commercial Registrations	400,000
Total Owners and Aircraft	1,940,000

Figure 2: Unmanned Aircraft Registry and Registration Gap. (Source: National Academy of Public Administration)

As shown in Figure 2, there were 1.54 million registrations recorded in the Unmanned Aircraft Registry as of February 18th, 2020. This figure comprises 400,000 commercial and 1.1 million

registered owners, the FAA compares estimates from these reports to the number of model users in its Unmanned Aircraft Registry

³³ Limited recreational owners refer to individuals operating under the registration program referred to in 49 USC 44809, and not those under 14 CFR part 107. The terms “recreational” and “commercial” in this study refer to the categories used to tally registrations in the Unmanned Aircraft Registry for 49 USC 44809 users.

recreational registrations.³⁴ If recreational ownership of sUAS is 40 percent greater than recreational registrations, then 1.54 million total aircraft are operating recreationally, with a resulting gap of 440,000 unregistered aircraft. If 50 percent of this registration gap can be attributed to multiple ownership, there are 220,000 unregistered aircraft owned by registered owners.

If, as the FAA estimated, 25 to 50 percent of the registration gap is attributable to non-compliance, the shortfall in compliance stands between approximately 110,000 and 220,000. The number of recreational and commercial registrations recorded, plus the 440,000 registration gap, equals 1.94 million total aircraft. This means that the registration gap accounts for 5 percent and 12 percent of the total number, 1.94 million.

During the final writing stages of this study, the FAA released its Aerospace Forecast for Fiscal Years (FYs) 2020-2040. While the FAA estimated that recreational ownership is now 34 percent greater than registration, the same limitations discussed in the sections below remain present.³⁵

The overall number of unregistered sUAS is likely even greater because the FAA assumes 100 percent registration for commercial owners. The FAA says that commercial users must file serial number, make and model. The agency's own estimates call this assumption into question. The FAA estimated that more than 600,000 commercial sUAS were sold in the United States in 2016 alone.³⁶ As of February 18, 2020, the FAA had registered just over 400,000 commercial sUAS.³⁷ While it is possible that many of the sUAS sold between 2016 and 2020 have never been operated and therefore do not have to register as a result, the agency does not have an estimate of this number.

This overall compliance shortfall is substantial. Taking a comparative approach to other federal registration systems illustrates the severity of the compliance issue that the FAA faces. As the next chapter shows, other registration systems have higher levels of compliance.

³⁴ U.S. Federal Aviation Administration. n.d. *UAS by the Numbers*. Accessed February 18, 2020. https://www.faa.gov/uas/resources/by_the_numbers/; Note: this source divides registrations between "recreational" and "commercial" among the Unmanned Aircraft Registry. Figures for each category apply to owners and aircraft under 49 USC 44809, and not aircraft under 14 CFR part 107.

³⁵ U.S. Federal Aviation Administration. 2020. *FAA Aerospace Forecast: Fiscal Years 2020-2040*. Washington, DC: U.S. Department of Transportation.

³⁶ U.S. Federal Aviation Administration. 2015. *80 Fed. Reg. 78597: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

³⁷ U.S. Federal Aviation Administration. n.d. *UAS by the Numbers*. Accessed February 18, 2020. https://www.faa.gov/uas/resources/by_the_numbers/.

The FAA's recently published Notice of Proposed Rulemaking on Remote Identification would require all aircraft intended to be used for recreational purposes to be registered with the FAA, narrowing the gap between ownership and registration.³⁸ It might also allow the FAA to validate registrations through investigations by its aviation flight inspectors and external law enforcement authorities.

Compliance Management

Similarly, the FAA is not actively and regularly tracking compliance levels, the Agency is not undertaking systematic efforts to improve future compliance estimates, their requisite data inputs, or use such estimates to inform operations and promote increased compliance.

It is important to emphasize that have been taken to improve the FAA's forecasts in general, but not the data informing compliance estimates. For example, the UAS Integration Office does use information from the Unmanned Aircraft Registry to issue a weekly report card to management. While this report card is used to improve forecasting, it does not inform efforts to increase compliance. Increasing registration compliance is not clearly stated in the goals or objectives of the agency-level strategic plan or the strategic documentation of the FAA's constituent offices.

The FAA's overall compliance challenges—specifying non-compliance levels among commercial and recreational users or providing that information to decision-makers—partly stem from the narrow focus of the registration effort on owners. The focus has been to put a workable system in place that provides a means to register owners with less attention on ensuring users flying day-to-day are identified.

UAS Trends Analysis

The Forecast Division tracks, measures trends, and develops UAS forecasts across several years. The FAA monitors UAS usage and market trends but has room to improve given the complexities and challenges in this area.

The FAA says its information on quantity of sUAS in the nation's airspace is limited. Presently, there is no civil sUAS market analysis that is all-encompassing in terms of units manufactured or purchased. Manufacturers only report revenue deriving from sUAS, saying the number of units they sell to be sensitive information. No current market forecast includes the total manufacturing

³⁸ Federal Aviation Administration. 2019. "Notice of Proposed Rulemaking: Remote Identification of Unmanned Aircraft Systems." Washington, DC, December 31. <https://www.federalregister.gov/documents/2019/12/31/2019-28100/remote-identification-of-unmanned-aircraft-systems>.

output of every industry actor, the total number of home-assembled sUAS, or the total number of sUAS in use for every application.

The usage of UAS across the United States has risen since 2015 when the FAA completed the IFR. Whether the growth rate in new sUAS purchases continues, the number of sUAS in existence will likely accumulate.³⁹ Estimating sUAS usage trends is difficult because of the challenges in obtaining data and understanding consumer behavior. Recognizing that that is the case, it is vital to continue the effort to study and understand these trends to inform decision-makers within the agency. It is important that the FAA uses such analyses to make collective assessments about the direction of sUAS usage.

Compliance Communications Efforts

The FAA has taken some steps to communicate to sUAS owner-operators the need to register their aircraft. However, there are noticeable gaps in this effort, and at least part of the compliance gap can be attributed to communications issues.

One significant challenge is that recreational sUAS users are not receiving strong messaging to register. There seems to be very little consistency with how and what is communicated to purchasers of sUAS. Online marketplace listings, for example, often fail to highlight the need to register sUAS that are available for purchase. Some websites do highlight the need to register with links to non-FAA-affiliated websites with very general flying information rather than to the FAA itself. No mention of the registration requirement is made on some third-party sites.

Within the sUAS market, the efforts of manufacturers to notify sUAS consumers of the need to register are insufficient and inconsistent. Most manufacturers provide little to no notification about the need to register. On their websites, there is minimal to no notification about the requirement to register the aircraft.

Very few manufacturers warn of the registration requirements on boxes or on slips inside product packaging. Some manufacturers cite the fact that the aircraft are packaged for sale in many countries that might have varying registration requirements.

³⁹ Study and market analysis by McKinsey & Company and the Teal Group Corporation estimated the total value of UAS activity in the commercial sector in the United States alone had reached \$1 billion by 2017. The value of this manufacturing and service activity could rise anywhere between \$8 billion and \$20 billion by 2026. The studies also estimated that by 2026, the commercial UAS sector will have an annual impact between \$31 billion and \$46 billion on the United States gross domestic product. McKinsey & Company anticipated that five factors will influence UAS growth through the coming years: infrastructure, regulations, technological capabilities, public acceptance, and economic drivers (the types of applications favored by private companies). In particular, there are several legislative and regulatory steps that a government must take before civil applications for UAS can be scaled up.

Some manufacturers have shifted the registration notification to their knowledge quiz on their online application. Further, the language in these applications sounds ambiguous and fails to strongly emphasize the vital importance of registration. Some manufacturers have the technological capability to prevent or otherwise constrain flying until an owner-operator confirms registration, asking if an owner-operator is aware of the requirement to register with the FAA before they can fly their aircraft. Use of this function among manufacturers is not widespread, however.

Manufacturers are a key partner in the registration effort. That strong relationship in communicating the registration requirement was envisioned in the IFR and discussions that led to it. The FAA at one point considered a point-of-sale registration whereby retailers, not the new owner-operator, would be required to make the registration. That was considered too onerous by the manufacturers and retailers, but the former committed in the IFR to support the registration effort. The FAA references a federal law which requires manufacturers to provide a safety statement with the sUAS at the time of delivery.⁴⁰ While the FAA provides a safety statement for manufactures on its website, it has not enforced the requirement that manufactures provide that statement at the time of sUAS product delivery. There is a clear need for the FAA to reengage manufacturers on the importance of registration and require manufacturers to include outside labeling and more affirmative warnings.

⁴⁰ U.S. Federal Aviation Administration. 2019. *Manufacturer's Toolkit*. March 6. Accessed March 27, 2020. https://www.faa.gov/uas/programs_partnerships/manufacturers_toolkit/.

Chapter 4: Foundational Role of the IFR

The FAA sUAS registration system includes many of the key requirements for a successful effort, when compared to best practices of other federal registration programs and international partners' sUAS registration systems. The FAA registration system enables the FAA to achieve other key milestones in its plans for integrating sUAS into the national airspace.

To assess the basic effectiveness of the registration regulation, the study sought to examine the soundness of its basic underpinnings of the regulation, not just whether individual provisions make sense. Registration is one issue in the larger concern of integrating sUAS as safely as possible in the nation's airspace, while advancing all the promise of this exciting technology. It is important to understand the relationship of registration to this larger undertaking and whether it makes a positive contribution toward the vision the FAA has adopted. Similarly, this registration system is just one of many registration systems run by the federal government and various international counterparts that are well-established.

Comparing the FAA's system as codified in the IFR against some of the best practices and other partners helps illustrate the basic structure and strength of the FAA's approach.

This chapter applies several lenses to examine the effectiveness of the sUAS registration regulation. It considers whether the key components of the rule and program meet best practices, comport with widely accepted international approaches, and permit the FAA to pursue its larger vision for safe and sensible integration of UAS with manned aircraft.

Initial Step Toward a Larger Vision

The sUAS registration system, according to key FAA officials and stakeholders, lays the groundwork for the FAA to pursue its larger vision for sUAS in the nation's airspace. The FAA's vision for sUAS operations in the nation's airspace entails UAS operating seamlessly alongside manned aircraft, occupying the same airspace, controlled in many cases by the same systems.⁴¹ It entails integrated operations that will ensure the balance among safety and advancement of this emerging technology.

⁴¹ Federal Aviation Administration. 2018. *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap: A Five-year roadmap for the introduction of civil UAS into the NAS*. United States Department of Transportation.

The FAA says it is taking a deliberate and incremental approach, seeking above all else to preserve the safety of the nation's skies, while also deliberately moving towards a larger vision that permits the wide usage of sUAS. To achieve that vision, a number of key regulatory, programmatic, and technological pillars will have to be in place.

After the issuance of the IFR in December 2015, the FAA was able to promulgate additional regulations. Most prominently, changes were made in part 107 to allow certain operations within sUAS operators' line of sight. Previously, to operate a craft in that manner, an owner-operator would have had to navigate a complicated exemption process. In December 2019, the FAA released the previously discussed Remote Identification NPRM that will allow identification information of sUAS that can be received by other parties. Future steps include development of "Detect and Avoid" technologies, along with an ecosystem that complements Air Traffic Control Services by allowing beyond visual line-of-sight drone operations at low altitudes in airspace where the FAA air traffic services are not provided. This latter initiative is known as Unmanned Aircraft System Traffic Management (UTM).⁴² Without universal registration and the basic ability to say "this aircraft belongs and is most likely flown by [insert a name]," these additional steps, as set forth in Figure 3, that ultimate vision will not be possible.

⁴² The FAA has established a research team with NASA and industry to develop the UTM concept. U.S. Federal Aviation Administration. n.d. *Unmanned Aircraft System Traffic Management (UTM)*. https://www.faa.gov/uas/research_development/traffic_management/.

Pipeline and Hazardous Materials Safety Administration (PHMSA). The former registers trucks and includes an online process to register with a low fee. The FMSCA obtains information on drivers and the trucks themselves, including market information about the make and model of trucks on the nation's highways. The registry is checked when trucks pull into the weigh stations along the nation's highways. The PHMSA registers shipments of potentially harmful materials over the nation's extensive network of pipelines. The pipeline registry similarly makes registration easy and collects data to understand market trends.

The sUAS registration system includes several of these broad features.

- **Ease-of use:** The IFR creates an alternative registration process, which moves from paper-based to an online system. Relevant sUAS owner-operators can easily and quickly upload information to a user-friendly website.
- **Means of Data Collection:** The FAA will have the ability with the registration information to understand major trends in sUAS usage. The FAA will be able to draw on information in the registry to collect data, like geographical location of users and, with potential changes in the Remote Identification NPRM, information that might include make and model of sUAS.
- **Enforcement:** The IFR sets up an organizational structure, rules, and procedures to drive users to register, including an accountability mechanism with penalties for lack of compliance.

It is noteworthy that the FAA appears to meet many of the best practices of federal registration. It is also important to note that the FAA has taken a flexible approach to the IFR, making several key adjustments as issues arise, technology changes, and the larger vision comes into greater focus. In February 2019, the FAA issued an NPRM that required users to display registration numbers on the outside of their craft, not inside of the battery compartment.⁴³

⁴³ U.S. Federal Aviation Administration. 2019. *84 Fed. Reg. 3669: External Marking Requirement for Small Unmanned Aircraft*. 30. Vol. 84. Washington, DC: U.S. Department of Transportation. <https://www.govinfo.gov/app/details/FR-2019-02-13/2019-00765>.

International Comparisons

Individual, government, and commercial use of sUAS is becoming ubiquitous across the globe. The projected annual revenue of the UAS industry in 2025 is estimated at \$82 billion.⁴⁴ In the U.S., the number of sUAS will reach 2 million, approximately six times the number of manned aircraft in the national airspace. As a result, North American and Europe governments are working to integrate this new and evolving technology into their respective national airspace.

Governments reviewed in this study – U.S., U.K., Canada, and the European Union – have established risk-based regulatory frameworks that are quite similar in nature to that of the FAA. Common requirements across the countries studied are the use of national registries, vehicle marking, pilot testing, and multiple operating restrictions (e.g., 400-foot ceiling, not beyond line of sight, etc.). While the overall framework is very similar across the different countries, there are notable differences as well.

Chief among the differences between the studies is the length of time each requirement has been in effect. While the U.S. requirements went into effect in December 2015, the European Union requirements will become effective in July 2020, or almost five years later. Canada and the U.K. went into effect in 2018 and 2019, respectively.

Another significant difference between countries is the degree of risk management in effect. While the U.S. system is based on risk, the European Union requires select operators flying in certain areas to submit a risk management plan (with the receiving country required to approve it before flight). In all countries, risk assessment and risk reduction options are a large part of mitigating the risk of sUAS in the airspace. The FAA carries out this practice, but it is not as closely tied to registration.

Among the principal differences between the countries studied is their different approaches to civil and criminal violations of their laws governing sUAS. While the U.S. has the largest fine in effect, up to \$250,000 USD, Transport Canada takes the approach of spelling out the fine for nearly every type of possible violation, including up to \$5,000 USD for failure to register. The study's research uncovered a single recorded violation of U.K. laws since 2014. The well-publicized sUAS incidents that closed Gatwick Airport in December 2018, while disrupting 140,000 passengers, have focused the country on whether additional reforms will be necessary. To date, the U.K.

⁴⁴ Association for Unmanned Vehicle Systems International. 2013. "The Economic Impact of Unmanned Aircraft Systems Integration in the United States." Arlington, Virginia.
https://higherlogicdownload.s3.amazonaws.com/AUVSI/958c920a-7f9b-4ad2-9807-f9a4e95d1ef1/UploadedImages/New_Economic%20Report%202013%20Full.pdf.

police have not closed the investigation (no one was arrested). The table below provides an overview of the key elements of a registration system across the countries studied.

One final difference across the various approaches is the government’s data collection, publication, and degree of action required under law. While the U.S. has more sUAS in operation than other countries, it does not publish and act on the data collected, e.g., registration compliance, incidents, accidents. The E.U. and Transport Canada apply the use of risk management principles to the data collected as well.

International sUAS Registration Requirements Comparative Analysis				
Countries Regulations	United States	Canada	United Kingdom	European Union
Effective Date	December 16, 2015	December 21, 2018	November 29, 2019	July 1, 2020
National Registry	Yes	Yes	Yes	Yes
Registration Data Elements	Personal Contact Info	Make Model Serial	Personal Contact Info	Make Model Serial
Registration Fee	\$5/Operator	\$5/Operator	£9 (\$11.65)	TBD
Vehicle Weight	250g-25kg (.55-55lbs.)	250g-20kg	250g-20kg	250g-25kg
Pilot Minimum Age	13 Years Old	14 Years Old	18 Years Old	16 Years Old
Operator Test	Not Required	Required	Required	Required
Classification System	Commercial & Recreational	Basic & Advanced	Commercial & Recreational	Open/Specific & Certified
Fines/Penalties	\$27,500 Civil \$250K Criminal	\$5,000 Individual \$25,000 Corporation	£1,000	TBD

Figure 4: International sUAS Registration Requirements Comparative Analysis. (Source: The National Academy of Public Administration).

The basic structure that the FAA has put together for sUAS registration is very solid and effective. The IFR helps the FAA embark on a path towards achieving its vision for sUAS where these craft operate side-by-side with traditional manned aircraft. The registration system also follows some of the best practices set by other federal agencies with registration systems. International partners have recognized the comprehensive nature of the FAA's sUAS system and used it to model their own systems.

Chapter 5: Accountability and Enforcement

Registration is a necessary but not sufficient step towards achieving the accountability called for in the IFR. The FAA has recorded a low number of violations of sUAS rules. This is not because few violations are occurring, but because owner-operators are not registered, law enforcement cannot determine the aircraft's owners, and law enforcement is uncertain about how to proceed. The FAA is relying on its existing organizational apparatus to enforce the IFR, though it is not being tested given the low number of enforcement cases. The FAA has provided an indirect means for local law enforcement agencies to access the aircraft registry, but this has major limitations. Much work needs to be done to ensure communication with, and education of, local law enforcement and to establish the partnership intended in the IFR.

A key question about the IFR's effectiveness is whether it can hold owner-operators accountable by tying an aircraft to its owner-operator. Another question is whether the agency has been able to enforce the IFR provisions more broadly. Prevention of potentially unsafe or unlawful operation of sUAS was central to the IFR. The FAA recognized the need for a mechanism to investigate and prosecute events, including those that require enforcement, up to and including significant fines. This chapter examines the effectiveness of the FAA's enforcement of the IFR's registration provision. It also describes the agency's approach and processes to ensure registration and the role of local law enforcement.

Accountability

The FAA reports very few safety issues from sUAS, including registration violations. However, the compliance levels reflect a limited capacity to tie users with their aircraft. The number of cases that the current enforcement structure is handling is limited by the fact that sUAS in flight cannot be tied to their owners. In 2018, according to figures provided by the FAA, the most recent, complete year of information available, there were 2,428 UAS events, with information obtained on the sUAS operator in only 77 instances. The FAA emphasizes that these events – a happening that could lead to being defined as a formal occurrence, incident, or accident – were for the most part unconfirmed. For example, just because a pilot reported seeing a sUAS does not confirm it was in violation of any regulations.⁴⁵

The FAA provided data on the disposition of UAS investigations from its Program Tracking and Reporting Subsystem from October 1, 2014 to December 31, 2019. In that time, the agency

⁴⁵ FAA Order 8020.11D sets out the agency's procedures and responsibilities for aircraft accident and incident notification, investigation, and reporting. Chapter 1 of the directive includes definitions of incidents, accidents, and events. https://www.faa.gov/documentlibrary/media/order/faa_order_8020.11d.pdf.

conducted 740 investigations, leading to 609 counseling sessions, 31 on-the-spot notices, nine training sessions, and 91 “other actions”. The FAA took formal administrative actions in 63 cases with 54 warning notices and nine letters of correction. Legal enforcement included 67 civil penalties, two suspensions, and two revocation of certifications.

These figures could be viewed as a very good sign, given that there may be upwards of 2 million aircraft operating in the nation’s airspace. However, the study concludes that the low numbers instead point towards a central flaw in the IFR, as simply having a registration system does not provide the ability to tie an aircraft to its owner-operator by itself. Potentially hundreds and thousands of cases of violations could not be investigated because an owner and operator could not be identified. These figures starkly show that registration is necessary, but not sufficient to ensure the safety of our national airspace or bystanders on the ground. Remote Identification, on which the agency is currently completing rulemaking, will provide the ability to quickly identify aircraft and to tie together craft and operator with a form of electronic license plate. This capability will be essential.

Broad Enforcement

The FAA is relying on the same investigation and enforcement organization and process it uses for manned aircraft. The FAA has tasked its inspection organization from the Flight Standards Service to conduct inquiries on UAS events. The ASH organization has similarly been assigned a UAS role similar its responsibilities towards manned aircraft. That group educates local law enforcement agencies on registration and other UAS rules and provides a means for local law enforcement to gain access to the registration database.

The FAA’s Air Traffic Control Centers provide pilot reports of events to LEAP agents at FAA headquarters. The agents document and package as much information on the event as possible and may refer the case to inspectors at the Flight Standards District Offices. These inspectors carry out the investigation and administer enforcement actions, under the oversight of the FAA’s Office of General Counsel.

While the FAA is enforcing the IFR, the agency seems poorly postured to manage a potential increase in sUAS cases. The current system is handling the caseload. Remote identification, if implemented in the form laid out in the NPRM with the requirement for model and serial number and the capability to pinpoint aircraft and owner-operator, will likely lead to a considerable increase in the number of cases. Such a case increase would put a great deal of pressure on the personnel who make up the enforcement system for sUAS registration.

It also does not appear that the FAA is using this enforcement information to ask “hard questions” to adjust policies and programs or drive results. There is a similar dynamic with compliance information, which was not being used as a management tool.

Local Law Enforcement

The role of law enforcement in illegal/prohibited sUAS operations was first described in the IFR.⁴⁶ The rulemaking clearly describes the roles and responsibilities of law enforcement agencies and describes how the FAA intends to collaborate with the law enforcement community. The IFR contains nearly three dozen explicit statements describing the importance of law enforcement to the FAA’s mission of safe skies. To achieve this mission, the FAA reiterated its intent to collaborate with local law enforcement on many levels. Chief among these priorities is the importance of quickly connecting police to an aircraft owner-operator in an investigation, stating in the IFR that “(the rule) encourages compliance with the registration requirement, and provides the FAA and law enforcement the ability to quickly connect individuals to their aircraft with the least amount of steps possible”.⁴⁷

The FAA provides information to local law enforcement on registration requirements and other relevant sUAS regulations. The LEAP agents are also responsible for outreach and education of law enforcement authorities. FAA has created and is providing an online toolkit with several documents. In January 2015, the FAA began to publish and post guidance on its website for the law enforcement community. The law enforcement toolkit is composed of more than a dozen documents authored by the FAA to help describe how law enforcement should approach sUAS. More recently, the FAA has augmented its collaborative efforts using webinars, YouTube videos, and panel discussions at law enforcement conferences.

There is still a great deal of confusion among local law enforcement on how to deal with clear violations regarding registration requirements and other unsafe operations. Local law enforcement relies on existing local laws to guide its efforts while FAA investigators are responsible for acting on federal laws like registration and marking requirements. Federal investigators act on complaints submitted by pilots and airport control towers, reports typically directed to the FAA’s Regional Operation Centers.

⁴⁶ US Federal Register, Volume 80, No. 241, Wednesday, December 16, 2015, Department of Transportation, Federal Aviation Administration, 14 CFR, Parts 1, 45, 47, et. al., Registration and Marking Requirements for Small Unmanned Aircraft, Final Rule.

⁴⁷ US Federal Register, Volume 80, No. 241, Wednesday, December 16, 2015, Department of Transportation, Federal Aviation Administration, 14 CFR, Parts 1, 45, 47, et. al., Registration and Requirements for Small Unmanned Aircraft, Final Rule. Page 78619.

The FAA provided a means for local agencies to access the aircraft registry and assigned liaisons to work with local law enforcement to access the database. Local law enforcement does not have direct access to the database, however. The FAA explains the lack of access is due to the need to protect the information of minors whose personal information is included in the registry. Local officers call the FAA's LEAP agents to obtain registrant information. As mentioned in the last section, LEAP agents often create a case based on this contact that is referred to the field for investigation. According to law enforcement organizations interviewed, this method of accessing the registry is slow and burdensome, and the overall information flow is irregular and inconsistent. Police must determine whom to contact and wait for a reply from one of 13 LEAP agents nationwide. The LEAP agents themselves are assigned to multiple aviation programs including investigations related to manned aviation violations and drug smuggling.

When the connection can be made between a sUAS and its operator, there appears to be no formal communications protocol followed between officers and special agents. In addition, there is no common incident form for police to complete and submit to the FAA electronically. Typically, the information exchange is conducted verbally over the phone and differs between every police and special agent, for every sighting. According to the law enforcement interviews, the current approach to this type of information exchange is rarely done in a timely fashion or in an electronic format conducive to subsequent analysis.

The FAA could take the step of safely providing access to the registry to every interested law enforcement agency by requiring police departments to adopt strict credentials and making access readily available to operation centers, often called "Fusion Centers". This approach would enable the fusion of this intelligence data alongside other important information in a timely fashion that protects the officer, community, and airspace. Real-time access to the registry could provide law enforcement with information about the sUAS owner-operator suspected of illegal or prohibited operation, including whether there is a match on other "most wanted" lists. Conversely, requesting police complete and provide a digital incident report form could make significant progress towards informing the FAA's future integration efforts.

The FAA has a number of opportunities to continue ongoing efforts to expand and improve communication with, and education of, local enforcement and to establish the true partnership intended in the IFR. The FAA recognizes that there are several key law enforcement associations, such as the Fraternal Order of Police and the National Sheriff's Association, that hold widely attended annual meetings that are an ideal opportunity to discuss the FAA's enforcement program. Such engagements could continue to grow and intensify.

Chapter 6: Notification, Education, and Communications

The FAA has successfully used the registration database to deliver key safety and flight warning notifications to sUAS operators, for example, during wildfires and major sporting events. Though the FAA’s registration website, the DroneZone, provides basic educational information, the site is challenging to navigate and may result in a visitor struggling to find critical information and resources. The FAA opted not to link an operator knowledge test on the website. The Panel believes an operator knowledge test is an important corollary to the registration experience and a best practice internationally.

One of the main purposes of the sUAS registration regulation is a means to notify users of flight restrictions and educate users on how to fly safely. In recent years, the FAA significantly expanded its communication capacity, presence, and outreach methods to oversee and monitor sUAS in the national airspace. The FAA is enhancing its communications strategy and must continue to do so in a number of areas.

In this chapter, the study assesses the effectiveness of these communications efforts, including releasing restrictions and notifications; its utilization of the main registration website for education; and broader communications challenges and opportunities. Most sUAS owners have no past experience with the FAA, and the unique challenges of reaching these owner-operators is explored.

Flight Restriction and Notifications

The FAA is successfully using the registry to notify users of flight restrictions, especially in releasing warnings against flying in areas during special events or emergencies.

Temporary Flight Restrictions (TFRs) are notices sent out by the FAA to restrict aircraft operations within designated areas.⁴⁸ These TFRs are used to inform owner-operators of relevant issues and are critical to the nation’s airspace. A diverse set of events may trigger the FAA to issue a TFR, such as aviation operations or firefighting missions that may increase the risk of a mid-air collision.

For disaster response areas, the FAA used information in the sUAS registry to send frequent warnings through email, social media, and online materials to registrants to avoid flying sUAS.

⁴⁸ A Temporary Flight Restriction (TFR) is a type of Notice to Airmen that defines an area restricted to air travel due to a hazardous condition, special event, or a general warning.

Examples of TFR events include but are not exclusive to the June 2016 California wildfires, October 2016 Hurricane Matthew, the February 2017 Iditarod sled-race in Alaska, and the November 2018 California wildfires. During this study, the FAA distributed notifications of restrictions over sUAS use around major sporting events like the Super Bowl and World Series.

The Remote Identification NPRM includes a proposed addition to the registration regulation which would require owner-operators to submit mobile phone numbers. If put into effect, this change would permit emergency and government-style text alerts. This change, if implemented, would create a direct and efficient method to reach out to UAS users, like the flood alerts local governments publish.⁴⁹

Strategic Targeting for Education and Outreach

DroneZone is the FAA's main website for all sUAS matters. The portal is where owner-operators register and obtain safe-to-fly information and access additional resources. The site reminds owners and operators of sUAS rules, as well as the "do's and don'ts" of flying. When an owner-operator is on the site to register, the FAA has an opportunity to educate and notify flyers, as well as interest them in additional important information.

The FAA is expanding its outreach through this site. According to the FAA, since the website was published, web traffic has reached 16 million-plus page views and more than 7 million visitors. Of these visits, 43 percent were related to UAS content.⁵⁰ The posts include topics such as No Drone Zone, FAA's annual UAS Symposium, Drone Safety Awareness Week, Remote Identification Announcement, and Drone and Airspace Live Webinars.

While the website has a user interface that is visually appealing, the user experience design needs improvement. The DroneZone can be quite difficult to navigate and does not actively encourage registrants and visitors to access additional resources. The educational material presents the information but is often difficult to find and is written in technical language that is challenging to understand. It often takes several "clicks" to access additional important resources.

The DroneZone site does not offer a knowledge test that determines whether someone understands the basic rules and ideas about flying safely in the nation's airspace. There is a

⁴⁹ U.S. Federal Aviation Administration. 2019. *Federal Register: Notice of Proposed Rulemaking - Remote Identification of Unmanned Aircraft Systems*. 250. Vol. 84. Washington, DC: U.S. Department of Transportation.

⁵⁰ U.S. Federal Aviation Administration. 2019. "Recreational Drone Flyers: Dos and Don'ts." Washington, DC: U.S. Department of Transportation.

https://www.faa.gov/uas/resources/community_engagement/recreational_flyers_toolkit/media/Rec_DroneFLyers_Flyer_AD_V1.pdf.

discussion among the FAA, industry partners, and other associations on how to implement the legislative requirement that all UAS users must complete a knowledge test.⁵¹ The FAA is considering whether these two processes – registration and the knowledge test – could be linked in some fashion with the FAA offering a version of the test along with other partners like interest groups, associations, and manufacturers. The initial view within the agency is that these two activities cannot be merged as one process deals with ownership, the other with operations, which, as has been mentioned previously, the agency sees as very distinct, mutually exclusive activities.

As safe flying is the primary goal of the nation’s airspace, a secured knowledge test available from the FAA would be helpful to serve the larger educational goals of the registration IFR. The FAA could at a minimum offer a version of the test on the DroneZone platform that would meet the legislative requirement. In this possible approach, completion of the test would not be a requirement before registration. Although these two processes would be distinct, registration and a knowledge test would be complementary. A comprehensive and secure test offered on the DroneZone site during registration would allow users to gain substantial and fundamental education and knowledge.

Meeting the Target Audience

A unique and significant challenge faces the FAA as the agency engages a whole new category of flyers who may have previously had limited to no contact with the agency. Recreational users are different from traditional manned aircraft pilots, who look to formal communications directly from the FAA and understand the criticality of the information provided. As a distinct and technologically astute group, sUAS users are often accessing news and information from non-traditional media and social media sources to understand any new regulation. The fact that sUAS flyers are not a “captive” audience, as mentioned above, compounds this unique communications situation.

One critical aspect of the FAA’s sUAS communications challenge is conveying the message that sUAS users are aviators flying aircraft. The initial perception of recreational sUAS users is often that sUAS are flying toys. Manufacturers often perpetuate this perception in their marketing campaigns. This divergent view was a major concern for the FAA, which, following clear federal statutes enacted in 2012, consider sUAS as another aircraft flying in the national air space.⁵² The goal of changing this mindset will continue to be significant for the FAA.

⁵¹ 14 USC 44809, Section g.

⁵² U.S. Congress. 2012. *Public Law 112-95: FAA Modernization and Reform Act of 2012*. Washington, DC.

The FAA's outreach efforts have emerged in two phases. During the first phase in the first few years after the IFR release, the FAA relied on traditional media sources and communications strategy to disperse information. That first set of communications from the FAA was neither in a digestible form nor distributed over increasingly popular online media sources, like Facebook or YouTube. The FAA did produce several media campaigns on Twitter in regard to registration, but besides these targeted efforts, the social media effort was minimal at the outset.

More recently, the FAA entered the second phase of its communications efforts and moved toward more nontraditional communications methods and strategies to gain a broader constituency of followers. Moreover, the communications team further incorporated different methodologies to expand innovative strategies by participating in non-traditional aviation events such as the Consumer Electronics Show (CES). The team were slated to attend for the first time the film festival South by Southwest (SXSW) in April of 2020, although that was cancelled due to the COVID-19 pandemic. Another strategy to meet their target audience is to partner with various influencers and influencer groups or individuals with the ability to influence potential buyers of a product or service by promoting or recommending the items on social media.⁵³ The utilization of social media influencers furthers the FAA's ability to reach a broader audience with their messaging output and scope.

On the official FAA Twitter page, the agency has revamped their communications strategy since October 2018 and currently averages 10 tweets per day. This is a significant increase from 2010, when their average was two tweets per day. Since January 2019, the FAA has tweeted a total of 15 tweets in regards to sUAS registration including responses and retweets. A DroneZone Twitter page was created in January 2020 and currently has 28 tweets. There are no tweets in regard to sUAS registration and three tweets on Remote Identification. They also have a presence on YouTube and Facebook. However, this content does not provide succinct and clear information as it relates to registration. Unofficial channels and groups often have greater viewership regarding regulations including registration. The FAA has an online presence and could further utilize the platform to maximize online engagement.

The FAA has also run into a dilemma of interacting with online and social media presenters and influencers who may have millions of viewers and billions of view counts, but who the FAA has concerns about unsafe flying. The agency is concerned about potential risks and mixed messaging that may encourage unsafe flying, but an appearance on shows or insertion of FAA's message would distribute the safe-flying and notifications more widely. So far, the FAA has resolved this dilemma by avoiding engaging the non-traditional media sources it views as higher risk. Further

⁵³ Merriam-Webster. n.d. *Influencer*. Accessed March 27, 2020. <https://www.merriam-webster.com/dictionary/influencer>.

research towards strategic collaborations with social media influencers and popular users would be beneficial and more expedient in the FAA's overall outreach program.

Currently, the FAA's communication's team aggregates all of the analytics information provided by each individual content platform. Although useful, there is a lack of uniformity of information, and this approach does not provide an enterprise level view of their content and engagement. Although there have been discussions of implementing an enterprise wide content management system, a reliable procedure has not been put in place.

The Forecast Division in March 2020 released a report that reinforced the need for targeted communications strategies for recreational users because, once registered, they receive the majority of their information from e-mail.⁵⁴ As email is the main mechanism registered users utilize to educate themselves, registration compliance should be communicated in this form. There is a significant need for the FAA to strengthen its outreach and communications efforts as a means to increase registration compliance.

⁵⁴ U.S. Federal Aviation Administration. 2020. *FAA Aerospace Forecast: Fiscal Years 2020-2040*. Washington, DC: U.S. Department of Transportation.

Chapter 7: Conclusion and Recommendations

Conclusions

The FAA took a significant step in 2015 with the sUAS registration Interim Final Rule. In response to the prospect of tens of thousands of unmanned aircraft operating without any means to find their owner-operators, the FAA quickly developed and released a comprehensive IFR that sought to keep the country's skies safe through a means of accountability and the education of sUAS users.

While more than 1.5 million sUAS owner-operators have registered, this study estimates that between 110,000 and 220,000 recreational users and an unknown yet potentially significant number of commercial users have likely failed to register. The FAA is not taking proactive steps to ensure every sUAS owner-operator who should register does so.

The IFR's basic structure has allowed the FAA to meet the essential statutory requirements, follow federal registration program best practices, and take a vital first step for its vision of seamless flight operations between manned and unmanned aircraft.

The FAA has not established the kind of accountability that was the main focal point of the IFR. Registration is a necessary, but not sufficient method to establish this ability to tie an aircraft back to its owner-operator. The FAA is successfully leveraging its existing inspection groups and larger organization to enforce the IFR, though those offices and business processes will likely be extremely pressed if a true system for accountability, which Remote Identification could provide, is put into place. The FAA has laid the foundation for a strong relationship with local law enforcement, but more work needs to be done.

The communications efforts with the sUAS registration system have had mixed success. The FAA successfully sends out many key alerts to registrants to avoid flying in restricted areas or around special events. However, its registration website can be difficult to navigate. A knowledge test is not tied to registration. While visitors to the web site have access to educational resources, they are not actively encouraged to use them.

FAA has struggled with compliance and effectiveness questions related to sUAS owner-operators. This is understandable as many of these owner-operators have no prior experience with the FAA, nor do they all understand that sUAS are dangerous vehicles if used improperly. Adding to this challenge is the fact the basic sUAS technology continues to grow and evolve with new types of craft emerging month after month.

Some of these issues likely reflect the organizational approach that the FAA took to implement the IFR, adding responsibilities to existing offices managing well-established processes. These offices must balance sUAS work against that of regular aircraft. There has not been an office with true authority to look across the organization and towards the future, while closing the inevitable gaps and seams that arise in administration of any complicated governmental regulatory effort.

The FAA's narrow view of registration as a strictly ownership matter, rather than an issue that equally concerns operations, also contributes to its sUAS registration challenges. This posture has prevented the agency from focusing on compliance and from leveraging the registration system to reach out to all sUAS users and ensure they have knowledge and information they need to fly safely.

Whatever the source of the sUAS registration challenges, the FAA must bring renewed attention to sUAS registration, bringing back the sense of urgency and focus shown during the 2015 holiday season. The danger is that sUAS technologies and usage develop so fast as to outpace the FAA's capacity and ability to regulate and manage the resulting challenges.

Following the recommendations set forth in this report will enable the FAA to bolster a vital part of aviation safety and help the country take advantage of the benefits for recreation and commerce that sUAS offers.

The Panel offers FAA recommendations in the following areas: Strategic Leadership, Organizational Enhancements, Financial Management, Regulation, Performance Management Enforcement, Education, and Communications.

Recommendations

Strategic Leadership

The Secretary of Transportation, the FAA Administrator, and the agency's senior leadership should lead a renewed focus on the importance of the registration program, informing Congress and the public more frequently of the critical role of registration in protecting the national airspace. Leadership should intensify its efforts to make the current system more effective.

1. Prioritize Registration

The FAA should ensure registration remains a top priority in its sUAS integration efforts, especially considering the statutes that require registration of all aircraft and the central role of safety in the FAA's mission.

2. Reinforce the Vision

The FAA should continue to underscore its broader vision of integrated operations of manned and unmanned systems to help stakeholders understand the need for registration and other operating restrictions.

Organizational Enhancements

While the Panel does not believe there is a need to substantially change the existing organizational structure that the FAA has put in place to oversee and manage sUAS registration, the existing UAS Integration Office should be provided significantly expanded authority and resources to have increased oversight on implementation and operations of the registration program.

3. Empower the Existing Integration Office

FAA should give greater responsibility and new authorities to the UAS Integration Office, including oversight authority of program implementation and ensuring that the registration system is operating effectively on a daily basis. A clearly designated program overseer-manager within the office would have responsibility to develop policy, coordinate on staffing levels, and set program finances and review costs and fees, as discussed further in recommendation 5 below. That overseer would coordinate closely with other divisions and offices with responsibilities for day-to-day execution of the registration program, like enforcement or database operations. The Office should also be responsible for the development of a quarterly performance metric dashboard and use this management tool to drive future decision making.

4. Expand and Intensify Intra-Agency and Interagency Coordination

The FAA should elevate one of its interagency committees, the UAS Executive Work Group for example, to create a high-level sUAS management council that brings together responsible agency officials to discuss cross-cutting issues and coordinate on a common agenda. The FAA should also expand its work with other federal agencies to ensure its UAS Executive Committee, which brings together senior officials from the FAA, the Department of Defense, the Department of Homeland Security, and NASA covers all the key federal stakeholders and continues to meet regularly to discuss common and cross-cutting issues. It is critical for the FAA to learn the lessons of other agencies and exchange best practices.

Financial Management

The FAA should ensure that the registration fee is correctly set to cover the costs of providing the public service. The agency must ensure it has clarity on program costs and plans for enhancements, along with the necessary financial reporting systems in place.

5. Financial Accountability

The designated program overseer-manager within the empowered UAS Integration Office discussed in recommendation 3 above, should also have responsibility for managing finances and be accountable for results in this realm. A program office with an overseer in charge of reviewing program costs, fees revenue, and maintaining a balanced budget would create greater accountability, ensuring officials have clear responsibilities and performance expectations.

6. Evaluate Fees and Costs

The FAA should reexamine its fees structure for the registration program. The FAA must be clear why it charges the current fee rate, and whether the current total revenue covers all program costs, allowing for full cost-recovery. The FAA should update its existing cost accounting system to provide greater visibility into the cost of registration, potential knowledge test-taking, law enforcement support, and other related functions. The FAA should accelerate its efforts to comply with U.S. Office of Management and Budget (OMB) guidance and U.S. Government Accountability Office (GAO) recommendations on financial reporting to ensure the financial management enhancements are in place prior to the Remote ID rulemaking and the registration final rule.

7. Conduct an ABC Study

The FAA should conduct an Activity-Based Costing (ABC) study to ensure it is setting the fee, currently \$5, at the right level.

Accelerate Planned Rulemakings

To address the compliance challenges and enhance its ability to notify users of flight restrictions, the FAA should consider pursuing a range of additional regulations.

8. Accelerate Remote Identification

The FAA should support the timely implementation of its rulemaking on remote identification to address the gap between the number of sUAS units owned and registration-compliant recreational owners. The final rule should include aircraft serial numbers and make and model information, as well as obtain registrant mobile numbers to facilitate timely flood-warning-style messages.

9. Enhance Package Labeling

The FAA should provide specific guidelines and require manufacturers to inform new owner-operators of the requirement to register their aircraft by requiring a statement on the inside and outside of the box.

10. Consider Adoption of Software Locks

To ensure the owner-operator of any given sUAS has registered with the FAA and taken a flight knowledge test, the FAA should explore the requirement that manufacturers implement a software lock on sUAS units. These locks can prevent operation of the sUAS before the owner-operator indicates that both legislative requirements – aircraft is registered and the operator takes a test – have been satisfied.

11. Finalize the IFR

In order to follow proper administrative procedure, learn the lessons from implementation of its registration regulation, and to consider feedback during the public comment period for the Remote Identification NPRM, the FAA should finalize and publish the Registration IFR.

Require Performance Management

FAA leadership should routinely monitor new registration trends and make regular program adjustments to enhance its existing efforts to meet the registration goals of owner-operator education, accountability, and notification.

12. Publish Compliance Trends Regularly

In line with recommendation number 1 to ensure registration is an agency priority, the FAA should track and report compliance metrics to the public.

13. Fully Understand Market Trends

The FAA should enhance its on-going efforts to understand the unmanned aircraft market more comprehensively and act on the data it collects from manufacturers and forecasters.

14. Report Enforcement Actions

The FAA should ensure that decision-makers, such as the Executive Director of the Flight Standards Service, the Executive Director of the UAS Integration Office, the Associate Administrator for Aviation Safety, and the FAA Administrator, receive regular reports on unmanned aircraft events, investigations, enforcement, and education actions.

15. Publish Metrics

Section 371 of the FAA Reauthorization Act of 2018 requires the FAA Administrator and the Secretary of Transportation to monitor and report on compliance, enforcement actions and fees. FAA should add the following additional areas to the performance metric

dashboard referred to earlier, including social media and website contacts with sUAS owner-operators, the number and geographical spread of warnings sent to owner-operators through the registry, and pilot education and testing.

Enhance Enforcement Program

The FAA should take steps to improve its ability to enforce the IFR, especially as Remote Identification, if implemented with key provisions like serial numbers, increases caseloads. A strong relationship with state and local law enforcement, which has already begun, will be a key ingredient to becoming better postured for accountability and enforcement.

16. Perform Business Process Review on Enforcement Functions

The FAA should conduct an end-to-end business process and staffing review to understand how an anticipated increase in caseload would impact the overall enforcement system. FAA should engage an independent research center to map the enforcement process and “test” that system against low, medium, and high caseloads to identify weak points and structural flaws.

17. Strengthen Local & State Law Enforcement Cooperation

The FAA should strengthen cooperation and collaboration with state and local law enforcement with the adoption of formal communications protocols, including a common incident form. The FAA should step up its outreach efforts, reaching out to additional local and state law enforcement associations. The FAA should provide the law enforcement community a means for more direct, expedient, and timely access to the registry, possibly through operations/fusion centers.

Notification, Education, and Communications

To meet the unique and significant challenge of outreach to a very large number of sUAS users who may be unfamiliar with the FAA, flight rules and restrictions, and the national airspace, the FAA should take a number of steps.

18. Reorganize and Release a New Version of the DroneZone

As the FAA continues to rely heavily on its website for user education, training, and registration, the FAA should enhance the DroneZone websites’ visibility, navigation, loading, and archiving features. The website should be intuitive and have a logical navigation roadmap, and search engine optimization.

19. Get More Creative with Outreach

The FAA should enhance creative methods of engagement with the non-traditional owner-operator of unmanned aircraft, including better collaboration of “individuals and centers of influence” to encourage compliance with registration and flight restrictions. The FAA

should develop and implement a content management system to manage its communications strategy at an enterprise level.

Appendix A: Panel and Study Team

Study Panel

Janet Weiss (Chair)*, Mary C. Bromage Collegiate Professor of Business and Professor of Public Policy, Gerald R. Ford School of Public Policy, University of Michigan. Former Visiting Scholar, Trachtenberg School of Public Policy and Public Affairs, George Washington University; Visiting Professor, McCourt School of Public Policy, Georgetown University; Former positions with University of Michigan: Vice Provost for Academic Affairs; Dean, Rackham Graduate School. Former Fellow, Center for Advanced Study in the Behavioral Sciences, Stanford, CA; Former positions with School of Organization and Management and Institution for Social and Policy Studies, Yale University: Assistant Professor; Associate Professor.

Anthony Scardino*, Managing Principal, Grant Thornton. Former Deputy Under Secretary (Acting) and Chief Financial Officer, United States Patent and Trademark Office, U.S. Department of Commerce; Associate Chief Financial Officer for Budget, U.S. Department of Housing and Urban Development; Deputy Staff Director and Chief Financial Officer, Federal Election Commission; Budget Officer, Broadcasting Board of Governors; Senior Budget Analyst, Federal Bureau of Investigation.

Cornelius Kerwin*, President Emeritus and Professor of Public Administration and Policy, American University. Former Provost, American University. Former positions with School of Public Affairs, American University: Dean; Acting Dean; Professor: Assistant Professor; Associate Professor. Dr. Kerwin is a nationally recognized specialist in public policy and the regulatory process and teaches courses in regulatory process and management. He is the author of the book “Rulemaking: How Government Writes Law and Makes Policy”, now in its fifth edition.

Brodi Fontenot*, CEO, Fontenot Strategic Consulting LLC. Former Assistant Secretary for Management and Chief Financial Officer (Nomination), U.S. Department of Treasury; Assistant Secretary for Administration and Senior Sustainability Officer, U.S. Department of Transportation; Deputy Assistant Secretary for Management and Budget, U.S. Department of Transportation; Budget Analyst for Transportation, Veterans’ Affairs, and Commerce and Housing Credit, United States Senate, Committee on the Budget; Analyst/Senior Analyst, U.S. Government Accountability Office.

Jamie Winders, Professor, Department of Geography, The Maxwell School of Citizenship and Public Affairs and Director of the Autonomous Systems Policy Institute, Syracuse University. Dr. Winders’ research interests and expertise in autonomous systems include questions related to

data ethics, ownership, and governance; impacts on marginalized communities and the built environment; the future of work; and public perception/acceptance.

Project Staff

Brenna Isman, *Director of Academy Studies* – Ms. Isman has worked at the Academy since 2008 and oversees the Academy studies, providing strategic leadership, project oversight, and subject matter expertise to the project study teams. Prior to this, Ms. Isman was a Project Director managing projects focused on organizational governance and management, strategic planning and change management. Her research engagements have included working with the National Aeronautics and Space Administration, the Environmental Protection Agency, the Social Security Administration, the Department of Veterans Affairs, as well as multiple regulatory and Inspector General offices. Prior to joining the Academy, Ms. Isman was a Senior Consultant for the Ambit Group and a Consultant with Mercer Human Resource Consulting. Ms. Isman holds a Masters of Business Administration (MBA) from American University and a Bachelor of Science (BS) in Human Resource Management from the University of Delaware.

Daniel Ginsberg, *Project Director*. Mr. Ginsberg has directed and provided subject matter expertise for a number of projects for the Academy and draws on his expertise as a defense, health care policy, and human capital consultant in Washington, DC. From 2009 to 2013, he served as the Assistant Secretary of the Air Force for Manpower and Reserve Affairs, leading the Air Force's efforts to provide trained and ready personnel, while transforming human capital management for the almost 700,000-person armed service. Mr. Ginsberg served for a decade as the senior defense policy advisor to U.S. Senator Patrick Leahy of Vermont. He is also a former member of the staff of the U.S. Senate Committee on Armed Services during the Chairmanship of U.S. Senator Sam Nunn of Georgia.

Joseph Mitchell, *Strategic Advisor*. As the Academy's Director of Strategic Initiatives and International Programs, Dr. Mitchell currently leads the Academy's Grand Challenges in Public Administration campaign, thought leadership efforts, and international engagement. He recently served at the General Services Administration to stand up its new Office of Shared Solutions and Performance Improvement and led a team to manage cross-agency projects and initiatives in support of the President's Management Agenda. Previously, he led and managed the Academy's studies program. He holds a Ph.D. from the Virginia Polytechnic Institute and State University.

Frank J. Principi, *Senior Advisor*. Mr. Principi has provided subject matter expertise to this study utilizing his previous experiences as a local elected official and management consultant. In elected office, he led efforts to finance public and private sector infrastructure including roads, schools, water/sewer, natural gas, electric, and communications. Mr. Principi was the Managing Partner

of Crisis Partners International and a Senior Consultant for Marsh & McLennan. Mr. Principi is a Master's Candidate at University of Maryland, College Park and holds a Bachelor of Science (BS) in Political Science and American History from the University of California, Los Angeles. He is also a former member of the staff of the U.S. House of Representatives Committee on Energy and Commerce during the Chairmanship of Congressman John Dingell.

Sharon Yoo, *Research Analyst*. Ms. Yoo provides research and analytical support to several Academy initiatives and draws on her international development, education, and technology policy expertise. She has extensive research experience and has published in these topics. She previously worked with organizations such as the UNDP, MIT Media Laboratory, and several technology start-ups. Her previous research includes Pakistan's energy crisis, North Korea's tuberculosis outbreak, and unique applications of artificial intelligence. She is proficient in Korean, Hindi/Urdu, and English. She holds a dual degree masters from The Johns Hopkins University School of Advanced International Studies and Harvard Graduate School of Education.

Kyle Romano, *Senior Research Associate*. Mr. Romano has provided research support for several Academy studies. Most recently, he has served on Academy projects assessing the alignment of the Federal Bureau of Prisons with its healthcare mission, and the U.S. Forest Service's research and development enterprise. He graduated from the Indiana University School of Public and Environmental Affairs where he earned a Master of Public Affairs. He attended the University of Central Florida for his undergraduate studies where he earned a B.A. in Political Science and a B.S. in Legal Studies.

Appendix B: Participating Individuals and Organizations

U.S. Federal Aviation Administration

Bhadra, Dipasis – Senior Quantitative Economist, Forecast and Performance Analysis Division, Office of Aviation Policy and Plans

Burchett, David – Program Manager, UAS Program Office Division, Office of Information and Technology, Office of the Chief Information Officer

Cruz, Emmanuel – Manager, Safety and Operations Branch, Unmanned Aircraft Systems Integration Office

Cunningham, Marcus – Acting AFX UAS Liaison, Aviation Safety Standards

Freeman, Courtney – Attorney, Regulations Division, Office of the Chief Counsel

Grogan, Jeremy – Flight Standards Service

Harris, Scott – Special Agent, Law Enforcement and Assistance Program, Office of National Security Programs and Incident Response

Hassig, Guido – Program Manager

Huber, Robert – Aviation Safety Analyst, Flight Standards Service

Hufty, Derek – UAS IPP Team Lead, Flights Standards Service

Jackson, John – Special Projects Program Manager, Office of Safety Standards, Aviation Data Systems Branch

Lukacs, Michael – Deputy Division Manager, Forecast and Performance Analysis Division, Office of Aviation Policy and Plans

Morra, Joseph – Director, Safety and Integration Division, Unmanned Aircraft Systems Integration Office

Morris, Kevin – National Administrator, FAA Safety Team

Olson, Kerin – Research Strategy, Planning, and Communications Lead, UAS Research Division

Orquina, Jessica Ann – Lead Communications Specialist, UAS Integration Office

Raley, Charles – Senior Attorney, UAS Team Lead for Enforcement, Policy and Outreach, Office of the Chief Counsel

Riffe, Janet – Manager, Enforcement Standards and Policy Division, Office of National Security Programs and Incident Response

Shiffer, Jeannie – Deputy Assistant Administrator, Office of Communications

Strande, Paul – Deputy Director, UAS Research Division

Thompson, Ken – Manager, Aircraft Registration Branch

U.S. Department of Transportation

Quade, William – Deputy Associate Administrator, Policy and Programs, Pipeline and Hazardous Materials Safety Administration

U.S. Government Accountability Office

Hung, Richard – Assistant Director, GAO

Krause, Heather – Director, Physical Infrastructure Team, GAO

Lawless, Maria – Senior Analyst, GAO

Sausville, David – Assistant Director, GAO

U.S. House of Representatives Transportation and Infrastructure Subcommittee

Burkett, Alex – Staff Director/Pilot

Lyons, Holly Woodruff – Staff Director

Ngo, Dan – FAA Detailee

Presti, Thomas “Hunter” – Senior Professional Staff

Tien, Mike – Senior Counsel

U.S. Senate Commerce Subcommittee on Aviation

Reynolds, Mike – Deputy Policy Director

Wildgoose, Laurence – Professional Staff Member

Wonnenberg, Isaiah – Research Assistant

Academy of Model Aeronautics

Dobbs, Tyler – Government Affairs Director, Academy of Model Aeronautics

Air Line Pilots Association, International

Kenagy, Randy – Manager, Engineering and Operations

DJI

Aitken, Mark – Director of United States Legislative Affairs

Schulman, Brendan – Vice President, Policy and Legal Affairs

Small UAV Coalition

Armistead, Amanda – Senior Vice President, Emerging Technologies, McGuire Woods Consulting

Walden, Gregory – Senior Advisor, Emerging Technologies – McGuire Woods Consulting

Law Enforcement

Colborn, Mark – Senior Corporal and Instructor Pilot, Helicopter Unit, Dallas Police Department

Barnard, Barry – Police Chief of Prince Williams County, Virginia

Mantel, Lisa – Deputy Director, Technical Assistance, Police Executive Research Forum

International Interviews

Cary, Leslie – Chief, Remotely Piloted Aircraft Systems, International Civil Aviation Organization

Stewart-Smith, Jeannie – Manager, Policy, Regulations & Stakeholder Engagement, Remotely Piloted Aircraft Systems Task Force, Transport Canada

External Experts

Blades, Michael – Vice President, Aerospace, Defense, and Security, Frost & Sullivan

Gettinger, Dan – Co-Director, Bard College Center for the Study of the Drone

Gottehrer, Gail – Emerging Technologies Attorney, Law Office of Gail Gottehrer, LLC

Mariani, Joe – Research Manager, Center for Government Insights, Deloitte

Ravich, Timothy – Assistant Professor, University of Central Florida

Routh, Adam – Research Manager, Center for Government Insights, Deloitte

Appendix C: IFR Description

This Chapter provides a description of the FAA’s Interim Final Rule for registration and marking of sUAS, its goals in promulgating the rulemaking, and details on its organizational structure and function for activities related to UAS.

Description of the IFR

Title 49 U.S.C. 44102 requires that all aircraft register prior to operation, and the FAA is required to develop and maintain an aircraft registry.⁵⁵ In order to comply with its statutory requirement to develop such a registry, in December 2015 the FAA established an online registration system.

Following the creation of this paper-based registration system, the FAA recognized that the volume of paper-based registration requests would quickly exceed its ability to process, and that it would need to create a less burdensome process for sUAS user and the FAA alike, “In addition to the safety justifications that support the immediate adoption of this rule, the FAA Aircraft Registration Branch (the Registry) will be unable to quickly process the total volume of expected small unmanned aircraft registration applications for existing unmanned aircraft and the proliferation of newly purchased unmanned aircraft. Thus, the FAA must implement a registration system that allows the agency greater flexibility in accommodating this expected growth”.⁵⁶

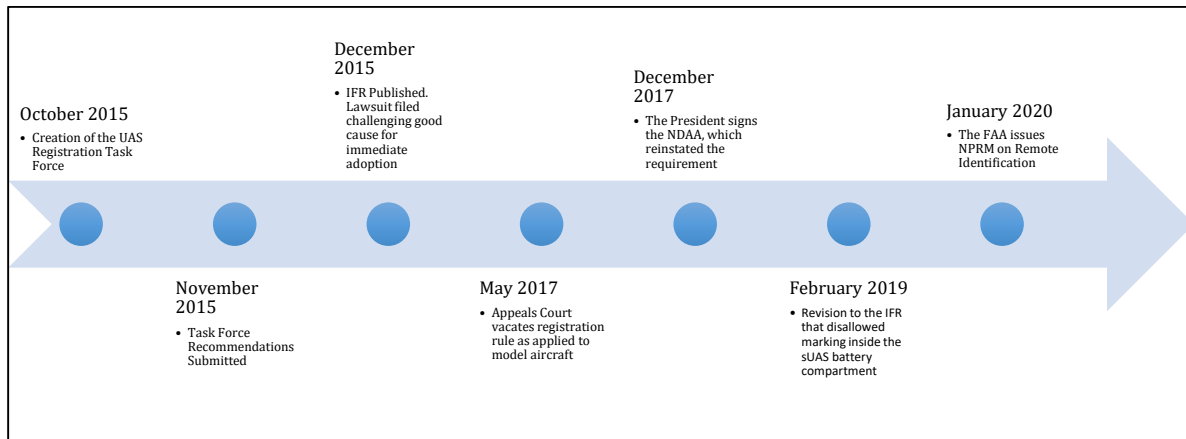


Figure 5: Key Actions Impacting Registration. (Source: The National Academy of Public Administration).

⁵⁵ U.S. Federal Aviation Administration. 2015. *80 Fed. Reg. 78593: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

⁵⁶ U.S. Federal Aviation Administration. 2015. *Federal Register: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

The Administrator chartered the UAS Registration Task Force (Task Force) on October 20, 2015 to inform rulemaking on an alternative registration process for sUAS. Its objectives were to:

1. Develop and recommend minimum requirements for UAS that would need to be registered.
2. Develop and recommend registration processes.
3. Develop and recommend methods for proving registration and marking.

On November 21, 2015, the Task Force provided a final report, including its recommendations, to the FAA Administrator. Information and data were also sought by the Secretary and Administrator from the public through the FAA's Notice of Proposed Rulemaking (NPRM) on registration and marking requirements for sUAS.

After considering public comments and recommendations from the U.S. Department of Transportation (DOT), the Task Force, and the public, the FAA developed an alternative process for registration available only to sUAS users in 14 CFR Part 48. Part 48, the FAA's Interim Final Rule on registration and marking requirements for small unmanned aircraft. The IFR was officially published in the Federal Register on December 16, 2015.

The following text provides some of the FAA's responses to public comments and the Task Force, as well as determinations made by the FAA in its IFR. The IFR includes the definitions for relevant terms:⁵⁷

Weight Threshold

Ultimately, the FAA accepted the weight-based threshold for triggering the registration requirement recommended by the Task Force. Aircraft weighing less than .55 pounds, and more than 55 pounds are excluded from the requirement.

⁵⁷ U.S. Federal Aviation Administration. 2015. *Federal Register: Registration and Marking Requirements for Small Unmanned Aircraft*. 241. Vol. 80. Washington, DC: U.S. Department of Transportation.

Unmanned Aircraft: an aircraft that is operated without the possibility of direct human intervention from within or on the aircraft. **Model Aircraft:** an unmanned aircraft that meets three criteria: capable of sustained flight in the atmosphere; flown within visual line of sight of the person operating the aircraft; and flown for hobby or recreational purposes. **Small Unmanned Aircraft:** an unmanned aircraft weighing less than 55 pounds (this includes everything that is on board the aircraft at takeoff).

Age and Citizenship Requirements

The IFR calls for the web-based registration process to require registrants to review a summary of sUAS operational guidelines before completing registration. Included in the web-based registration process are links to educational material on basic aviation laws and safety. The web-based registration process is limited to operators 13 years of age and older, and follows requirements specified by the Children’s Online Privacy Protection Act. Non-U.S. citizens that wish to conduct model aircraft operations in the U.S. are allowed to do so, provided that individuals complete the process set forth in part 48 and comply with the relevant statutory requirements. A corporation that is not a U.S. citizen may register when it is organized and doing business under the laws of the U.S. or a state, and the aircraft is based and primarily used in the U.S.

Registration Prior to Operation

The IFR currently requires that all owners must register online, or through the paper-based process, prior to operation of the sUAS. Owners of model aircraft are registered with a single Certificate of Aircraft Registration and are assigned a registration number that constitutes registration for each of their aircraft. Owners of model aircraft must submit basic contact information to register.⁵⁸ Owners of sUAS to be used as other than model aircraft must provide aircraft-specific information in addition to basic contact information in order to complete registration. Each aircraft must have a unique number that exists under that profile.

The FAA is required by statute to charge a fee for registration to recover the cost of providing registration services. Owners of model aircraft will be charged a single \$5 fee for registration, and \$5 for the renewal of their registration every three years. Owners of UAS to be used other than as model aircraft will be charged a fee of \$5 to register each of their aircraft, and \$5 for the renewal of each of their aircraft every three years. The IFR sets a \$5 fee for each owner-operator to register. The rate is the same fee that the agency charges for the registration of any aircraft.

Transfer of Ownership and Identification

Owners of model aircraft should remove their unique identifier from the aircraft before transfer or sale. Since individual owners of UAS used exclusively as model aircraft are not required to submit aircraft-specific information, there is no need for the seller to update the registration system upon a transfer or sale. Owners of sUAS used other than as model aircraft are required to update the registration system upon transfer of ownership, destruction, or export of a registered sUAS.

⁵⁸ Name, address, and email address.

The unique identifier for all sUAS “must be maintained in a condition that is legible and be affixed to the sUAS by any means necessary to ensure that it will remain affixed to the aircraft during routine handling and all operating conditions”. The unique identifier must be readily accessible and visible upon inspection of the sUAS. The FAA deems the identifier as “readily accessible” if it can be accessed without the use of any tools. On February 25, 2019, the FAA issued a revision to the IFR that disallowed marking the unique identifier inside the battery compartment of the sUAS.⁵⁹ The revision was made to address the concerns of law enforcement “regarding the risk a concealed explosive device poses to first responders who must open a compartment to find the small unmanned aircraft’s registration number”. The agency acknowledged that as of the date of the rulemaking, serial numbers may be repeated as there was no mechanism in place for manufacturers to ensure a given serial number is unique to a specific aircraft.

Compliance Approach and Enforcement

The FAA’s approach to enforcement, spelled out in FAA Order 8000.373, is to employ the least harsh means to remediate a situation.⁶⁰ Failure to register an aircraft can result in fines of up to \$250,000 and/or imprisonment for up to three years.

Information Required from Registrant

The FAA developed the registration system and requirement in compliance with all federal information technology requirements and guidelines regarding the security and protection of information.⁶¹ The agency determined that email addresses from modelers are necessary to create a web-based account through which to register themselves and obtain their unique identifier, as well as receive ongoing educational materials and other relevant information. The web-based platform established by the IFR will allow the general public to search the part 48 registry database by unique identifier, though this search has not been made available to date.⁶²

⁵⁹ U.S. Federal Aviation Administration. 2019. *U.S. Code of Federal Regulations: Title 14 Part 48 Section 48.205*. Washington, DC: U.S. Department of Transportation. https://www.ecfr.gov/cgi-bin/text-idx?SID=f89bcac44702b47ddfeb4d2240655e6&mc=true&node=se14.1.48_1205&rgn=div8.

⁶⁰ U.S. Federal Aviation Administration. 2015. *Order 8000.373: Federal Aviation Administration Compliance Philosophy*. U.S. Department of Transportation. https://www.faa.gov/documentlibrary/media/order/faa_order_8000.373.pdf.

⁶¹ U.S. Congress. 2014. *Public Law 113-283: Federal Information Security Modernization Act of 2014*. Washington, DC.

⁶² This provision in the IFR has not yet been implemented.

Remote Identification Notice of Proposed Rulemaking

On December 31, 2019, the FAA published its Notice of Proposed Rulemaking on Remote Identification of Unmanned Aircraft Systems in the Federal Register.⁶³ Remote identification is a technology that allows identification of an aircraft location and control consoles used by the owner-operator. It is often referred to as creating a “license plate” for UAS. The NPRM on Remote Identification included two potential changes to sUAS registration, including requiring non-commercial users to register the serial number of each aircraft and requiring owner-operators to provide a mobile number in the database to facilitate notification and enforcement. The FAA collected comments on the NPRM until March 2nd, 2020.

⁶³ U.S. Federal Aviation Administration. 2019. *Federal Register: Notice of Proposed Rulemaking - Remote Identification of Unmanned Aircraft Systems*. 250. Vol. 84. Washington, DC: U.S. Department of Transportation.

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