A GROWING BUZZ: AN ANALYSIS OF SMALL UNMANNED AIRCRAFT SYSTEMS PART 107

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I. INTRODUCTION

Technology and innovation have long been central cogs in the growth of the human race. From the first sharpened stones to the creation of modern supercomputers, mankind has consistently lurched itself forward with the aid of technology. Some, such as Bill Gates, are receptive to technological advance, and see drone technology as potentially "impactful . . . in positive ways to help society."[1] Other public figures, including Senator Rand Paul, have spoken out against drones, citing privacy concerns for U.S. citizens.[2] Paul's concerns regarding privacy and the operation of drones do not go unheard. Imagine yourself at home in your suburban home on a late July evening. The family pool is in operation, and your daughter is enjoying her summer vacation by spending the afternoon swimming outside. Suddenly, the quiet summer evening is interrupted by a faint buzz, as if a microscopic bee was flittering near your ear. Your daughter rushes inside, exclaiming that a drone is outside. As you step into your backyard, you see a small flying object hovering in the air. Attached is a camera, which, for all you know, is recording the events transpiring in your private backyard. This was the situation in which William Merideth of Hillview, Kentucky found himself in late July, 2015.[3] Merideth disposed of the drone by shooting the drone with a shotgun, causing it to crash. Merideth was subsequently arrested and charged with first degree criminal mischief and first degree wanton endangerment.[4] Merideth, along with his neighbors, described the drone hovering over backyards as "creepy" and

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[1] Mario Trujillo, *Bill Gates: Amazon Is 'Optimistic' On Drones*, THE HILL (Feb. 12, 2013, 5:06 PM), http://thehill.com/blogs/ballot-box/191789-bill-gates-amazons-drone-timeline-over-optimistic.

[2] Rand Paul, *Don't Let Drones Invade Our Privacy*, CNN (June 15, 2012, 9:16 AM), http://www.cnn.com/2012/06/14/opinion/rand-paul-drones/index.html.

[3] *Hillview Man Arrested for Shooting Down Drone; Cites Right to Privacy*, WDRB NEWS (July 28, 2015, 12:38 PM), http://www.wdrb.com/story/29650818/hillview-man-arrested-for-shooting-down-drone-cites-right-to-privacy.

[4] *Id.*

"weird," and cited concerns over the drone being piloted by a potential thief to "case" their homes for robbery.[5] Merideth's charges were later dropped by a Bullitt County District Court Judge, who stated that he "had a right to shoot at this drone."[6] Merideth's actions in July of 2015 are not an isolated incident. Drone incidents have increased across the world as drone sales have increased.[7] This note will analyze the newly enacted United States drone regulation scheme entitled Small Unmanned Aircraft Systems Rule (Part 107). This note will look beyond the statutory operational limits provided in the Small Unmanned Aircraft Systems Rule to offer additional statutory remedies to prevent the ever increasing number of drone-related incidents—particularly with new drone operators.[8]

Part II of this note will provide a brief history of private drone usage to provide the reader context for the subsequent analysis. This brief history will primarily focus on the rapid growth of the drone industry in the mid-2010s, and explain the reasons for this massive growth. This history will be overlaid with statistical and anecdotal evidence to support the premise that drone-related incidents are increasing in frequency.

Part III of this note will analyze the current legislation, the Small Unmanned Aircraft Systems Rule (Part 107). Part III will analyze the features and strengths of this legislation, providing an understanding of the baseline operational standards pilots of small unmanned aircraft should be aware of.

Part IV of this note will offer a solution to the growing problem of negligent operation of small unmanned aircraft. Specifically, I will propose an expansion of the scope of the Small Unmanned Aircraft Systems Rule to encompass all aircraft weighing under fifty-five pounds. Additionally, I will suggest a "learner's" period of operation. This six-month beginner period will require a minimum of ten hours of logged flights under limited operational standards. This period will allow new pilots to obtain a competent level of operation, in a manner that creates a significantly lowered risk to the public and the pilot.

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[5] *Id.*

[6] *Judge Dismisses Charges for Man Who Shot Down Drone*, WDRB NEWS (Oct. 26, 2015, 4:34 PM), http://www.wdrb.com/story/30354128/judge-dismisses-charges-for-man-who-shot-down-drone.

[7] Lucinda Shen, *Drone Sales Have Tripled in the Last Year*, FORTUNE (May 25, 2016), http://fortune.com/2016/05/25/drones-ndp-revenue/.

[8] *UAS Sightings Report*, FED. AVIATION ADMIN. (Mar. 25, 2016), http://www.faa.gov/uas/resources/uas_sightings_report/.

II. History of Private Drone Operation

A. General Introduction—What Is a "Drone"?

The Oxford Dictionary defines a "drone" as "a remote-controlled pilotless aircraft or missile."[9] Drones have taken on many connotations to the general public. Drones are often most broadly thought of in their usage by militaries around the world to conduct covert surveillance and missile strikes. It is no secret that the military application of pilotless aircraft and missiles is the primary usage for this type of technology. However, the usage of these drones, and the lengthy discourse on the legality and morality of their use, will not be examined here. Instead, this note will focus on the type of remote-controlled pilotless aircraft that private citizens use for a variety of reasons. These aircraft are referred to as "quadcopters," due to the four spinning blades that keep the aircraft in the air. A quadcopter is defined as "an unmanned helicopter having four rotors."[10]

As early as 2006, quadrotor helicopters were being developed from earlier types of flying toys and components from other remote-controlled toys such as cars or trucks.[11] These initial designs were described by researchers as "robust and simple," due to their lack of complicated components which added to the cost of production and development associated with other types of helicopters.[12] However, researchers critiqued these designs for their unreliability and lack of performance.[13] The community of quadcopter enthusiasts grew, resulting in a widespread grassroots development of technology to improve the reliability and performance issues that plagued initial quadcopter designs.[14] These developments increased interest in quadcopters for researchers and enthusiasts alike. The developments have created an industry that shows no signs of slowing down.

Quadcopter sales have continued to consistently grow. In a report published by the retail research firm NPD group, quadcopter sales grew from around $65 million from May 2014 to April 2015, to over $200

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[9] *Drone*, OXFORD ENGLISH DICTIONARY (2d ed. 2016).

[10] *Quadcopter*, OXFORD ENGLISH DICTIONARY (2d ed. 2016).

[11] Paul Pounds, Robert Mahoney & Peter Corke, *Modelling and Control of a Quad-Rotor Robot*, AUSTL. ROBOTICS & AUTOMATION ASS'N 1 (2006), http://www.araa.asn.au/acra/acra2006/papers/paper_5_26.pdf.

[12] *Id.*

[13] *Id.*

[14] *See generally Welcome to the Open Source Next Generation Multicopter*, NEXT GENERATION UNIVERSAL AERIAL VIDEO PLATFORM, https://ng.uavp.ch/FrontPage (last updated Sept. 21, 2016) (providing an example of grassroots development of quadcopter technology).

million from May 2015 to May 2016.[15] The report averages the amount spent on each quadcopter as $550.[16] Therefore, at the minimum, an average of over 363,000 units were sold. Although this number is not an accurate reflection of the actual number of units sold due to variations of prices of each specific model, the volume of quadcopters sold is clear. This increase in sales can be connected to the ability for producers of quadcopters to produce units at low prices and technological advances that have made the acquisition of quadcopters both easier and more enticing.

The price of quadcopters presents a low-cost entry point for someone seeking a new hobby. For instance, the U818A Plus, a quadcopter which boasts a 720p camera and a range of eighty meters[17] (roughly seventy-five percent of the distance of a standard football field), allows those who are interested in quadcopters to enter the hobby for around $50 dollars.[18] This particular model is featured as one of the better options for those seeking to purchase their first quadcopter.[19] Cheap base models with impressive features are possible due to lower than ever cost-to-performance ratios that technological advances have created. For instance, the price-per-megapixel increased over 200 percent from 2011 to 2015.[20] The cost of imaging is not the only technological advance that has been integrated into quadcopters. The price of a microprocessor transistor cycle (the same type of small form factor processor found within quadcopters), has fallen drastically,[21] while the speed in which these transistors process information has increased exponentially.[22] Additionally, quadcopters have developed features that have increased their appeal to the ordinary consumer. The most notable of these is the integration of camera technology. Cameras attached to quadcopters produce visually spectacular images and provide practical commercial usages. For example, a start up in Switzerland named Gamaya

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[15] Shen, *supra* note 7.

[16] *Id.*

[17] *Discovery2 / U818A Plus*, UDI RC, http://www.udirc.com/portfolio/discovery2-u818a-plus (last visited July 15, 2017).

[18] *See* Product Results for U818A, AMAZON, https://www.amazon.com (enter "U818A" into search query).

[19] *See* Mike Prospero, *Best Drones 2017*, TOM'S GUIDE, http://www.tomsguide.com/us/best-drones,review-2412.html (last updated May 24, 2017, 11:40 AM).

[20] *Image Sensor Growth*, HIS iSUPPLI MOBILE AND WIRELESS COMM. SERVICE, http://www.pwc.com/gx/en/technology/mobile-innovation/assets/image-sensor-steady-growth-for-new-capabilities-image-1.jpg (last visited June 29, 2017). "Megapixel" is a unit of measurement for digital camera resolution. *See megapixel*, OXFORD ENGLISH DICTIONARY (2d ed. 2016).

[21] Ray Kurzwell, *Microprocessor Cost Per Transistor Cycle*, SINGULARITY, http://www.singularity.com/images/charts/MicroProcessCostPerTrans.jpg (last visited Feb. 8, 2017).

[22] Ray Kurzwell, *Microprocessor Clock Speed*, SINGULARITY, http://www.singularity.com/images/charts/MicroprocessorClockSpeed.jpg (last visited Feb. 8, 2017).

is using imaging technology within quadcopters to increase the efficiency and costs associated with farming in an effort to increase profits of farmers.[23] The use of mobile phones and tablets as remote control devices used to fly and provide a live feed of images from the quadcopter have also eliminated the complications associated with seemingly overwhelming and complicated traditional controls. The low entry point and technological innovations that make quadcopter piloting an appealing hobby are a major factor for the exponential growth the market has seen in such a short period of time.

The future of the quadcopter market is exponentially larger than the current level. Barring major legislative efforts to limit the operation of quadcopters, analysts expect quadcopters sales to continue to multiply. In a report published by the Federal Aviation Administration ("FAA") in August of 2016, "hobbyist" quadcopter sales were projected to grow from 1.9 million units sold in 2016 to 4.3 million units sold annually by the year 2020.[24] The same report forecasts an increase of "commercial non-model aircraft" to increase from 600,000 sold in 2016 to over 2.7 million sold by 2020.[25] These numbers clearly illustrate a massive change from a similar report published in 2014. In the 2014 report, the number of commercial non-model aircraft projected to be in operation by the end of 2014 was "roughly 7,500."[26] These reports indicate the "takeoff" that the quadcopter hobby will continue to have.

B. Public Opinion Regarding Quadcopter Use

Despite the increase of private quadcopter purchases in the United States in recent years, public opinion has yet to reflect the same enthusiasm. Instead, a growing displeasure with the increase in quadcopter usage is clear.[27] In a study conducted by the Pew Research Center and Smithsonian magazine regarding the future of technology in the United States, only 22% of Americans surveyed thought that allowing "personal and commercial

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[23] Katie Fehrenbacher, *This Startup Is Changing Farming with Drones and AI*, FORTUNE TECH (May 23, 2016), http://fortune.com/2016/05/23/startup-gamaya-farming-with-drones-ai/?iid=leftrail.

[24] *Unmanned Aircraft Systems*, FED. AVIATION ADMIN. 31, http://www.faa.gov/data_research/aviation/aerospace_forecasts/media/Unmanned_Aircraft_Systems.pdf (last visited Nov. 15, 2016).

[25] *Id.*

[26] *Federal Aviation Administration Aerospace Forecast Fiscal Years 2014 – 2034*, FED. AVIATION ADMIN. 69, http://www.faa.gov/data_research/aviation/aerospace_forecasts/media/2014_FAA_Aerospace_Forecast.pdf (last visited Nov. 15, 2016).

[27] *See* Shen, *supra* note 7.

drones . . . to fly through most U.S. airspace . . . would be a change for the better."[28] Of the four technological advances surveyed in the study, allowing personal and commercial drones to fly through United States airspace contained the lowest percentage of Americans who viewed this technological advance as a positive change.[29] Conversely, "63% of Americans [thought] it would be a change for the worse if personal and commercial drones [were] given permission to fly through United States airspace."[30] This majority is not reflected only in traditionally older demographics. Sixty percent of men and sixty-one percent of women surveyed in the age range of eighteen to twenty-nine stood with the majority of Americans who viewed allowing private and commercial drones to operate in United States airspace as a change for the worse.[31]

C. The "Bad Image"

This public opinion conundrum has created what Ulrike Esther Franke calls an "image problem."[32] Franke states this image problem is derived from the preliminary militaristic usage of drones, which creates an image of a "Predator-like 'killer' drone."[33] However, Franke is optimistic when it comes to the future of civilian operated quadcopters. Franke cites the development of small quadcopters to take "dronies,"[34] and a burrito delivery system referred to as the "burrito bomber"[35] as practical and positive reflections of quadcopter technology that can be used to illustrate positive uses of quadcopters—uses that could improve the social and practical lives of citizens who are otherwise "unenthusiastic" about the development of quadcopter technology.[36]

This unenthusiastic majority of Americans who have expressed a general displeasure to the operation of quadcopters by private citizens might

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[28] *U.S. Views of Technology and the Future: Science in the Next 50 Years*, PEW RESEARCH CENTER 8 (Apr. 17, 2014), http://www.pewinternet.org/files/2014/04/US-Views-of-Technology-and-the-Future.pdf (internal quotations omitted).

[29] *Id.* at 7.

[30] *Id.* at 8 (internal quotations omitted).

[31] *Id.*

[32] Ulrike Esther Franke, *Civilian Drones: Fixing an Image Problem?*, THE CTR. FOR SECURITY STUD. BLOG NETWORK (Jan. 26, 2015), http://isnblog.ethz.ch/security/civilian-drones-fixing-an-image-problem.

[33] *Id.*

[34] David Shamah, *Israeli Non-GPS Powers 'Selfie' Nano-Drone*, THE TIMES OF ISR. (Dec 14, 2014, 4:17 PM), http://www.timesofisrael.com/israeli-nano-gps-powers-selfie-nano-drone/.

[35] *The World's First Airborne Mexican Food Delivery System*, DARWIN AEROSPACE, http://www.darwinaerospace.com/burritobomber (last visited Nov. 18, 2016).

[36] PEW RESEARCH CENTER, *supra* note 28, at 7.

have cause for concern. Various incidents have created large-scale problems surrounding the operation of quadcopters.

D. Collision with Airplanes

The essential characteristic of a quadcopter is that it flies. When quadcopters fly near airports, quadcopter pilots risk colliding with aircraft that are already in flight. A collision could endanger the lives of aircraft passengers. From November 2014 to August 2015, the FAA cited 764 separate instances in which unmanned aircraft (including quadcopters) were operated near or around areas in which airplanes or helicopters were in use.[37]

These instances are not unique to the United States. On April 17, 2016, a quadcopter allegedly struck an aircraft which was approaching London's Heathrow Airport to land.[38] Although no debris or other evidence was found in the area, the British Civil Aviation Authority launched an investigation into the matter.[39] This incident is not new to Heathrow. The Airprox Board, the safety regulation board in the United Kingdom, reported twenty-three "close encounters" with quadcopters at the popular airport.[40] Twelve of these incidents were noted as presenting a "serious risk of collision."[41] One of these incidents involved a quadcopter being "70 feet from the left wing" of a Boeing 777 airplane on takeoff.[42]

The operation of quadcopters around these areas presents a natural threat to those who are onboard aircraft. The likelihood of small airborne objects being sucked into jet engines upon takeoff is a real threat. A well-known example of a similar accident occurred in January 2009, when a pilot was forced to conduct an emergency landing of an aircraft into the Hudson River in New York after a goose was sucked into the engine of the plane.[43] The continued operation of quadcopters near airports and aircraft in flight creates an unnecessary risk for passengers.

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[37] *UAS Events Nov 2014 – Aug 2015*, FED. AVIATION ADMIN., http://www.faa.gov/uas/media/UASEventsNov2014-Aug2015.xls (last visited Feb. 2, 2017).

[38] Tim Hume & Richard Allen Greene, *Investigations Launched After Suspected Drone Strikes Passenger Jet in London*, CNN (Apr. 18, 2016, 1:33 PM), http://www.cnn.com/2016/04/17/europe/london-heathrow-drone-strikes-plane/.

[39] *Id.*

[40] *Id.*

[41] *Id.*

[42] *Id.*

[43] Robert F. McFadden, *Pilot Is Hailed After Jetliner's Icy Plunge*, N.Y. TIMES (Jan 15, 2009), http://www.nytimes.com/2009/01/16/nyregion/16crash.html.

E. Negligent Operation

Negligent operation of quadcopters is a clear world-wide issue. Stories depict quadcopters crashing around the world. For example, a quadcopter was crashed into the White House at 3am in January of 2015.[44] In Cape Town, South Africa, a quadcopter malfunctioned mid-flight and crashed through an office building, striking a man on the head.[45] In the United Kingdom, quadcopter incidents reported to police have increased from 94 in 2014 to 425 in 2015.[46] At the time of publication, there had been 272 reported incidents in the United Kingdom in 2016.[47] Ironically, the first drone-related death was reported in the United Kingdom the following day. A group of people were seen leaving the area of a reported quadcopter flight when they crashed, killing one woman inside the car.[48] According to the *Independent*, it is being regarded as the "first fatality linked to the non-military use of drones."[49] These reports represent the varied instances in which negligent operation of drones have caused security issues, injury, public nuisance, and have even been linked to death.

F. Misuse

The misuse of quadcopters is also an issue that must be considered. Most notably, a video surfaced on YouTube of a homemade quadcopter firing a small caliber handgun four times, while remaining in the air.[50] Other notable misuses include two men who attached fireworks to a quadcopter in early 2015.[51] The negligent operation and misuse of quadcopters present safety concerns for any person who comes into contact

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[44] Zeke J. Miller, *Drone That Crashed at White House Was Quadcopter*, TIME: POL. (Jan 26, 2015, 3:20 PM), http://time.com/3682307/white-house-drone-crash/.

[45] Steve Borrello, *Drone Crashes Through Window, Hits Man's Head*, ABC NEWS (Apr. 8, 2016, 9:30 PM), http://abcnews.go.com/International/drone-crashes-window-hits-mans-head/story?id=38253589.

[46] Peter Yeung, *Drone Reports to UK Police Soar 352% in a Year Amid Urgent Calls for Regulation*, INDEP. (Aug. 7, 2016), http://www.independent.co.uk/news/uk/home-news/drones-police-crime-reports-uk-england-safety-surveillance-a7155076.html.

[47] *Id.*

[48] Adam Lusher, *London Woman Dies in Possibly the First Drone-Related Accidental Death*, INDEP. (Aug. 8, 2016), http://www.independent.co.uk/news/uk/home-news/drones-fatal-road-accident-first-non-military-drone-death-accident-car-crash-surveillance-safety-a7180576.html.

[49] *Id.*

[50] Samuel Gibbs, *Drone Firing Handgun Appears in Video*, THE GUARDIAN (July 16, 2015, 9:26 PM), https://www.theguardian.com/technology/2015/jul/16/drone-firing-handgun-video-youtube.

[51] Andy Stewart, *Roman Candle Attack Drone 2.0*, YOUTUBE (Mar 10, 2015), https://www.youtube.com/watch?v=S0GBeOnxA4M.

with them. A quadcopter capable of discharging a small caliber firearm multiple times while remaining in air is a misuse of quadcopters that could harm citizens if used by criminals. Although these are extreme incidents, incidents involving quadcopters are nonetheless common and must be addressed through legislative action. These misuses create clear safety issues for the general public.

III. ANALYSIS—SMALL UNMANNED AIRCRAFT PART 107

In 2016, the FAA expanded the scope of its existing laws to "allow the operation of small unmanned aircraft systems" within the "National Airspace System."[52] This expansion, referred to as the "New Small Unmanned Aircraft Systems Rule (Part 107)," has created operational guidelines and specifications that operators of Small Unmanned Aircraft Systems must adhere to. Part 107 must be considered by all quadcopter users in the United States to ensure compliance; as the FAA itself states, each quadcopter operator has a "responsibility to understand and abide by the rules."[53] The following aspects of Part 107 are the essential statutory requirements all quadcopter operators must keep in mind before they begin piloting quadcopters in the United States: the applicability of the new rule, changes in operational guidelines, visibility requirements, containment of the aircraft, and control of the aircraft. Each is considered in turn.

A. Scope—What is a Small Unmanned Aircraft System?

An important factor to consider when interpreting Part 107 is the correct definitional classification of a typical consumer quadcopter. Controversy surrounded the classification of each specific class of aircraft system the FAA chose to regulate.[54] Ultimately, the FAA recognized the definition that Congress applied in the FAA Modernization and Reform Act of 2012.[55] In the aforementioned act, Congress defined an unmanned aircraft as "an aircraft that is operated without the possibility of direct human intervention from within or on the aircraft."[56] A small unmanned aircraft was defined as an "unmanned aircraft weighing less than 55

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[52] Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 124, 42064 (June 28, 2016).

[53] *Unmanned Aircraft Systems*, FED. AVIATION ADMIN., https://www.faa.gov/uas/ (last modified Feb. 10, 2017, 3:20 PM).

[54] *Id.*

[55] *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42064.

[56] FAA Modernization and Reform Act of 2012, sec. 331, § 40101, 126 Stat. 11, 72.

pounds."[57] In Part 107, the FAA clarified that the fifty-five pound requirement was the "total takeoff weight" of the aircraft.[58] The FAA chose this definition for two reasons. First, the FAA explained that "heavier aircraft . . . pose greater amounts of public risk in the event of an accident, because they can do more damage" upon crashing.[59] Second, the FAA explained that using takeoff weight is analogous to the regulation of other aircraft the FAA regulates.[60] Therefore, a Small Unmanned Aircraft is an aircraft that cannot be piloted within or on the aircraft itself, and must weigh less than fifty-five pounds in its entirety before taking off.

The FAA also regulates the usage of communication systems that direct aircraft through input of their human operators on the ground.[61] The term "unmanned aircraft system" includes the "associated elements (including communication links and the components that control the unmanned aircraft) that are required for the pilot in command to operate safely and efficiently in the national airspace system."[62] Therefore, the FAA regulates the entirety of the craft, from the weight of the craft to the methods in which the aircraft is controlled.

B. Remote Pilot in Command

When piloting an Unmanned Aircraft System, a pilot must understand the role of Remote Pilot in Command. The "Remote Pilot in Command" designation is a re-labeling of the term "Pilot in Command," codified in Part 91.3 of the Code of Federal Regulations. Consequently, a "Remote Pilot in Command" must adhere to the same standards that are articulated for a Pilot in Command. Part 91.3 of the Code of Federal Regulations establishes the responsibilities of a "Pilot in Command" of more typical aircraft, such as plans and helicopters.[63] CFR 91.3(A) establishes that the pilot in command is "directly responsible" in addition to the "final authority" regarding the "operation of the aircraft."[64] Consequently, the Remote Pilot in Command has ultimate authority over the operation of the aircraft, and assumes responsibility of compliance with any and all operational requirements. This standard may seem like a higher degree of

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57 *Id.*
58 Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42086.
59 *Id.* at 42085.
60 *Id.* at 42086.
61 *See* FAA Modernization and Reform Act of 2012 § 331.
62 *Id.*
63 *See* 14 C.F.R. § 91.3 (2017).
64 *Id.*

responsibility than a hobbyist piloting a quadcopter should be subjected to. The reasoning supplied by the FAA provides insight into the decision to impose this stringent standard. According to the FAA, the purpose of CFR 91.3(A) is to ensure autonomy regarding the "safety of the operation" of the aircraft.[65] In defining the operational roles of pilots and other parties, the FAA applied the rule codified in CFR 91.3(A) to ensure the same purpose—ensuring a sole party is responsible for the safe operation of the aircraft.[66] The FAA also stated that the "Remote Pilot in Command" must be "designated . . . before or during the flight."[67]

The Remote Pilot in Command is not the only party permitted to operate the aircraft. Specifically, the FAA states that "the flight controls of a small UAS may be augmented by another person during operation."[68] Operation by a third party requires compliance with a separate set of regulations. The transfer of control of the quadcopter may only occur when no other operational violation of Part 107 occurs.[69] All operational requirements must be adhered to during the handoff of controls to the third party operator and while the third party operator is in control of the aircraft. The Remote Pilot in Command also has other duties when determining whether or not to hand off the controls—namely, to ensure no "hazard" to any other entity could occur.[70]

Practically, pilots of quadcopters must understand the ramifications of the "Remote Pilot in Command" standard. This standard imposes ultimate liability for the actions of the aircraft on the Remote Pilot in Command. While the transfer of control to another party seems to logically terminate liability, this is not the case. The "Pilot in Command" standard imposes a duty of ensuring safety and responsibility on the Pilot in Command from the time the aircraft takes off to the time it lands.

C. Time and Visibility Requirements

In addition to the requirements imposed on pre-flight and during flight operation, the FAA has imposed requirements on the time of day and visibility in which small unmanned aircraft systems may be flown. Under

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[65] Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 124, 42087 (June 28, 2016).

[66] *Id.*

[67] *Id.* at 42088.

[68] *Id.*

[69] *Id.*

[70] *Id.*

Part 107, may not be piloted during overnight hours.[71] However, Part 107 does provide an exemption for "civil twilight,"[72] on the condition that the aircraft has "lighted anti-collision lighting" that can be seen for "3 statute miles."[73] The prohibition of overnight operation of small unmanned aircraft systems is logical. The use of these aircraft overnight limits the ability of the operator on the ground to determine the distance and altitude the aircraft is from the operator. Lack of light also limits the operator's ability to avoid other hazards in the sky around the aircraft. Without adequate lighting, these aircraft hang in the air as a metaphorical landmine for pilots of other aircraft. Without the ability to see these aircraft or detect them on onboard radar, pilots of larger craft (often with civilians onboard), are placed at a much higher risk of harm. Therefore, prohibiting overnight flights ensures that all parties avoid an increased risk that poses no additional benefit to anyone. Part 107 also regulates the distance in which an unmanned aircraft may travel from clouds. Part 107 states that these aircraft must remain "500 feet below the cloud," and "2,000 feet horizontally away from the cloud."[74] These visibility requirements are measured from the "control station," or area in which the user is operating the aircraft.[75]

Part 107 is silent in regard to operation under questionable weather conditions. The FAA cited the variance in aircraft that fall under Part 107 that can operate in different conditions.[76] Part 107 Section 49(a)(1) "require[s] the Remote Pilot in Command to assess local weather conditions."[77] This assessment is part of the larger pre-flight check that a remote pilot in command must undergo before flying a small unmanned aircraft.[78] By shifting the limitation from a statutory mechanism to a duty imposed on the Remote Pilot in Command, the FAA has given increased autonomy to Remote Pilots in Command. These pilots understand their craft, local weather conditions, and operational abilities on a personal level. These individual factors cannot be captured by a statutory mechanism. The deference that is given to Remote Pilots in Command is in line with the central theme granting these pilots autonomy in the safe operation of their flights.

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[71] *Id.* at 42102.

[72] *Id.* ("Civil Twilight takes place 30 minutes before official sunrise and 30 minutes after official sunset.").

[73] *Id.*

[74] *Id.* at 42105.

[75] *Id.* at 42107.

[76] *Id.*

[77] *Id.*

[78] *Id.*

D. Containment and Loss of Positive Control

Part 107 also regulates the distance in which a small unmanned aircraft system can be flown from the pilot of the aircraft. This Confined Area of Operation[79] is limited by both the horizontal and vertical boundaries of operation.[80] The horizontal boundary is the distance an aircraft can travel from the pilot along the earth, as opposed to into the air.[81] The horizontal boundary is limited by the line of sight requirement found in Part 107.31.[82] The natural curvature of the earth, coupled with the limited ability of human sight, also limit the horizontal boundary in which lawful operation of an aircraft can occur. The FAA has articulated the horizontal boundary as a "circle around the person maintaining visual contact with the aircraft with the radius of the circle being limited to the farthest distance at which the person can see the aircraft sufficiently to maintain compliance with 107.31."[83]

In effect, the FAA has limited the horizontal boundary of operation to the area in which the pilot can maintain a visual line of sight with the aircraft. Losing visual line of sight with the aircraft increases the risk of an accident occurring due to the pilot's inability to determine the location of the craft. If a pilot cannot determine the physical location of the craft, he cannot take emergency action to prevent striking and causing harm to others.

Part 107 also limits the vertical distance a small unmanned aircraft system may travel.[84] The vertical boundary is defined as the distance an aircraft can travel upward from the position of the pilot, or the Maximum Altitude an aircraft can achieve.[85] Part 107 places the maximum altitude a small unmanned aircraft can achieve at 400 feet above ground level.[86] The FAA described this ceiling of operation as a safety mechanism to provide distance between small unmanned aircraft system and manned aircraft operations, meaning airplane, helicopter, and other similar flights.[87] The operation of most manned aircraft operations occurs at an altitude "higher than 500 feet above ground level."[88] In creating a 100-foot buffer zone, the

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[79] *Id.* at 42114.
[80] *Id.*
[81] *Id.*
[82] *Id.*
[83] *Id.*
[84] *Id.* at 42116.
[85] *Id.*
[86] *Id.*
[87] *Id.*
[88] *Id.*

FAA has considered the safety of manned aircraft operations, while also "integrat[ing] small UAS operations into the NAS [National Airspace System]."[89] The balancing of the interests of those who wish to use small unmanned aircraft systems and the safety of manned piloting operations ensures both parties may safely operate their craft. The use of the 100-foot buffer achieves this objective while still allowing plenty of operational territory for small unmanned aircraft systems.

Part 107 also institutes an exception for the operation of small unmanned aircraft systems near structures. Specifically, the FAA has expressly allowed the operation of small unmanned aircraft systems at an altitude of higher than 400 feet above ground level if the aircraft is "within a 400-foot radius of the structure, and . . . does not fly higher than 400 feet above the structure's immediate uppermost limit."[90] Proponents of this exception stated that the exception would allow small unmanned aircraft systems to be used to perform inspections and other tasks that would traditionally place persons in danger.[91] The FAA found merit in this argument, and extended permissible operation for conducting these operations. This exception also achieves the purpose of the maximum altitude provision. A majority of manned aircraft do not operate within 400 feet of large structures due to the danger of striking these structures.[92] Therefore, the exception does not limit the purpose of the maximum altitude rule, and provides a benefit to consumers that use small unmanned aircraft to conduct specific operations that would otherwise endanger individuals.

E. Mitigating Loss of Positive Control Risk

Part 107 also imposes regulations to prevent the loss of control of the aircraft. In instituting these regulations, the FAA recognized that the nature of the small unmanned aircraft systems industry requires "flexibility" in its regulation.[93] Various types of small unmanned aircraft systems contain multiple variables that create problems in attempting to regulate the "diverse"[94] class of aircraft.[95] The FAA has adopted four "broadly

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[89] *Id.*
[90] *Id.*
[91] *Id.* at 42117.
[92] *Id.* at 42118.
[93] *Id.* at 42119.
[94] *Id.*
[95] *See generally id.* (explaining how diversity of aircraft affects the mitigation of loss of control).

applicable constraints" to guide pilots in their operation.[96] These constraints apply to all small unmanned aircraft systems, regardless of their unique qualities. The FAA reasoned that these constraints will guide pilots in creating their own "operational and aircraft-specific loss-of-control mitigation measures."[97]

The first constraint is an outright speed limit. The FAA prohibits operation of an unmanned aircraft at a speed of over 87 knots, or 100 miles per hour.[98] This speed is measured from the groundspeed of the craft, as opposed to the airspeed of the craft.[99] The FAA stated that this constraint was intended to provide "safety benefits" to anyone in the area where an unmanned aircraft is flown. [100] The FAA states that "traveling at high speed poses a higher risk to persons, property, and other aircraft" as opposed to an aircraft traveling at a slower speed.[101] This rule focuses on controlling damage in the event of an accident as much as the prevention of loss of control at all. Slowing the speed in which an unmanned aircraft strikes something naturally lowers the risk of damage. Specifically, the FAA cites a finding that "the kinetic energy of a 55-pound object moving at 100 mph could cause significant damage to a large aircraft."[102] Additional arguments in support of the speed limit, such as the risk of maintaining line of sight with piloted aircraft and having time to see other aircraft, were also used to justify the 100 mph speed limit. [103] Therefore, the FAA is attempting to limit both the risk of loss of control, and the damage that could occur if a loss of control occurs. The FAA also stated that achieving the speed limits described in this constraint can only occur if "all" of the other "applicable provisions of part 107" are achieved.[104] In effect, other provisions such as maintaining line of sight (Part 107.31) create a lower effective speed limit that pilots must adhere to because of the constraints of other operational limits contained in Part 107.

Part 107 also forbids a pilot to "operat[e] . . . more than one small UAS at the same time."[105] The FAA explained their reasoning for adopting this rule as follows:

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[96] *Id.* at 42119.
[97] *Id.*
[98] *Id.* at 42120.
[99] *Id.*
[100] *Id.*
[101] *Id.* at 42119-20.
[102] *Id.* at 42120.
[103] *Id.*
[104] *Id.*
[105] *Id.* at 42121.

> Performing the duties required of a crewmember in real time is a concentration-intensive activity and as such, it is necessary to place a limitation on the number of UAS that a person can operate simultaneously.[106]

In determining whether or not to allow the operation of multiple aircraft at once, the FAA stated that piloting a small unmanned aircraft system requires "active attention," and piloting multiple aircraft would diminish the attention a pilot can devote to operating an aircraft. [107] Naturally, diminishing the attention of a pilot could "introduce additional risk into the NAS."[108] The FAA has determined that the attention required to pilot a single small unmanned aircraft in a manner that prevents increased risk of harm to others outweighs the benefit of allowing a pilot to operate multiple aircraft at once. To date, the FAA has rejected the arguments of proponents of multi-operation.[109] However, the proponents of multiple operation state that technological advances are making the safe and simultaneous operation of multiple small unmanned aircraft systems possible.[110] The FAA must consider the safety of the general public when considering these technological advances, and ensure that the concentration required to adequately and safely operate one small unmanned aircraft system is not disturbed by adding more aircraft.

Part 107 also addresses flying a small unmanned aircraft system over people.[111] The standard articulated in Part 107 states that a pilot is:

> prohibit[ed] . . . [from] operat[ing] . . . [a] small unmanned aircraft over a person unless that person is either directly participating in the small UAS operation or is located under a covered structure that would protect the person from a small unmanned aircraft.[112]

However, Part 107 provides an exception to allow flight "over a person who is inside a stationary covered vehicle."[113] In justifying this exception, the FAA distinguished manned aircraft from small unmanned aircraft

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[106] *Id.*
[107] *Id.*
[108] *Id.*
[109] *See generally id.* at 42121–22 (detailing the arguments presented for and against the operation of multiple quadcopters at once).
[110] *See generally id.* (explaining future technological advances that will enable the safe operation of multiple quadcopters).
[111] *Id.* at 42123.
[112] *Id.*
[113] *Id.*

systems due to the level of certification the aircraft must undergo before flight is possible.[114] Small unmanned aircraft systems are not subject to the scrutiny that manned aircraft are subject to, and, as the FAA argues, "will likely have a higher failure rate than certified aircraft."[115] The FAA also instituted this rule by looking to the future in citing its own expectation that "the use of small UAS" will "increase after issuance of this rule."[116] These findings are supported by a growing increase in sale of quadcopters.[117] The FAA cites the main concern is not operational error, but mechanical failure.[118] To address the inherent safety concern, the FAA has instituted the ban of flight over people to protect people who are not protected by a structure or stationary automobile "in the event of mechanical failure."[119] The FAA also cited similar rules for other analogous groups, such as the Academy of Model Aeronautics, which prohibit flight over people in the same way prescribed in Part 107.39.[120] Although some commenters have argued against the rule to allow flight by smaller unmanned aircraft systems, the FAA has chosen to institute the prohibition of flight over unprotected individuals to ensure the safety of those individuals. [121]

Finally, Part 107.49 requires the Remote Pilot in Command to "ensure that all persons directly involved in the small UAS operation receive a briefing that includes operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards."[122] The FAA instituted this briefing requirement to ensure that all involved in the flight have "greater situational awareness" of the operation, and can better "avoid the flight path" of the aircraft in the event of a mechanical failure.[123] Briefing all of those involved in the flight ensures all are aware of all aspects of the flight. The institution of a pre-flight briefing ensures that compliance checks, inspection of the aircraft, and other necessary safety precautions are taken to ensure that the operation of the small unmanned aircraft system does not pose any unnecessary hazard to the pilot, crew, or others in and around the area of flight.

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[114] *Id.* at 42124.

[115] *Id.*

[116] *Id.*

[117] Shen, *supra* note 7.

[118] Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42125.

[119] *Id.*

[120] *Id.*

[121] *See id.* at 42125 (discussing various arguments for allowing the flight of small unmanned aircraft over people).

[122] *Id.* at 42132.

[123] *Id.*

IV. RESOLUTION

The Small Unmanned Aircraft Systems Rule is effective because it creates operational limits (speed, height, etc.) and imposes liability on the operator of the aircraft for any damage caused. However, the operational standards of Part 107 do not dispose of the unreasonable risk for accidents, particularly for new quadcopter pilots. Additionally, not all quadcopters purchased on the market today are subject to these operational guidelines. The omission of lighter classes of quadcopters allow pilots to escape the important operational guidelines the Small Unmanned Aircraft Systems Rule creates. Resolutions to these problems are considered below.

A. An Outright Registration Requirement

A simple search of the online retailer Amazon reveals that many quadcopters are marketed in a manner that specifically features the lack of FAA registration required.[124] Quadcopters that weigh 0.5 pounds are exempt from FAA registration requirements.[125] This limits the FAA's ability to monitor the volume of operating quadcopters in the United States. In the event that an unregistered quadcopter crashes and causes damage to a person or property, the injured party must have a means to collect the information of the owner of the aircraft so they may seek a remedy. Video evidence onboard the craft may aid the injured party in finding the owner of the craft. However, the very nature of a crash increases the potential for loss of video footage. This solution also requires that the quadcopter be recording video at the time of the crash. Allowing quadcopter pilots to avoid liability for damage caused by quadcopter crashes is contrary to public policy. Our judicial system seeks to make injured parties whole. In the event that an injured party lacks a method to identify the owner of the craft, they face a much more difficult path to obtaining a remedy.

To remedy this problem, the FAA should require registration of all quadcopters by effectively expanding the scope of Part 107 to cover all aircraft weighing up to fifty-five pounds. This registration process would allow the FAA to collect more data regarding the individuals who are operating quadcopters and their locations—data which may be useful in determining how to further refine unmanned aircraft legislation in the future. Registration with the FAA will impose liability on these pilots due

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[124] *See* Product Results for Quadcopter, AMAZON, https://www.amazon.com (enter "quadcopter" into search query).

[125] 14 C.F.R. § 48.15(b) (2005).

to the application of Part 107 because these pilots will fall within the scope of the regulation. Making these pilots aware of the regulation will, at the very least, create a class of mindful pilots who are aware of the presence of operational regulations. Registration of all unmanned aircraft systems also creates a method of identifiable liability for parties who are harmed from the negligent operation of these aircraft. Identification by make, model, and serial number are all clear methods of identification in the event of a crash. While this information should not be publicly displayed for privacy reasons, the collection of this information by the FAA will be an effective method for parties who are harmed by negligent operation of an unmanned aircraft to identify the owner of the aircraft.

Finally, aircraft registration allows the FAA to implement limited operational standards for new pilots. This period would begin at the time a pilot registers his or her aircraft with the FAA. This period of time allows the pilot to become familiar with the controls of their craft under controlled circumstances. These limited operational standards should limit speed and distance of the aircraft, because these factors pose the greatest risk to pilots, other persons, and nearby property. This "new learner" period should be determined by a definite period of time, similar to the six-month requirement for many new drivers to learn how to operate automobiles. In addition to this time requirement, the pilot should be required to log ten operational hours at a minimum. While this requirement may seem low, energy technology limits the period of time these aircraft may be piloted to less than thirty minutes.[126] Therefore, potential pilots must conduct at least 20 separate flights, from takeoff to landing. This provides ample experience for the pilot to obtain a level of competency in piloting. These flights should be logged with the FAA at the end of the initial six-month period to ensure that a pilot has ample training before proceeding to unrestricted flight. This "new learner" period will promote good flight habits and practice while also eliminating the high risk posed by long-distance, high-speed flights. Lower operational maximums (speed and distance) also lower the potential for damage to other persons and property that could result from a new pilot operating a quadcopter at its maximum limits.

The registration of all small unmanned aircraft establishes a method for the FAA to inform all pilots of the operational guidelines described in the Small Unmanned Aircraft Systems Rule. Additionally, the registration requirement eliminates the possibility of a Remote Pilot in Command escaping liability for damage caused by a crash. Registration of the aircraft

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[126] Douglas James, *10 Drones With The Best Flight Times*, DRONESGLOBE (Jan 2, 2017), http://www.dronesglobe.com/guide/long-flight-time/.

will allow the person harmed to obtain information regarding the owner of the aircraft. The registration process also allows the FAA to create limited operational standards for beginner pilots by requiring a limited form of operation (reduced speed and distance from operator), for all new pilots. This process will allow pilots to become familiar with the technical aspects of their craft while also honing their skills as a pilot.

B. The New Learner Period in Detail

Part 107 creates operational standards for all quadcopter pilots. However, these operational standards pose additional risks—specifically for new pilots without operational experience. The experience required to respond to unique and potentially hazardous flight conditions requires veteran experience that new pilots do not possess. In effect, operational standards regarding speed, vertical altitude, and horizontal altitude can be arguably lawful but hazardous for new pilots. To address this problem, Part 107 should implement lowered operational boundaries for beginner pilots. These standards would be designed to hone a pilot's skill before removing the restricted standards for full flight capabilities. These lowered operational boundaries will be akin to those of a "learners permit" that drivers across the United States must undergo before they are permitted to operate an automobile by themselves.

As stated in Section III—Analysis, the speed limit for any aircraft falling within the scope of the Small Unmanned Aircraft Systems Rule is 100 miles per hour.[127] While many quadcopters cannot achieve this speed, many quadcopters achieve high speeds close to this operational limit.[128] Inexperienced pilots that are eager to test the limits of their quadcopter may lose control of these craft at these high speeds, increasing the risk of harm to people and property near the quadcopter. FAA studies have revealed that a small unmanned aircraft system traveling at 100 miles per hour can pose a "higher risk to persons, property, and other aircraft."[129] Traveling at a speed much lower than the standard limits the risk of accidents.[130] FAA studies have also found that "the kinetic energy of a 55-pound object moving at 100 mph could cause significant damage to a large aircraft."[131] While operation near airports and at altitudes in which a quadcopter may strike an aircraft

[127] Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42119–20.
[128] *Id.*
[129] *Id.*
[130] *Id.* at 42120.
[131] *Id.*

are expressly forbidden by the law, these high speeds still pose an unreasonable risk for the loss of control of the quadcopter. This loss of control poses a risk of damage to persons and property in the area.

To remedy this problem, speed limits must be reduced for inexperienced pilots. Specifically, speed must be limited to match the restricted operational space in which the pilot must operate (*see below*, 150 ft. x 150 ft.). The craft must remain at a speed that the pilot may safely operate the craft in the given operational space. Limiting the speed to twenty miles per hour allows the pilot to traverse the operational space in mere seconds, simulating high speed, unrestricted flight. This speed allows the pilot to train at a safe speed while practicing piloting skills. This speed limit also limits the damage a crashing aircraft may cause, lowering the risk that newer pilots pose to the general public. This speed limit decreases the risk of damage to people and property, while also providing a way for pilots to increase their piloting skill.

Additionally, the operational distance from pilot to quadcopter must be limited. The Small Unmanned Aircraft Systems Rule creates a general Visual Line of Sight standard for horizontal distance.[132] This general standard, while effective in practice, is a dangerous standard for inexperienced pilots. New pilots may lose sight of their quadcopter easily, vastly increasing the risk of a crash. To remedy this problem, beginner pilots should keep their quadcopters at a much closer distance. This distance should be limited to no more than 150 horizontal feet away from the place in which the pilot is operating the quadcopter. In effect, this restriction provides a quadcopter pilot a half of a football field of operational distance. While this space may seem small initially, the small space allows the pilot to observe all potential obstacles and hazards that could befall the small unmanned aircraft system at all times, while also providing the pilot ample room to test their competency in piloting their aircraft.

Finally, the maximum altitude for small unmanned aircraft systems must be limited. The maximum altitude a small unmanned aircraft system can legally achieve is 400 feet, or 133.33 yards in the air. [133] This altitude is equivalent to a thirty-five story building. This is quite high considering the size of most craft. For instance, the DJI Phantom series, a highly recommended beginner class quadcopter, is fourteen-by-fifteen inches.[134]

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[132] *Id.* at 42137.

[133] *Id.* at 42116.

[134] DJI INNOVATIONS, NAZA FOR MULTI-ROTOR USER MANUAL 43 (2012), https://images-na.ssl-images-amazon.com/images/I/A1GEvRWhZZS.pdf.

Attempting to effectively spot an aircraft of this size from 400 feet away creates a vision problem. Inexperienced pilots may lose sight of their craft or fail to gauge the true distance of their craft from the ground. Gaining familiarity with spotting the aircraft in the air is essential to safe operation. Additional hazards such as wind speed and turbulence that are otherwise undetectable at ground level can also be dangerous to new pilots. Wind gusts and turbulence create a risk of loss of control, posing an unreasonable risk of harm to people and property near the quadcopter.

To remedy this problem, Part 107 should limit the vertical boundary to 150 feet for beginner pilots. Combined with the horizontal limitation of 150 feet, this vertical boundary creates a defined box in which beginner pilots may operate their craft. While this height is still quite tall when compared to a building (twelve to fourteen stories), this range is more manageable for pilots who are learning to deal with hazards such as varying wind speed and turbulence, and also familiarizes the pilot with the practice of sighting their craft while it is in the air.

By creating these limited "beginner" operational boundaries, the FAA will allow new pilots to gain the experience necessary to competently operate their craft. While gaining this experience, pilots will pose a substantially lower risk to people and property around them. Allowing these pilots to practice their piloting skill while also limiting the risk associated with cultivating this practice provides an effective means for both new pilots and the public to be safer in the future.

V. CONCLUSION

In conclusion, (Part 107) is a positive step forward in integrating quadcopters into the US Airspace, in addition to regulating the operation of these craft. Part 107 is the first step in solving the growing problems surrounding the operation of quadcopters by inexperienced pilots who have little to no flight experience. The volume of inexperienced pilots participating in the hobby of piloting quadcopters and other unmanned flight apparatus is only growing. The shrinking price of consumer grade electronics has allowed quadcopter producers to create low cost, entry level units that capable of long distance, high speed flight. Consumers have responded to these lower prices—sales figures illustrate the growing rate in which consumers purchase quadcopters, and tend to show that the market will only continue to grow. For the most part, the legislation addresses the issues presented by the growing influx of new quadcopter pilots. Part 107 provides practical operational guidelines that operators of quadcopters can easily understand and apply in practice. Part 107 creates operational boundaries on speed, distance from the pilot a craft may be, and defines the airspace in which the pilot may operate the quadcopter.

To limit the risk posed by the operation of aircraft regulated by Part 107, the FAA should require registration of all aircraft that are purchased and subsequently flown. This practice allows the owner of each individual aircraft to be known to the FAA in the event of an accident. At the time of registration, the pilot will begin a six-month "beginner" period in which they will be required to operate their aircraft at limited operational boundaries. These pilots will be required to undergo ten hours of training flights that must be logged with the FAA over this six-month period. In this time, beginner pilots will operate their craft in a limited, 150-foot by 150-foot space at no more than twenty miles per hour. This area allows the pilot to develop competent piloting skills while also limiting the risk of accidents that occur at farther distances and higher speeds. This limitation will create a more skillful and experienced class of quadcopter pilots.

The solutions offered herein provide enhancements to Part 107 that provide additional safeguards to the American public. While the initial operational guidelines from Part 107 may be effective, these added operational guidelines still give beginner pilots an uncomforting amount of freedom considering their lack of experience. The benefit of the proposed solutions is two-fold: By creating tighter operational boundaries for new pilots, the risk of loss of control is minimized. Requiring new quadcopter operators to operate their crafts at slower speeds and in smaller areas limits the risk of losing control. By creating an initial "beginner" period for new pilots, the public is also safer. People and property are often the victims of the negligent operation of quadcopter or technological failure. Instituting this "learner" period ensures that all quadcopter pilots possess a baseline level of competence, decreasing the frequency of quadcopter accidents in the United States. Decreasing the frequency of quadcopter accidents is paramount for the safety of people and property across the country. The solutions provided here will create a new class of quadcopter pilots who are aware of Part 107's operational guidelines, and are focused on preventing harm to others.

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