PAPERWEIGHTS: FAA REGULATION AND THE BANISHMENT OF COMMERCIAL DRONES

Robert Glenn Olsen[†]

On Sunday, December 1, 2013, Charlie Rose and 60 Minutes revealed Amazon's ambitious vision of the future: drones. CEO Jeff Bezos described fleets of autonomous drones crossing the skies carrying consumer goods. The goal? Thirty minutes from clicking "buy" in your Amazon shopping cart to finding the item on your front porch. Bezos's vision was only outdone by his timeline for implementation, four to five years.[1]

As ambitious as the plan was, it was not mere fantasy. A year before, Congress had addressed the idea of drones in the national airspace.[2] The 2012 FAA Modernization and Reform Act addressed three classes of drones: (1) public drones; (2) recreational drones; and (3) civil drones.[3] First, Congress ordered the Federal Aviation Administration (FAA) to work with government agencies to provide for the use of public drones.[4] Second, Congress removed recreational drones from the FAA's purview.[5] Third, Congress directed the FAA to regulate and "integrate" civil drones into the national airspace by September 30, 2015.[6] Given that Congress explicitly dealt with recreational civil drones,[7] the general order to regulate civil drones applies to commercial drones, laying the foundation for Bezos' optimism.

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† J.D. Candidate, 2018, University of California, Berkeley, School of Law.

1. CBS News, *Amazon Unveils Futuristic Plan: Delivery by Drone*, CBS NEWS:60 MINUTES OVERTIME (Dec. 1, 2013), http://www.cbsnews.com/news/amazon-unveils-futuristic-plan-delivery-by-drone/ [https://perma.cc/98MF-8246].

2. *See* FAA Modernization and Reform Act of 2012 (FAA Reform Act), Pub. L. 112-95, § 331-336, 126 Stat. 72, 72-78 (2012).

3. *Id.* §§ 332, 334, 336. Note that the FAA Reform Act first discuses civil drones, § 332, then public drone, § 334, and recreational drones last, § 336.

4. *Id.* § 334.

5. *Id.* § 336.

6. *Id.* § 332.

7. Civil means not public—these drones are privately owned. *See* 49 U.S.C. § 40102(a)(16) (2012). Section 332 of the FAA Reform Act addresses private, non-recreational drones. FAA Reform Act, Pub. L. 112-95, §§ 332, 336. This tends to include drones operated for commercial purposes.

On August 29, 2016, the awaited FAA regulation for civil unmanned aircraft, 14 CFR Part 107, took effect.[8] The results were underwhelming. Drones remain recreational craft and tools for expensive photography.[9] Commercial drone operations are novelties.[10] The prohibitions swallow the allowances.[11] Drones may not operate in populated areas, cargo operations are all but prohibited, and drones are virtually tethered to their operators.[12] Drones are thus relegated to the fringes of the national airspace.[13]

At first glance the FAA's strict limitations appear sound.[14] Scholars argue that drones do not fit the regulatory framework that the FAA has developed since the inception of aviation oversight.[15] These reservations, while applicable to small-scale operators, fail when applied to large-scale operators such as Amazon.[16] Large-scale commercial drone operations are consonant with key aspects of the FAA's framework.[17] The Administration can, and should, provide a regulatory framework that supports the use of commercial drones in the national airspace.

Part I of this Note examines the history of aviation safety oversight in the United States. It tracks important legislative and regulatory developments and concludes with a formulation of three principal lessons from the Administration's history. Part II introduces Congress's driving legislation, discusses the FAA's regulatory response, surveys FAA rationale for various drone rules, and briefly describes the drone waiver scheme. This Part concludes with a summary of various permitted and

8. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,064 (June 28, 2016) (to be codified at 14 C.F.R. pts. 21, 43, 61, 91, 101, 107, 119, 133, and 183).

9. *See* Erik Olsen, *Gentlemen, Start Your Drones*, N.Y. TIMES (Nov. 11, 2015), https://www.nytimes.com/2015/11/12/sports/drone-racing-competition.html?_r=3 [https://perma.cc/K8RQ-YTA2] (documenting the rise of the new sport of drone racing); *Phantom Series*, DJI (last visited Feb. 5, 2017), http://www.dji.com/phantom-4 [https://perma.cc/4XMF-24S7] (marketing the drone as a photography platform).

10. *See, e.g.*, Daniel White, *Google and Chipotle Are Testing Drone Burrito Delivery at Virginia Tech*, TIME (Sept. 14, 2016), http://time.com/4493291/google-tests-drone-deliveries-virginia-tech/ [https://perma.cc/S76W-WEQA].

11. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,066–67.

12. *Id.*

13. *See id*. As will be discussed, *infra* Section *II.C*, the new drone regulations permit little meaningful commercial use.

14. *Infra*, Section III.C.2.

15. *See e.g.*, Henry H. Perritt, Jr. & Eliot O. Sprague, *Law Abiding Drones*, 16 COLUM. SCI. & TECH. L. REV. 385, 390 (2015).

16. *Infra*, Section III.C.2.

17. *Id.*

prohibited drone uses. Part III of this Note evaluates the regulatory prospects for commercial drones use and addresses various concerns to large-scale drone operations. This Part concludes that large-scale commercial drone operations fit within the historical framework of the FAA's aviation oversight. Part IV concludes and provides recommendations for implementing regulations in support of commercial drone operations.

I. AIRPLANES AND THE U.S. GOVERNMENT

A. CHAOTIC SKIES AND THE PROSPECT OF REGULATION

In the beginning, American skies were unregulated. Aviation's utility had been established "even before" the First World War.[18] Yet by 1925, aviation still scarcely played a role in the nation's economy.[19] The national image was one of "gypsy fliers" and outrageous stuntmen, not of safe and reliable transportation.[20] Even if passengers could be found, funding could not be. Financial investment and reasonable insurance rates were nearly impossible to procure in the absence of federal regulation.[21]

On one hand, aviation presented little public threat. From 1921 through 1925, an average of 71 people were killed in aviation-related accidents annually.[22] On the other hand, aviation had its fair share of spectacular crashes. During one week in July of 1922, New York City was treated to three aviation incidents, including a stunt plane crashing into a populated beach.[23]

There was one success story: airmail. The service began in May of 1918 with equipment loaned from the U.S. Army and, by 1920, established a transcontinental route.[24] The service's safety record was unmatched.[25] In 1924, American commercial aviation suffered one fatality for every 13,500 miles flown—the airmail had just one for every 463,000 miles.[26] This record was not born of luck. The Air Mail Service employed

18. NICK A. KOMONS, BONFIRES TO BEACONS 13 (1978).

19. *Id.* at 15. Indeed, it was largely a commercial failure, for the most organized private use of airplanes was the transportation of bootleg alcohol, while airlines rarely survived to their second birthday. *Id.* at 14–15, 17.

20. *Id.* at 28–29.

21. *Id.* at 29.

22. *Id.* at 23

23. *Id.* at 25. That same week, a pilot with a record of reckless flying crashed in Washington, D.C, killing a passenger. *Id.*

24. *Id.* at 18–19.

25. *Id.* at 21 (noting that from 1922 to 1925 the service suffered only ten fatalities).

26. *Id.* at 25.

numerous mechanics for stringent aircraft inspections and mandated regular pilot examinations.[27]

The lesson was clear to Secretary of Commerce Hoover, "that [aviation] is the only industry that favors having itself regulated by the government."[28] Per the Air Commerce Act of 1926, the new Aeronautics Branch of the Department of Commerce would oversee air traffic rules, aircrew and mechanic certification, and aircraft airworthiness.[29] This included evaluation of aircraft design, construction, and manufacturing.[30] The branch was given considerable leeway to devise detailed regulations, a practice that remains to this day.[31]

B. THE CIVIL AERONAUTICS ACT OF 1938

Federal regulation was a resounding success. Prior to 1926, only one airline survived longer than two years. By 1930, the Big Four, United, Eastern, American, and TWA, were born.[32] Though airmail contracts and government subsidies still propped them up, airline consolidation meant capital consolidation. Now airlines could sponsor aircraft development.[33] American Airlines introduced the iconic Douglas DC-3 in June of 1936.[34] 1940 brought the Boeing 307, the first pressurized airliner.[35] Further, safety regulation appeared effective. From 1930 to 1932, scheduled domestic airlines in the United States suffered one passenger fatality for

27. *Id.* at 20–21. In 1925, 94% of employees were ground personnel. Aircraft underwent a 180-item inspection after every flight. Engines were overhauled every 100 hours, airframes every 750. *Id.*

28. *Id.* at 22.

29. Air Commerce Act of 1926, Pub. Res. No. 69-27, 44 Stat. 568, § 3; DEP'T OF TRANSP. FED. AVIATION ADMIN., HISTORY OF AVIATION SAFETY OVERSIGHT IN THE UNITED STATES 2 (2008) [hereinafter *FAA History*]; ROBERT M. HARDAWAY, AIRPORT REGULATION, LAW, AND PUBLIC POLICY 9 (1991) (describing the creation of the Aeronautics Branch in the Department of Commerce).

30. Air Commerce Act, § 3(b)(1).

31. *FAA History*, *supra* note 29, at 2. In 1928, Aeronautics Bulletin No. 14 was issued detailing the requirements for aircraft design certification, known as type certification, as well as Aeronautics Branch recommended practices. *See* Aeronautics Bulletin No. 14, Dept. of Comm., Aero. Branch (1928); *see generally*, 14 C.F.R. § 25 (FAA regulation of transport aircraft design).

32. Most of the credit for the consolidation goes to the economic regulation regime of Postmaster General Walter Folger Brown, a topic beyond the scope of this Note. R.E.G. DAVIES, A HISTORY OF THE WORLD'S AIRLINES 123–28 (1964) (documenting Brown's regime under Hoover to provide for airline consolidation and stability).

33. *Id.* at 133.

34. *Id.* at 134.

35. *Id.* (noting the implementation of pressurized aircraft with the Boeing Model 307).

every 4.8 million passenger-miles flown.[36] From 1933 to 1935 this count dropped to one in 18 million.[37]

Yet even this record offered little protection against well-publicized disasters.[38] On May 6, 1935, a TWA DC-2 crashed outside of Kansas City, Missouri.[39] Killed in the crash was Senator Bronson Cutting of New Mexico.[40] Though the Bureau of Air Commerce found TWA at fault,[41] the loss of a colleague galvanized Congress into action.[42]

The Civil Aeronautics Act was passed the following June of 1938. The new Civil Aeronautics Authority, headed by an administrator and a five-member board,[43] was tasked with aviation infrastructure, economic regulation, and safety regulation.[44] For infrastructure, the authority was to establish and oversee civil airway and provide the necessary ground facilities, airfields, and navigational aids.[45] On the safety front, the authority registered aircraft, certified aircrews, and certified airworthiness.[46] Where the Air Commerce Act had simply directed the Aeronautics Branch to evaluate aircraft design and manufacture, the 1938 Act enumerated the three-part system in use to this day: type certification for qualified designs; production certification for acceptable manufacturing; and airworthiness certification for every aircraft fit to fly.[47]

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36. KOMONS, *supra* note 18, at 277.

37. *Id.*

38. DONALD. R. WHITNAH, SAFER SKYWAYS 118–19 (1966). On October 7, 1935 a Boeing 247-D crashed into the ground a thousand feet short of the airfield, killing all twelve aboard. The following January 14, an American Airlines DC-2 was lost along with all seventeen aboard. Then in April, apparent pilot error brought down a TWA DC-2 near Uniontown, Pennsylvania, and in September, ten were killed when a Stinson SM-6000-B crashed near Pittsburgh after the fuel select valve was accidentally set to "off." *Id.*

39. KOMONS, *supra* note 18, at 278; S. Rep. No.74- 2455, at 2 (1936).

40. KOMONS, *supra* note 18, at 278; S. Rep. No.74- 2455, at 1.

41. KOMONS, *supra* note 18, at 282.

42. In fact, in what Komons describes as "disdain for facts" and "gross distortions," the congressional investigation lay most of the blame upon weather and the bureau. *Id.* at 283–85, 296–97; *see generally* S. Rep. No.74- 2455.

43. Civil Aeronautics Act of 1938, Pub. L. No. 75-706, 52 Stat. 973, § 201(a)–(b).

44. *See generally* Civil Aeronautics Act, §§ 301–416.

45. Civil Aeronautics Act, § 302(a)–(c).

46. *See generally* Civil Aeronautics Act, §§ 501–610.

47. *See* Air Commerce Act § 2(b); Civil Aeronautics Act, § 603. Designs for aircraft, aircraft engines, and propellers would be evaluated per the Authority's requirements. Civil Aeronautics Act, § 603. Inspection included tests of materials and full-scale flight trails. *Id.* § 603(a). Once a type certificate was issued, a manufacturer had to undergo a second evaluation, proof that subsequent products would conform to the type certificate. *Id.* § 603(b). Even after the grant of a type certificate for the airframe, engine, and propeller, the entire aircraft itself underwent inspection for an airworthiness

C. THE FEDERAL AVIATION ACT OF 1958 AND THE MODERN ERA

Starting in 1937, aviation safety was dictated by the Civil Air Regulations. As before, Congress delegated to the Civil Aeronautics Board to promulgate and regularly update the regulations.[48] The safety regulations—along with advances in navigation, air traffic, and even air carrier policy—aided the steady decline of air carrier fatalities over the next two decades.[49] However, the growth of commercial aviation, faster aircraft, and the anticipation of jet air travel raised serious concerns.

On June 30, 1956 a TWA Super Constellation and United Airlines DC-7 collided in open skies.[50] The planes fell 21,000 feet into the Grand Canyon, killing the combined 128 passengers and crew.[51] In the crash report, the agency admitted that it did not know why the aircraft had not seen each other.[52] More troubling, the crew of Super Constellation had been alerted to the presence of the DC-7 in their vicinity.[53]

The spring of 1958 brought two more disasters. On April 21, an Air Force fighter jet collided with a United Airlines DC-7 near Las Vegas, Nevada.[54] The following May 20, a military T-33 trainer collided with a Capital Airlines Vickers Viscount over Brunswick, Maryland.[55] The situation was dire. President Eisenhower wrote to Congress weeks later to

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certificate, which would remain visible on the aircraft throughout its airworthy life. *Id.* § 603(c).

48. *Id.* § 601(a).

49. *FAA History*, *supra* note 29, at 10–11.

50. CIVIL AERONAUTICS BD., ACCIDENT INVESTIGATION REPORT, SA-320, File No. 1-0090, 1 (1957) [hereinafter *Grand Canyon Report*].

51. *Id.*

52. *Id.* at 24. Though there were scattered clouds, both planes were justified in flying under visual rules. *Id.*

53. *Id.* This crash was not an isolated incident. *Id.* at 19. President Eisenhower had already begun investigating the larger issue. *See generally* EDWARD P. CURTIS, AVIATION FACILITIES PLANNING, FINAL REPORT BY THE PRESIDENT'S SPECIAL ASSISTANT (1957) [hereinafter *Curtis Report*]. At the president's request, the Curtis Report proposed a significant overhaul of air traffic control and management. Congress responded with the Airways Modernization Act of 1957. The Airways Modernization Board, though only a temporary solution, would be tasked with evaluating the current air traffic control regime, researching new methods, and putting forth a plan for implementation. MESSAGE FROM THE PRESIDENT OF THE UNITED STATES, H.R. DOC. NO. 85-406, 2; Airways Modernization Act of 1957, Pub. L. 85-133, 71 Stat. 349, § 2(b). The board would terminate on June 30, 1960 when its task was to be complete. Airways Modernization Act § 5.

54. *FAA Historical Chronology, 1926–1996*, FED. AVIATION ADMIN. (May 5, 2016), https://www.faa.gov/about/history/chronolog_history/media/b-chron.pdf .

55. *Id; see also* ARNOLD E. BRIDDON, FAA HISTORICAL FACT BOOK, A CHRONOLOGY 68 (1974).

call for comprehensive aviation reform.[56]

The Federal Aviation Act of 1958 tasked the Federal Aviation Agency, newly freed from the Department of Commerce,[57] with consolidated oversight of the nation's aviation and the integrated civil and military airspace.[58] The new regime also worked to modernize air traffic control.[59] Radar was required on most new aircraft.[60] The agency updated the nation's radar infrastructure, implemented aircraft identification transponders, and commissioned the first computers for air traffic control.[61] The following January 1, 1959, the Agency began migrating the Civil Air Regulations into Title 14 of the Code of Federal Regulations, where they remain.[62]

D. TAKEAWAYS FROM FAA HISTORY

The FAA's history teaches three lessons that may be applied to drones: (1) safety regulation promotes commerce, (2) air traffic management must be consolidated and include more than just visual collision avoidance, and (3) public perception matters.

First, safety regulation promotes commerce. The Air Commerce Act provided for the feasibility of commercial aviation. Evaluation of aircraft, engines, pilots, and ground crews made the early airlines safer and more reliable. This allowed airlines to profit under the airmail contracts and become effective means of passenger transport. In the fifteen years following regulation, Boeing, Douglas, and Lockheed matured into formidable aircraft manufacturers. The rickety airplanes of the 1920s gave way to the Boeing 307, the Douglas DC-4, and the Lockheed Constellation.[63] Far from inhibiting aeronautics, safety regulation helped the aviation industry thrive.

Second, air traffic management must be consolidated and include more than just visual collision avoidance. In the 1950s, multiple Air Force jets

56. H.R. Doc. No. 85-406.

57. Federal Aviation Act of 1958, Pub. L. 85-726, 72. Stat. 731, § 301.

58. *Id.* § 102–03, § 307.

59. HARRY P. WOLFE & DAVID A. NEWMYER, AVIATION INDUSTRY REGULATION 27 (1985). (citing WHITNAH, *supra* note 38, at 281–83); *Elwood "Pete" Quesada: The Right Man for the Right Job,* FED.AVIATION ADMIN. (last visited Dec. 21, 2016), https://www.faa.gov/about/history/people/media/Elwood_Quesada.pdf [https://perma.cc/YDV7-W7AB] [hereinafter *Quesada*].

60. WOLFE & NEWMYER, *supra* note 59, at 27.

61. *Quesada*, *supra* note 59.

62. *See* Changes in Civil Air Regulations to Conform with Federal Aviation Act of 1958*,* 24 Fed. Reg. 4 (Jan. 1, 1959).

63. DAVIES, *supra* note 32, 138–39.

collided with civilian airlines due to the chasm between military and civil air traffic control.[64] These collisions, along with the Grand Canyon incident, demonstrated that, even in wide-open skies, pilot eyesight was not enough to prevent disaster.[65] Today, all commercial aircraft are equipped with radar and commercial air traffic is tracked across the nation.[66]

Third, the public perception of safety is significant. Even as aviation safety improved, significant regulation was driven by high profile crashes. The death of Senator Bronson Cutting drove the Civil Aeronautics Act. The string of air-to-air collisions in the 1950s scared Congress, once again, into action. The public does not see the day-to-day success and high safety of aviation. Instead, it reacts to the spectacular nature of aviation disasters.[67]

II. THE FAA AND DRONES

This Part summarizes FAA drone regulation. Section A introduces drones and the legislation that brought about their regulation. Section B briefly summarizes the FAA's rules in 14 CFR Part 107, reviews relevant commentary and rationale from the Administration, and touches upon the drone waiver program. Section C provides a functional synopsis of the permissibility of various potential drone uses following the enactment of Part 107.

A. DRONES FINALLY GET ATTENTION

In 2012, Congress passed the comprehensive FAA Modernization and Reform Act. The Reform Act funded the FAA from 2012 to 2015 and provided for, among others, airport improvement, next generation air traffic control, and new noise and environmental regulations.[68] Notably, the act directed the FAA to address the issue, somewhat overdue, of drones in the national airspace.[69]

64. The worst was in Las Vegas, where civilian and military towers just six miles apart cleared aircraft for flight. *See* H.R. Doc. No. 85-406.

65. *See* H.R. Doc. No. 85-406; *see also Grand Canyon Report*, *supra* note 50, at 17.

66. 14 C.F.R. § 135.175; *see, e.g.*, FLIGHT AWARE, https://flightaware.com/ [https://perma.cc/LVV9-CRPM] (providing real-time commercial airline flight tracking) (last visited Feb. 26, 2017).

67. *See FAA History*, *supra* note 29, at 4.

68. FAA Reform Act, Titles I.D, II, and V.

69. *Id.*; *see* M. Ryan Calo, *The Drone as Privacy Catalyst*, 64 Stan. L. Rev. Online 31 (2011) ("The FAA faces increasing pressure to relax its restrictions and is considering rule-making to reexamine drone use in domestic airspace."). .

"Drone" is the colloquial term for an aircraft that is not operated by a pilot located on or within the aircraft.[70] The term spans broadly from Elmer Sperry's gyrostabilized biplanes[71] to Lockheed's ramjet powered GRD-21.[72] Though often serving military functions in the past, from reconnaissance[73] to ordinance delivery,[74] drones have recently been popularized as the quad-copter photography platform,[75] the surveillance swarm,[76] and even collegiate burrito delivery.[77]

Title III, Subtitle B, Unmanned Aircraft Systems, directs the FAA in two broad categories, research and regulation. The FAA is to set up six test ranges for the development of drone flight operating standards and best practices.[78] These flight operations standards must integrate with the FAA's next-generation air transportation system, NextGen.[79]

Regulation falls into three categories: civil, public, and recreational. The FAA is to develop rules and regulations for the operation and certification of public drones by federal, state, or local governments.[80] These drones may be permitted to fly either by certificate of authorization or by certificate of waiver granted by the FAA.[81] Recreational drones, on the other hand, are generally exempt from FAA regulation.[82] FAA

70. BART ELIAS, CONG. RESEARCH SERV., R42781, FEDERAL CIVIL AVIATION PROGRAMS: AN OVERVIEW 11 (2012); FAA Reform Act, §331(2).

71. LAURENCE R. NEWCOME, UNMANNED AVIATION: A BRIEF HISTORY OF UNMANNED AERIAL VEHICLES 16–20 (2004) ("Sperry's work with gyroscopes for maritime applications led him to attempt to develop a gyrostabilizer for airplanes in 1909. . . . On 6 March 1918, a Curtiss-Sperry Aerial Torpedo catapulted cleanly into the air, flew its planned 1000-yd flight, then dived at its preset distance into the water off Copiague, Long Island.").

72. *Id.* at 88–89 ("Designed as an unmanned complement to the Mach 3 A-12 Blackbird reconnaissance aircraft, [the GRD-21] was intended to penetrate those environments over hostile territory too dirty (radiation) or too dangerous (SAMs) over which to risk the manned SR-71.").

73. *Id.* at 88 (describing the "GRD-21 reconnaissance drone").

74. *Id.* at 20 (documenting the "potential of Sperry's device as . . . pilotless flying bomb"). *See also id.* at 110 (describing U.S. Air Force operation of General Atomics RQ-1 Predator drones equipped with AGM-114 Hellfire missiles over Afghanistan in October 2001).

75. *See Phantom Series*, *supra* note 9 (emphasizing the Phantom 4 consumer drone as a photography platform).

76. *See* Calo, *supra* note 69, at 29 (noting "the widespread domestic use of drones for surveillance seems inevitable").

77. White, *supra* note 10.

78. FAA Reform Act §§ 332(a)(2)(G)–(H), 332(b).

79. *Id.*

80. *Id.* §§ 334, 331(4).

81. *Id.* § 334(c).

82. *Id.* § 336(a).

regulation of civil drones therefore applies generally to drones with a commercial purpose.[83]

By order of Congress, the FAA is to "develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system."[84] Aside from the research mentioned previously, the FAA is given regulatory responsibility over the certification and operation of drones as well as the registration and licensing of both drones and pilots.[85] The Administration has broad discretion. The FAA will determine which classes of drones, if any, do not pose a threat to public safety or national security and whose allowed operation may be expedited.[86] Flight permission for these classes of drones is based upon the FAA's choice of airworthiness certification, certificate of authorization, or certificate of waiver.[87] For drones that do not fall into this expedited category, the FAA is to issue a rule to allow for operation of these civil, including commercial, drones in the national airspace.[88]

B. THE FAA TAKEOVER OF DRONES

1. FAA Drone Regulations

On June 28, 2016, 14 C.F.R. Part 107—Small Unmanned Aircraft Systems, was published to the Federal Register.[89] As dictated in the FAA Reform Act, Part 107 exempts recreational drones from regulation.[90] The regulations place significant restrictions upon civil drones, however. Though drones may transport cargo for hire, the combined weight of the aircraft and payload may not exceed fifty-five pounds. Further, interstate drone commerce is prohibited. The regulations prohibit commercial drone operation across state lines, in the District of Columbia, or in U.S. territories. Drones may only be operated during daylight and may not exceed unaided visual range of the remote pilot.[91] They may not fly faster than 100 miles per hour, nor may they operate above an altitude of 400

83. 42 U.S.C. § 40102(a)(16) (2012).
84. FAA Reform Act, § 332(a)(1).
85. *Id.* § 332(a)(2)(A)–(B).
86. FAA Reform Act § 333(a)–(b)(1).
87. *Id.* § 333(b)(2).
88. *Id.* § 332(b)(1).
89. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,064, 42209 (June 28, 2016) (to be codified at 14 C.F.R. pts. 21, 43, 61, 91, 101, 107, 119, 133, and 183).
90. *See id.*
91. Pilots are, however, allowed to wear standard corrective lenses. Id. at 42066 (Table 1—Summary of the Major Provisions of Part 107).

feet above ground level. A curious exception, though, allows for operation from a structure as long as the drone remains within 400 feet of the structure. Drones may not be operated from aircraft, nor may they be operated from a moving vehicle except in sparsely populated areas. Of course, reckless and dangerous operations are prohibited. Last, and perhaps most important, are two points: (1) no airworthiness certification is required for a drone, though it is the pilot's responsibility to inspect the drone prior to flight; and (2) drones may only operate over people directly involved with operation of the drone.[92]

2. FAA Commentary in the Federal Register

The FAA offers extensive commentary in the Federal Register about nearly every aspect of the final rules for drones. Four aspects of the regulation frame commercial drone operation: the visual line of sight requirement, the cargo operation allowance, lack of airworthiness standards, and flight over people.[93]

a) Flight Within Visual Range

The see-and-avoid requirement is fundamental to the avoidance of midair collision.[94] Drone pilots do not have the same perspective as a manned aircraft pilot.[95] Wherever a manned aircraft is, so too are the pilot's eyes. When a drone flies away, the remote pilot remains in place.

This difference is the basis for the visual line-of-sight requirement. The remote pilot, or visual observer, must be able to: (1) know the drone's location; (2) determine the drone's attitude, altitude, and direction of flight; (3) observe the surrounding air traffic; and (4) ensure that the drone does not endanger others.[96] These qualitative requirements supplement the primary collision avoidance mechanism, separation of air traffic.[97] The line-of-sight requirement, taken as a whole, is a condition-specific

92. *Id.*

93. *See infra*, Section II.C.

94. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,092. Recall the air traffic crisis of the 1950s, Airways Modernization Act of 1957, and the Federal Aviation Act of 1958. Midair collision, as applied to drones, is broader than collision with aircraft. Indeed, segregation of drone and manned aircraft airspace should prevent that occurrence. *See id.* at 42,093. For the purposes of this Note, drone collision is taken to mean collision with other drones, structures, birds, or other low-altitude collision risks.

95. *Id.*

96. *Id.* at 42,093.

97. *Id.* The FAA notes that drones are unlikely to come into contact with higher-speed manned aircraft due to airspace restrictions and altitude limitations of the drones themselves. *Id.*

precaution.[98] Remote pilots must operate with reasonable safety based upon weather, visual obstructions, and visual ability of the observer.[99] The goal is for the remote pilot to see and avoid obstacles so as to not endanger people, property, or other aircraft.[100]

However, this requirement must be accomplished with the naked eye.[101] Commentators requested permission to use first-person video (FPV) or light-detection-and-ranging (LIDAR) to satisfy the line-of-sight requirement.[102] While FPV would allow a remote pilot to view airspace as though within the drone, the FAA found the camera view distortions and the possibility of image transmission failure to negate any benefits.[103] The Administration conceded that both FPV and LIDAR showed promise, but cited a lack of data for each method as an obstacle to sound rulemaking.[104]

b) Cargo Operations

The proposed drone regulations did not allow for the transport of cargo for hire.[105] Comments submitted by companies such as Google and Amazon convinced the FAA to relax this prohibition.[106] While transport of cargo for compensation is permitted under the final rule, its scope is severely "limited."[107]

The FAA explains that commercial drone traffic rising to the levels of "air carriers" and "air transportation" as defined in 49 U.S.C. § 40102[108] would require the Department of Transportation to develop new economic and safety regimes for drone "air carriers."[109] Four limitations on drone operations prevent that result.[110] First, drone cargo operations may not cross state boundaries, the District of Columbia, or U.S. territories. Second, the visual line-of-sight requirement cannot be waived for cargo drone operations. This is intended to strictly limit the amount and

98. *Id.* at 42,096.
99. *Id.* The remote pilot may even lose visual sight briefly as the drone passes an obstacle. *Id.* at 42,095.
100. *Id.* at 42,095.
101. *Id.* at 42,093. Recall, however, remote pilots are allowed to wear standard corrective lenses. *Id.*
102. *Id.* at. 42,094.
103. *Id.*
104. *Id.*
105. *Id.* at 42,074.
106. *Id.* at 42,075.
107. *Id.*
108. *Id.* at 42,076.
109. *Id.* at 42,077.
110. *Id.* at 42,076.

usefulness of drone cargo traffic.[111] Third, the weight restriction of fifty-five pounds plus the air traffic limitations should keep drone traffic from interfering with manned commercial traffic. Fourth, drones may not transport hazardous materials.[112] Under these rules, only nominal drone cargo commerce is allowed.

c) Lack of Airworthiness Standards

There is no drone airworthiness certification. Drones operating under Part 107 will not exceed fifty-five pounds, not carry passengers, and are restricted to visual line-of-sight flight. Thus, drones pose a far lesser threat to people and property on the ground than manned aircraft.[113]

Instead of an airworthiness regime, the pilot in command of a drone is required to inspect the drone prior to every flight. This includes the control surfaces, wiring, mechanical linkages, hydraulic lines, and radio transmissions—but does not include a flight test.[114] Pilots may not simply rely upon drone self-diagnostic software. Nor may the inspection interval be relaxed.[115] In the absence of airworthiness regulations, the FAA recommends that pilots inspect drones in compliance with manufacturer manuals and checklists.[116]

d) Flight over People

Under Part 107, drones are not allowed to operate over people unless those people are under stationary cover or in a stationary, covered vehicle.[117] Manned aircraft are allowed to fly over people because of their airworthiness certifications. Drones, on the other hand, do not have airworthiness certifications.[118] This prohibition is not a matter of pilot competence but of drone electro-mechanical failure. The preflight inspection is meaningful, but it does not establish the requisite reliability

111. *Id.*
112. *Id.*
113. *Id.* at 42,151.
114. *Id.* at 42,150.
115. *Id.*
116. *Id.* The commentary does not address the possibility of manufacturer manuals being errant or inadequate. *See id.*
117. 14 C.F.R. § 107.39. The FAA clarified that this is not a ban on flight over locations occupied by people. Flights over structures or stationary vehicles containing occupants are perfectly acceptable. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,123, 42,127. However, flight over moving vehicles is not permitted due to the dangers of dynamic motion. Realistically, the FAA anticipates that drones crashing into roadways will cause traffic accidents. *Id.* at 42,127.
118. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42, 124.

to permit flight over humans.[119]

The FAA considered two possibilities to permit of flight over people. First, the FAA did not reject outright the idea that drone operators obtain insurance to permit flight over people. However, this proposal was rejected for rule addition because the FAA lacks to power to require insurance.[120] The second proposal was for an airworthiness certification regime. The FAA acknowledged that such a certificate would be a useful indication of reliability, but declined to create a regime for drones. Instead, the FAA appeared to direct pilots to the experimental airworthiness certificate in 14 C.F.R. Part 21.[121] For both proposals, the FAA noted that the prohibition of flight over people might be waived.[122]

The FAA also clarified the meaning of direct participant.[123] Drones are allowed to operate near and above direct participants. However, only those people involved in operating or ensuring the safety of the drone flight are direct participants.[124] Consent is not enough to make a person a direct participant.[125] Operation over people may be permitted on a case-by-case basis via the waiver process.[126]

3. Waivers Under 14 C.F.R. § 107.200

Though the regulations are stringent, many requirements and limitations may be waived. These include prohibitions against operation from moving vehicle or aircraft,[127] operation of multiple drones,[128] operation over people,[129] and operations in certain manned airspace.[130] Limitations[131] subject to waiver include daylight operations,[132] visual line

119. *Id*. at 42,124–25.
120. *Id.* at 42,127.
121. *Id.* at 42,126.
122. *Id.* at 42,125–26.
123. Drones may not operate over people not "directly participating" in the drone operation. 14 C.F.R. § 107.39.
124. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,128.
125. *Id.* The FAA believes a consenting non-direct participant lacks the necessary situational awareness to be present beneath drone operations. *Id.*
126. *Id.* at 42,138.
127. 14 C.F.R. § 107.25.
128. *Id.* § 107.35.
129. *Id.* § 107.39.
130. *Id.* § 107.41.
131. The categorization of "prohibition" or "limitation" is not a substantive distinction between the regulations. Some regulations are drafted as prohibitions against certain activity, while others are drafted as limitations to certain permitted activity.
132. *Id.* § 107.29.

of sight operations,[133] visual observer restrictions,[134] yielding the right of way,[135] and the drone operating limitations.[136] As discussed above, the FAA has prohibited two waivers for the purposes of drone cargo transport: operation from a moving vehicle or aircraft, and visual line of sight operations.[137]

Three waivers are notable for commercial drone operations.[138] The FAA granted Cable News Network (CNN) a waiver to operate over people, and two companies, PrecisionHawk, Inc. and BNSF Railway (BNSF), received waivers for the visual line of sight requirement.

CNN is permitted to fly drones over people, barely. Waiver conditions limit the drone to 1.37 pounds at five miles per hour up to twenty-one feet above ground level.[139] Further, CNN may only operate drones over people within private or controlled-access property[140] and may not operate over an open-air assembly of people. Finally, CNN must provide notice to all present that drone operations may occur overhead.[141]

Both PrecisionHawk and BNSF are permitted to fly drones beyond the visual range of a remote pilot.[142] However, the drone must still be within visual range of a designated observer. Communication between the pilot and observers must be efficient enough to allow safe operation.[143] BNSF must keep its drones within 200 feet of the ground or within 200 feet of a structure.[144] PrecisionHawk may not operate drones around people, obstacles, or structures.[145] Last, both companies' drones must be equipped

133. *Id* § 107.31.
134. *Id.* § 107.33.
135. *Id.* § 107.37(a).
136. *Id.* § 107.51.
137. *Id.* § 107.205(a), (c).
138. Currently, only CNN has received a waiver for operation over humans. The PrecisionHawk and BNSF waivers are representative of the waivers for the visual line of sight requirement. *See* U.S.DEP'T OF TRANSP. FED. AVIATION ADMIN, CERTIFICATE OF WAIVER NO. 107W-2016-00001, Issued to Cable News Network, 3–4 (2016) [hereinafter *CNN Waiver*].
139. *Id.* No explanation is given for the height restriction. *See id.*
140. Of course, landowner authorization is required. *Id.* at 3.
141. *Id.* at 4.
142. U.S.DEP'T OF TRANSP. FED. AVIATION ADMIN., CERTIFICATE OF WAIVER NO. 107W-2016-00002, Issued to PrecisionHawk, 3 (2016) [hereinafter *PrecisionHawk Waiver*]; U.S.DEP'T OF TRANSP. FED. AVIATION ADMIN, CERTIFICATE OF WAIVER NO. 107W-2016-00003, Issued to BNSF, 3 (2016) [hereinafter *BNSF Waiver*].
143. *Id.*
144. *BNSF Waiver*, *supra* note 142 at 4.
145. *PrecisionHawk Waiver*, *supra* note 142 at 3.

with high visibility markings.[146]

C. PUTTING IT ALL TOGETHER

Based upon the restrictions of Part 107, what drone operations are permitted? While newsgathering drones are severely restricted,[147] personal filming and photography drones are generally permitted. Alas, for those anticipating food or Amazon Prime delivery via drone, useful cargo operations are effectively prohibited. However, agricultural and environmental uses, such as examining livestock, crops, or wildlife, are allowed.

1. Agricultural and Environmental Uses

Some of the least restricted drone uses under Part 107 are agricultural or environmental.[148] They include crop dusting, livestock or wildlife tracking, and the inspection of crops, forests, or foliage. Environmental or agricultural drones are unlikely to encounter non-participating people. The line of sight restriction is not so burdensome.[149] Nor should the 55-pound weight limit restrict operation.[150] In sum, agricultural and environmental

146. *Id.* at 4; *BNSF Waiver*, *supra* note 142 at 5. "High visibility" markings include fluorescent or neon color schemes and patterns to distinguish a drone from the surroundings. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,064, 42,114 (June 28, 2016) (to be codified at 14 C.F.R. pts. 21, 43, 61, 91, 101, 107, 119, 133, and 183). The FAA does not have data about the efficacy of various "high visibility" color schemes and will not require specific markings. *Id.* However, the FAA will consider "high visibility" markings in evaluating drone operation waivers. *Id. See also PrecisionHawk Waiver*, *supra* note 142 at 4; *BNSF Waiver*, *supra* note 142 at 5.

147. *See CNN Waiver*, *supra* note 138.

148. *See* Margi Murphy & Christina Mercer, *19 companies using drones right now: Amazon, Asda, the BBC and more*, TECH WORLD (Dec. 14, 2016), http://www.techworld.com/picture-gallery/personal-tech/6-best-uses-of-drones-in-business-3605145/ [https://perma.cc/Z56H-XRBS]; *see also Top 12 Non Military Uses for Drones*, AIR DRONE CRAZE (last visited Dec. 22, 2016), http://www.airdronecraze.com/drones-action-top-12-non-military-uses/ [https://perma.cc/7TLA-ZW6K]; *see also* Adam C. Uzialko, *7 Cool Commercial Drone Uses Coming to a Sky Near You*, BUS. NEWS DAILY (July 27, 2016), http://www.businessnewsdaily.com/9276-commercial-drones-business-uses.html [https://perma.cc/ACB7-LEGQ].

149. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,076. The FAA believes that visibility will usually be limited to one mile. This allows for a stationary pilot to survey more than three square miles. Additionally, while the pilot vision is limited to one mile, the drone may certainly see further.

150. Perritt & Sprague, *supra* note 15, at 427 (explaining that for all but Hollywood or newsgathering camera crews, the fifty-five pound limit is not a barrier to drone film or photography). Theoretically, a container of fertilizer or pesticides can be of whatever size is necessary to keep the drone and payload under fifty-five pounds.

drone uses are generally permitted by Part 107.[151]

2. Film and Photography Drones

As discussed, newsgathering drones are subject to substantial limitations[152] not easily waived.[153] The FAA notes that drone operations on a film set will be subject to waiver procedures under 14 C.F.R. §107.200.[154] However, uses by the general public, including filming an event such as a wedding, seem to be permitted without a waiver for three reasons.

First, the visual line of sight requirements should not inhibit camera drone operations. Drone operators will almost certainly wish to remain within visual range of the film subjects. Second, the drone need not fly over people but may film the event from an angle such that the drone is offset at a safe distance.[155] Third, the first two points assume an outdoor event. At indoor events, FAA regulations do not apply.[156] Therefore, it appears Part 107 will not significantly inhibit drone filming and photographic operations.

3. Cargo Drones

Cargo drone operations are generally prohibited for two reasons: the prohibition of flight over people, and the visual line of sight restriction.

First, the prohibition against flight "over" people is broad. As with prior regulations, it is a safety standard, not a bright-line rule.[157] The prohibition prevents harm to people on the ground in case of drone failure. The regulation effectively has two parts. First, does the flight path take the drone "directly over" uncovered people?[158] "Over" should be read liberally, as objects rarely fall straight down out of the sky.[159] Second,

151. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,066–67 (Table 1).

152. Primarily the restriction of flight over people. 14 C.F.R § 107.39.

153. *See generally CNN Waiver*, *supra* note 138.

154. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,128.

155. *Id.* at 42,130. Given the significant height and weight restrictions on CNN's waiver to operate over people, filming from an angle appears to be the better option for the filmmaker. *See CNN Waiver*, *supra* note 138.

156. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,096.

157. *Id.* at 42,129–30.

158. *Id.* at 42,129.

159. *Id.* at 42,131 ("This is a performance standard: It is up to the remote pilot in command to choose the best way to structure his or her small UAS operation to ensure that prohibited flight over a person does not occur and that the small aircraft will not

even if the flight path is clear, will the trajectory of the drone, upon failure at any point along the flight path, carry it into the vicinity of a person? It is important to recall, when a drone fails in flight it retains its forward motion as it falls.[160] If the drone fails while engaged in a turn, it may depart from the flight path. People under shelter may be in danger from the drone impacting at an angle. Further, civil drones are often quad-copters. If the engines do not fail in unison the drone may depart from even a straight flight path. In sum, the term "over" includes large swathes on either side of a drone's flight path that must be clear of people.

The prohibition on flight over people includes a ban on operation over moving cars. Anywhere the drone can lose control and hit a person or moving car is off-limits.[161] Urban communities and city centers are thus barred. Suburban communities present little greater possibility. Drones would need to hopscotch between various structures to avoid people and cars. Realistically, everyone around must be inside and cars must be parked for a drone to deliver to a doorstep.

Nor does a waiver present a meaningful alternative at this time. CNN's waiver limits the drone to twenty-one feet above the ground.[162] Houses, trees, and telephone lines easily reach twenty-one feet in height. The height restriction thus negates drones' ability to fly safely above obstructions before descending vertically onto a safe patch of doorstep or backyard.[163] In addition, the 1.38-pound weight restriction makes drone delivery unviable.[164]

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impact a person if it should fall during flight.").

160. *Id.* at 42,129.

161. *See id.* at 42,130.

162. *See CNN waiver*, *supra* note 138. Amazon's proposed air traffic for Prime Air sets high-speed ingress and egress from 200 to 400 feet, with slower approach below 200 feet. *See* Amazon, *Revising the Airspace Model for the Safe Integration of sUAS*, (July 2015), https://utm.arc.nasa.gov/docs/Amazon_Revising%20the%20Airspace%20Model%20for%20the%20Safe%20Integration%20of%20sUAS%5B6%5D.pdf; *see also* Press Release, DHL, Successful Trial Integration of DHL Parcelcopter into Logistics Chain, (May 9, 2016) http://www.dhl.com/en/press/releases/releases_2016/all/parcel_ecommerce/successful_trial_integration_dhl_parcelcopter_logistics_chain.html [https://perma.cc/P3MQ-ZQ29].

163. Indeed, vertical ascent and descent are among the primary benefits of helicopters and helicopter type drones.

164. Amazon would certainly be limited in products deliverable by drone. Chipotle burritos, themselves approaching 1.38 pounds would be generally impermissible. On Dec. 23, 2016, the Author purchased a burrito and a burrito bowl at the Chipotle located at 7020 Amador Plaza Rd., Dublin, CA 94568. The burrito, comprising white rice, chicken, pico de gallo, guacamole, and lettuce, weighed 1.26 lbs. The burrito bowl, comprising brown rice, black beans, chicken, pico de gallo, hot salsa, sour cream, cheese, guacamole, and lettuce, weighed 1.63 lbs.

Second, the visual line of sight restriction may not be waived for drone cargo operations.[165] The FAA anticipates that this restriction limits the operation of the drone to about one mile around the remote pilot.[166] In urban and suburban environments, this visual range is further diminished. At such distance, the consumer may be better served on foot or via car. Over open ground, weight restrictions make a pickup truck a more effective means of cargo transport. In effect, drone cargo operations are prohibited.

III. WHAT ARE THE PROSPECTS OF DRONE COMMERCE?

Realistically, FAA regulations provide for minimal drone use. Drones are tethered to their operators. They are subject to numerous weather and daylight restrictions. Drones are virtually prohibited from operation in urban or suburban locations. While the FAA provides for waivers, such waivers are limited in their allowances. Cargo drones are all but forbidden. The only viable uses of drones appear to be agricultural, environmental, and photographic.

This Part considers the potential of commercial drone operation in the future. Section A briefly examines Congressional guidance in the 2012 FAA Reform Act. Section B assesses the regulatory barriers to expanded drone commerce. Section C evaluates whether or not drone commerce may fit within the FAA's regulatory sphere.

A. THE 2012 FAA REFORM ACT PROVIDES LITTLE GUIDANCE TO THE FAA.

Congress's drone guidance is found in Section 332 of the FAA Modernization and Reform Act, entitled "Integration of Civil Unmanned Aircraft Systems into National Airspace System."[167] Subsection (a)(1) requires the FAA to develop a plan to "safely accelerate the integration of civil" drones into the national airspace. Subsection (a)(3) mandates that the FAA "provide for the safe integration of civil" drones into the national airspace by September 30, 2015.[168]

"Integrate" is the focal point. The term, however, is not defined. It does not appear in any of the prior aviation-related legislation.[169] Nor is it

165. 14 C.F.R. §107.205(c).

166. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,076.

167. FAA Reform Act § 332.

168. *Id.*

169. Per the Adobe Reader Search Function, the root "integrat" does not appear in

defined in the aviation-specific section of the U.S. Code.[170] The term is used only once in the FAA Modernization and Reform Act to describe "integrated airport system planning," again without further definition.[171]

Turning to the dictionary, "integrate" is defined as: to combine (parts) into a whole.[172] The term "integrate" unifies multiple parts; in this case, drones and pre-existing air-traffic. However, what Congress intended by "integration" is uncertain. Realistically, the FAA Reform Act provides little guidance and no measure for compliance with its direction.[173] Thus, the FAA cannot be faulted for ignoring a Congressional mandate to put Amazon delivery drones on every street.

B. THE CURRENT REGULATORY SCHEME DOES NOT SUPPORT DEVELOPMENT TOWARD MEANINGFUL DRONE COMMERCE.

Drone operations are not yet normal. They engage in no noticeable level of air commerce. Cargo transport via drone is a novelty for a lucky few[174] and non-existent for most.[175] Commercial film and photography by drone is severely limited.[176] Operation without a waiver requires strict segregation of film subjects and drones. Ultimately, Part 107 communicates a message contrary to widespread drone commerce: drones may be used in the national airspace, but nowhere near the American populace.

1. The Commentary to Part 107 Does Not Support Developments in Favor of Drone Commerce.

FAA commentary to the drone final rule indicates a resistance to the integration of drones into the national airspace. First, drones will not be subject to airworthiness certification. However, lack of certification is the rationale for further operation restrictions. Second, the Administration has

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any of the following legislation: Air Mail Act of 1925, Pub. L. No. 68-359, 43 Stat. 805; Air Commerce Act of 1926, Pub. Res. No. 69-27, 44 Stat. 568; Air Mail Amendment of 1926, Pub. L. No. 69-331, 44 Stat. 692; Civil Aeronautics Act of 1938, Pub. L. No. 75-706, 52 Stat. 973; Airways Modernization Act of 1957, Pub. L. 85-133, 71 Stat. 349; Federal Aviation Act of 1958, Pub. L. 85-726, 72. Stat. 731.

170. *See* 49 U.S.C. § 40102 (2012).

171. FAA Reform Act § 132(b).

172. *Integrate*, OXFORD ENCYCLOPEDIC ENGLISH DICTIONARY (3d ed. 1996).

173. *See* FAA Reform Act §§ 332, 333.

174. *See* White, *supra* note 10.

175. Amazon Prime Air is not operating; they are waiting for "regulatory support." *See* Amazon Prime Air, *Frequently Asked Questions*, AMAZON (last visited Dec. 21, 2016) https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011 [https://perma.cc/J3ZQ-2K9V].

176. *See CNN Waiver*, *supra* note 138.

resisted new technology to aid the drone visual line-of-sight requirement. Third and last, the FAA is reluctant to permit and regulate drone cargo transportation.

First, there is no airworthiness certification for drones. In place of airworthiness, drone operators are required to inspect drones before flight. Pilots must inspect for visible defects, broken linkages, severed hydraulic or electrical lines, and general wear and tear.[177] This requirement has multiple flaws. To start, it conflates two different jobs, which the Air Mail Service separated nearly ninety years ago: pilot and mechanic.[178] This is not to say that pilots lack mechanical competence. But the efficacy of the drone inspection assumes competence outside a pilot's area of expertise.[179] Following that reasoning, the FAA finds the pre-flight inspection an inadequate assurance of safety. They note that, while the remote pilot may observe maintenance issues during the pre-flight inspection, assessment of the system reliability and fatigue strength[180] of the drone remains difficult to assess.[181] Therefore, safety concerns about mechanical or system failure during flight over people remain.[182]

Additionally, the lack of an airworthiness standard rests upon circular reasoning. Drones pose a lower risk to people on the ground than do manned aircraft, so no airworthiness certification is needed.[183] Yet manned aircraft are allowed to fly over people because their reliability is assured by airworthiness certification.[184] Drones, lacking airworthiness certification, will suffer lower reliability, and the preflight inspection does not remedy this higher failure rate.[185] Therefore, drones may not fly over

177. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,064, 42,150 (June 28, 2016) (to be codified at 14 C.F.R. pts. 21, 43, 91, 101, 107, 119, 133, and 183).

178. KOMONS, *supra* note 18, at 21–22.

179. Whether or not this is true, the barriers to entry in the drone market are low. Perritt & Sprague, *supra* note 15, at 417. Then again, large operators such as DHL and Amazon may have the expertise to make the self-inspection process effective. The FAA has a long history of designating industry representatives for regulatory examination. *See* Air Commerce Act § 2(b)(3).

180. Fatigue strength measures how a material withstands cyclic, as opposed to constant (static), loading. RICHARD G. BUDYNAS & J. KEITH NISBETT, SHIGLEY'S MECHANICAL ENGINEERING DESIGN 266 (9th ed. 2012). A common example is bending a paperclip back and forth until it snaps into two pieces.

181. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,124.

182. *See id.*

183. *See id.* at 42,151.

184. *See id.* at 42,124.

185. *See id.*

people, which sufficiently mitigates the risks.[186] If drone operation is prohibited, then drones pose no safety threat.

Numerous commentators applauded the lack of airworthiness certification.[187] They believed the airworthiness examination would be costly and a time-consuming, stifling progress. Modovolate Aviation stated that airworthiness certification would impose unwarranted costs on drone manufacturers and operators, discouraging commercial operation.[188] In reality, the lack of certification has done the opposite. The FAA has used the decision as a rationale to prevent drones from operating over people. This, in turn, effectively prohibits a large portion of potential commercial drone uses.

Second, the visual line of sight restrictions show an unwillingness to accommodate new drone technology. Facially, the requirements make sense. In order to see and avoid obstacles, remote pilots must have a view of the sky around the drone.[189] In an effort to make the rules flexible and based upon good judgment, the rules have few quantitative requirements.[190] The visual line of sight requirement favors compliance with the purpose, air traffic safety and avoidance of obstacles, rather than a bright-line rule.[191]

However, at the expected one-mile range limit,[192] is the remote pilot's vision, including depth and motion perception, acute enough to avoid unexpected obstacles or other drones? The rule also allows for drones to briefly pass out of visual sight of the operator. While this flexibility is necessary, the air-to-air collisions of aircraft of the 1950s[193] pose the question: is any lack of visibility safe? The air traffic control agenda of the Airways Modernization and Federal Aviation Acts indicate that air traffic safety is a product of more than just pilots' visual acuity.

Commentators asked the FAA to allow first-person cameras, LIDAR, or traffic collision and avoidance systems (TCA-S) to satisfy the "see-and-

186. *See id*. at 42,182 (explaining that the prohibition of flight over people, among others, "significantly reduce[s] the risk of a mid-air collision or the likelihood that the unmanned aircraft will fall on top of a person standing underneath it.").

187. *See id.* at 42,181.

188. *Id.* at 42,181–82; Henry H. Perritt, Jr., Comment by Modovolate Aviation, LLC on Proposed Rule to Operation and Certification of Small Unmanned Aircraft Systems (Feb. 23, 2015) Docket no. FAA-2015-0150-017, 4.

189. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,093.

190. *See id*. at 42,066 (Table 1).

191. *See id.* at 42,093, 42,096.

192. *See id.* at 42,076.

193. *See* Part I.C, *supra*

avoid" requirement. The FAA declined each alternative due to a lack of data to support rulemaking.[194] Yet the FAA Modernization and Reform Act directed the FAA to create six test ranges for the purpose of researching drone operation and traffic management.[195] These systems might receive waivers.[196] However, the waiver system presents industry with no criteria for development. It is a cursory dismissal of alternative see-and-avoid systems.

Third, the FAA has expressed reluctance to allow drone commerce. Although the FAA allowed limited commercial operation after industry outcry,[197] the FAA remains clear that they do not want drone commerce to attain the level of "air transportation" by "air carriers" as defined in 49 U.S.C. § 40102. To allow that level of commerce would require the administration to develop new infrastructure for drone air traffic.[198]

As a result, drone cargo transport is permitted, but only within visual line of sight, at less than fifty-five pounds, and away from people. Realistically, this prohibits drone cargo transportation. The line-of-sight requirement means the drone pilot must be able to see both the departure and delivery points. In transporting cargo less than fifty-five pounds over a distance of two miles, the drone's only advantage over a pickup truck is novelty.[199] Drone cargo is the exception, not an integrated norm. The commentary to Part 107 demonstrates the FAA's reluctance to integrate civil drones into the national airspace.

2. The Drone Waiver Regime Shows No Greater Support of Drone Commerce.

A survey of drone waivers does not indicate any greater promise for drone commerce. First, CNN's drone waiver conditions are prohibitive.[200] A reasonable speculation[201] is that CNN wants to use drones to provide elevated perspective or to capture events too dangerous for film crews to

194. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,094.

195. *See* FAA Reform Act, § 332(a)(2)(G)–(H).

196. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,094.

197. *See id.* at 42,075.

198. *See id.* at 42,077.

199. It is conceivable that drones would be used to transport cargo across intrastate rivers.

200. Recall that drones operating over people under CNN's waiver are limited to 1.37 lbs., 21 ft. above ground, at 5 mph. *See CNN Waiver*, *supra* note 138.

201. Based upon the fact that CNN is a news reporting company.

enter. A height limit of twenty-one feet allows minimal perspective,[202] and CNN may not operate drones over public protests or gatherings.[203] Even with the waiver, FAA regulations severely inhibit CNN's ability to exploit the benefits of gathering news via drone.

Second, PrecisionHawk and BNSF's waivers of visual range restrictions are a misnomer. Even if not the pilot's visual range, the drones must be operated within someone's visual range.[204] It is permission to daisy-chain[205] visual observers. Currently, these are the only waivers of the visual range requirement.[206] Yet these waivers indicate no willingness to allow alternative see-and-avoid technology be used.

Three conclusions have been drawn up to this point. First, commercial drones are not yet in wide use. Second, the FAA commentary indicates resistance to widespread drone operation. Third, the FAA waiver procedure shows no greater willingness to deviate from the restrictions on drone use. In sum, current regulations do not support commercial drone operation.

C. DRONE COMMERCE MAY FIT WITHIN THE FAA'S REGULATORY SPHERE.

On the surface, the FAA's apparent reluctance to permit drone commerce appears justified. Commentators applauded the regulation, arguing that drones are incompatible with the regulatory framework developed over the past ninety years. These arguments are rational in application to small-scale and private drone operations. However, analysis of the Administration's history indicates that large-scale commercial drone operations fit within the FAA regulatory framework.

1. Drone Commerce Faces Challenges.

At first glance, drones may not appear to fit within the existing regulatory scheme. Drones have different flight characteristics than manned aircraft. Scholars argue that drones may be difficult to regulate for sociological reasons. The FAA's experience in safety regulation, air traffic control, and public perception management may teach against the

202. An elevation of twenty-one feet is also unlikely to be beyond the reach of an unruly crowd's throwing arm.

203. *See CNN Waiver, supra* note 138.

204. *See id.*; *PrecisionHawk Waiver*, *supra* note 142; *BNSF Waiver*, *supra* note 142.

205. The waiver permits the pilot to be outside visual range, with a visual observer reporting the drone operation back to the pilot in real time. *See PrecisionHawk Waiver*, *supra* note 142; *BNSF Waiver*, *supra* note 142.

206. As of Dec. 21, 2016.

integration of drones into the national airspace.

Drones, specifically the ubiquitous quad-copters,[207] lack two characteristics enjoyed by standard manned aircraft. First, drones are not stable. Standard commercial aircraft are statically stable. When the aircraft is disturbed from level flight the aerodynamic characteristics of the aircraft tend to return the aircraft to level flight.[208] A quad-copter drone disturbed from level flight will not naturally return to level flight, but will require complex flight control inputs.[209] Second, quad-copters cannot glide. When commercial airliners lose power they can glide for considerable distances.[210] Quad-copter drones, without fixed wings, cannot glide to safety. Instead they crash into the ground below.[211] Drone's lack of safety contingencies undermines the safety required for air carrier success.[212]

Professor Henry H. Perritt, Jr. has argued that stringent FAA drone regulation lacks a stable sociological foundation. Aircraft pilots enjoy a robust culture of safety and are agreeable to FAA regulation.[213] Such safety and compliance protect aircraft investment costs—and lives.[214] Further regulatory violations are easy to detect for manned aircraft due to their size, noise, and need to operate from an airport.[215] On the other hand, drone pilots do not have a pre-existing mutual relationship with the FAA. There is no culture of safety or compliance for the FAA to found rules upon.[216] Safety is not paramount because drones are inexpensive[217] and the

207. *See Drone Reviews*, CNET (last visited Dec. 21, 2016), https://www.cnet.com/topics/drones/products/ [https://perma.cc/9BFP-DSBV] (reviewing primarily the four-engine "quadcopter" and variants of that type, including the tri-copter and octo-copter).

208. *See generally* ROBERT C. NELSON, FLIGHT STABILITY AND AUTOMATIC CONTROL, 40–85 (2d ed. 2007) (detailing the theory and calculations of aircraft static stability).

209. *See* Perritt & Sprague, *supra* note 15, at 421.

210. *See* Richard Witkin, *Jet's Fuel Ran Out After Metric Conversion Errors,* N.Y. TIMES (July 30, 1983), http://www.nytimes.com/1983/07/30/us/jet-s-fuel-ran-out-after-metric-conversion-errors.html [https://perma.cc/CD5R-RPL3] (documenting an Air Canada operated Boeing 767's unpowered glide sixty miles to safety after the aircraft ran out of fuel).

211. Perritt & Sprague, *supra* note 15, at 433 ("When microdrones experience a loss of power . . . they just fall out of the sky.").

212. Note that "air carrier" refers generally to the transportation of either goods or passengers. *See* 42 U.S.C. § 40102 (2012). Even though commercial drones would carry cargo instead of passengers, they still pose a threat to people on the ground in the event of failure.

213. Perritt & Sprague, *supra* note 15, at 412–417.

214. *Id.* at 405, 413.

215. *Id.*at 405.

216. *Id.* at 412–417.

217. *Id.* at 416.

drone failure does not harm the pilot.[218] Detection of regulatory breach is also difficult as drones are small, may operate anywhere, and are aloft for short times.[219] In this light, drones appear incompatible with current FAA manned aircraft regulation.

This banishment of drones from common use may simply be the lesser of two evils. Were the FAA to permit greater drone operation, the lack of safety contingencies and the inability to enforce regulation might lead to a negative public reaction. Self-help proposals are not hard to find on the Internet.[220] Even scholars have addressed the issue of reasonable drone self-defense.[221] These arguments seem to provide a rational foundation for the FAA's current restrictions on widespread drone commerce.

2. Drone Commerce Does Fit the FAA's Regulatory Mold.

The above safety and sociological arguments fail, however, when directed toward large-scale drone operators. Commercial drone operations follow the lessons of the FAA's history. First, aviation safety promotes commerce. The FAA can regulate and promote large-scale drone manufacturers and operators just as they manage and regulate the manned aviation industry. Second, air traffic management must be consolidated and include more than visual avoidance. The FAA provides the platform for consolidated drone traffic regulation, and the early success of autonomous cars shows that autonomous drones can be integrated into the current airspace infrastructure. Third, public perception of safety is significant. Commercial drone operators depend upon public confidence as do airlines and the FAA.

First, the FAA's history teaches that safety regulation promotes aviation commerce. Prior to the regulation of civil aircraft, the heavily regulated Air Mail Service was the safest aviation enterprise.[222] The regulation of civil aviation in 1926 aided the rise of lasting airlines as safe

218. *See id.* at 416–17 (noting that pilot harm in a drone crash is pecuniary, and generally not physical).

219. *Id.* at 406–07.

220. *See, e.g.*, Max Slowik, *Tacnition's New 12-Gauge Depleted Uranium Anti-Drone Loads*, GUNS.COM (April 1, 2013), http://www.guns.com/2013/04/01/tacnitions-new-12-gauge-depleted-uranium-drone-loads/ [https://perma.cc/UK6K-ZZZZ]; *Johnny Dronehunter: Defender of Privacy*, YOUTUBE (July 29, 2014), https://www.youtube.com/watch?v=jIXwQVFt8Ho [https://perma.cc/S3YD-CD8A].

221. *See, e.g.*, A. Michael Froomkin & P. Zak Colangelo, *Self-Defense Against Robots and Drones*, 48 CONN. L. REV. 1, 3 (2015) (addressing the question of whether a landowner may shoot down a trespassing drone).

222. *See* KOMONS, *supra* note 18, at 21 (noting the excellent safety record of the airmail service); *id.* at 23 (noting the lower safety record of civil aviation).

and effective modes of transportation.[223] Drones can enjoy the same result.

FAA oversight of large-scale drone operators can mimic oversight of aircraft manufacturers. The FAA no longer employs an army of inspectors to oversee aircraft manufacturing.[224] Today, the FAA relies upon thousands of designated engineering representatives (DERs) across the country.[225] Thus, the aviation industry regulates itself and the FAA spot checks.[226] This arrangement has proven successful, with American commercial aviation as safe as ever before.[227] Though many of these DERs are employees of aerospace companies, the directory of independent consultant DERs is extensive.[228] These regulatory consultants can be harnessed for a drone airworthiness regime.

Different flight characteristics and contingencies need not relegate drones to the fringes. FAA regulations generally specify the ends, a level of reliability or safety required, but not the means.[229] The Administration looks to the creativity of industry to develop compliant designs.[230] Following the Air Commerce Act, safety regulation did not stifle innovation.[231] On the contrary, that era gave birth to many iconic aircraft,

223. *See* DAVIES, *supra* note 32, at 123–28, 133 (discussing the creation of the Big Four airlines and the growth of the airlines to financial maturity); *see also* KOMONS, *supra* note 18, at 277.

224. *See FAA History*, *supra* note 29, at 2–3.

225. FED. AVIATION ADMIN., FAA CONSULTANT DER DIRECTORY (2017), https://www.faa.gov/other_visit/aviation_industry/designees_delegations/designee_types/media/DERDirectory.pdf.

226. *See FAA History*, *supra* note 29, at 35.

227. *See Accidents Involving Passenger Fatalities: U.S. Airlines (Part 121) 1982–Present*, NAT. TRANSP. SAFETY BD. (last visited Dec. 22, 2016), https://www.ntsb.gov/investigations/data/Pages/paxfatal.aspx [https://perma.cc/M6VH-EWCL]. From Jan. 13, 1982 to Dec. 27, 1989, U.S. commercial airlines suffered 1,191 passenger fatalities, not including the 243 killed in the bombing of Pan Am Flight 103 over Lockerbie, Scotland on Dec. 21, 1988. From October 3, 1990 to June 6, 1999, U.S. commercial airlines suffered 774 passenger fatalities. From Jan. 31, 2000 to Feb. 12, 2009, U.S. commercial airlines suffered 474 passenger fatalities, not including those killed on Sept. 11, 2001. *Id.* While fatalities have substantially decreased, the NTSB notes that air travel activity has nearly doubled since 1982. *Id. See also* Flight Safety Foundation, *Worldwide Airliner Accident Fatalities*, AVIATION SAFETY NETWORK (last visited Dec. 22, 2016), https://aviation-safety.net/graphics/infographics/1945-2015_Airliner_accident_fatalities.jpg [https://perma.cc/YHX4-QHWY] (depicting a downward trend in airliner accident fatalities across the world since the early 1990s).

228. FAA Consultant DER Directory, *supra* note 225.

229. *See e.g.*, 14 C.F.R. 25.561–562.

230. For example, the Boeing 737 is designed and manufactured by Boeing, not by the FAA. The FAA merely reviews and approves the design, manufacture, and test data.

231. *See* DAVIES, *supra* note 32, at 138–39.

such as the Douglas DC-3.[232] Indeed, drones hold an advantage over early aircraft. While the ability of airlines to sponsor aircraft development was a significant achievement in the 1930s,[233] Amazon and DHL already have the ability[234] to invest in drone technology in order to comply with FAA regulation.

Second, drone traffic management must be consolidated and include more than visual avoidance. By the 1950s, it was clear that pilot line of sight was often insufficient to prevent air-to-air collision.[235] Following the 1958 Federal Aviation Act, FAA air traffic management grew to include radar, transponders, and computers to manage air traffic more effectively.[236] Reliance solely upon pilot vision is even less sound for drones than aircraft, as remote pilots must view at distance.[237] Further, the FAA opted not to allow first-person video or LIDAR to satisfy the line-of-sight requirement because of view distortion and transmission failure.[238] But the safest and most acute drone pilot may be the autonomous drone.

Autonomous road vehicles are a proof of concept for the autonomous drone. In 2016, Waymo, Alphabet's autonomous car program, reached two million autonomously driven miles.[239] Most of these miles were driven on city roads, meaning that these autonomous vehicles were designed to operate within a pre-defined framework, regular roads.[240]

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232. *See id*. at 133–34.

233. *See id.* at 133.

234. Besides prior discussions of Amazon and DHL drone tests, both corporations are generally profitable. *See* David Goldman, *Amazon Shares Soar on Fourth Straight Profitable Quarter*, CNN TECH (Apr. 28, 2016), http://money.cnn.com/2016/04/28/technology/amazon-earnings/ [https://perma.cc/Y2TE-5AMW]; *see also* Press Release, DHL, Deutsche Post DHL Group delivers strong earnings performance in Q1 2016 (May 11, 2016), http://www.dhl.com/en/press/releases/releases_2016/all/dpdhl_delivers_strong_earnings_performance_in_q1_2016.html [https://perma.cc/E9CV-4T2D].

235. *See Grand Canyon Report*, *supra* note 50, at 19, 24 (noting there was no evidence the ill-fated aircraft "were not being operated in accordance with . . . visual flight rules" yet admitting "[i]t is not possible to determine why the pilots did not see each other"); *see also* H.R. Doc. No. 85-406 (calling for an Airways Modernization Board to revolutionize air traffic management in the U.S.).

236. *See* WOLFE & NEWMYER, *supra note* 59, at 27; *see also Quesada*, *supra* note 59.

237. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,064, at 42,092 (June 28, 2016) (to be codified at 14 C.F.R. pts. 21, 43, 61, 91, 101, 107, 119, 133, and 183).

238. *See id.* at 42,094.

239. *On the Road*, WAYMO (last visited Dec. 22, 2016), https://waymo.com/ontheroad/ [https://perma.cc/HL5X-4963].

240. *See id.*

Drones require complex computer flight systems[241] and can be programmed to operate within FAA-defined airspace.[242] Indeed, drones have an advantage over autonomous cars. Drone traffic infrastructure may be tailored from scratch; autonomous cars face numerous regulatory hurdles as they integrate with roads designed for human drivers.[243] Autonomous cars show, however, that the human pilot may be removed.[244] Autonomous see-and-avoid systems such as LIDAR and drone interconnectivity provide for effective management.[245] Thus, autonomous drones, programed to operate within a defined airspace, are compatible with the FAA's regulation.

Third, commercial drone operators depend upon public perception just as the FAA does.[246] Lack of public confidence in aviation was partly responsible for airline failure in the early 1920s.[247] Safety regulation preceded airlines becoming financially independent in the 1930s.[248] Public confidence in airline safety and reliability thus benefits airlines.[249] The same holds for drone cargo operators. Aside from any safety concerns, consumers decide whether or not to ship via drone based upon the perception of delivery reliability.[250] Therefore, commercial drone operators and the FAA have similar interests in the public's perception.

Drones are consonant with these three lessons from FAA history. Though critics argue that drones are unfit for the same regulatory scheme

241. Perritt & Sprague, *supra* note 15, at 421.

242. *See id.* at 423–24. Professor Perritt envisioned these built-in law abiding features to limit regulatory deviations commanded by drone pilots. *Id.* at 423–24.

243. Drones may have an easier time, given the regulatory hurdles autonomous vehicles face. *See* Jessica S. Brodsky, Note, *Autonomous Vehicle Regulation: How an Uncertain Legal Landscape May Hit the Brakes on Self-Driving Cars*, 81 BERKELEY TECH. L.J. 851, 853 (2016) ("it remains unclear how [autonomous cars] fit into existing legal and regulatory frameworks").

244. See *On the Road*, *supra* note 239.

245. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,094; Perritt & Sprague, *supra* note 15, at 435–36.

246. *See* KOMONS, *supra* note 18, at 283–85, 296–97; S. Rep. No. 75-2455. Though, it is true that industry and FAA blame are not always equally, or fairly given. TWA involvement in the Cutting Crash report almost certainly influenced Congress's decision to blame the Bureau of Air Commerce rather than the airline. *Id.* at 283–85 (describing TWA's involvement in the Congressional investigation).

247. *See* KOMONS, *supra* note 18, at 28–29.

248. *See id.* at 277; DAVIES, *supra* note 32, at 133.

249. Tim A. Becker, *Passenger Perceptions of Airline Safety: Marketing Safety Records*, FLIGHT SAFETY DIGEST, Oct. 1992, at 1.

250. Even if companies like Amazon insist upon shipping via drone, against consumer wishes, the shipper will bear the cost of drone failure in replacement and re-shipment of goods.

as manned aircraft, their arguments are primarily directed at small-scale drone operations. Large-scale operations do fit within the FAA framework. First, larger drone manufacturers and drone carriers can be overseen as the aviation industry is. Second, autonomous road vehicles and current air traffic control methods have laid the foundations for drone traffic management. Third, the public-image interests of the FAA align with those of drone operators. In the FAA's favor, some safety concerns about drones have not been ameliorated. However, these concerns are not enough to support the continued banishment of drones from the national airspace. Large-scale commercial drone operations' compatibility with FAA regulation warrants aggressive regulation for the promotion of drones in air commerce.

IV. CONCLUSION

On August 31, 2016, FAA drone regulations, 14 C.F.R. Part 107, went into effect. Yet instead of permitting widespread commercial drone operations, drones remain relegated to the fringes of our airspace. Perhaps Jeff Bezos was too optimistic in planning for drone delivery by the end of 2018. Scarcely two years remain to achieve his goal and a revolution in the FAA's drone regulation is unlikely during that time. However, the vision of commercial delivery drones is feasible.

Among others, three courses of action will help to enable commercial drone operations in American airspace. First, Congress should amend the 2012 Reform Act to give the FAA a clearer directive. The current direction to "integrate" civil drones is vague. Instead, Congress should provide more specific metrics for the FAA to meet, such as outlining an airworthiness certification regime for drones.[251] Further, Congress can clarify whether they simply want the FAA to contemplate drones or whether Congress wants a concerted effort to implement and normalize commercial drone operations.

Second, the FAA needs to provide regulations in terms of levels of safety, rather than simple prohibitions, for at least the pilot and line-of-sight requirements and the prohibition on flight over humans. Nothing is perfectly safe.[252] Prohibiting flight over humans does not address the

251. *See* Civil Aeronautics Act, § 603 (outlining the airworthiness certification process for civil aircraft).

252. For example, the passenger seat requirements for commercial aircraft are written in terms of a particular level of safety. Occupied passenger seats must withstand 9g-static and 16g-dynamic loads. 14 C.F.R. §§ 25.561–62. These numbers are not a perfect level of safety. When a commercial airliner plunges into the side of a mountain, passengers

technological issues causing the safety concern. Instead of prohibition, the FAA should specify a minimum level of electrical and mechanical reliability required for drone automation, flight beyond visual range, and flight over humans. Even if no current drone meets the requirements, the safety regulation will either drive innovation or companies will decide that current ground delivery is safer and more cost effective. Requiring a level of safety, rather than prohibiting potentially dangerous activity, gives commercial drones the opportunity to develop instead of flatly barring their use.

Third, drone manufacturers can take the initiative and prove their safety records to the FAA. Amazon and DHL have both successfully tested drone delivery systems.[253] Amazon and DHL should test the reliability of their drones the way Waymo has been testing autonomous cars on public roads.[254] Commercial drone testing would need to be performed in secluded airspace, perhaps at one of the FAA's six drone flight test areas.[255] Just as Boeing's first jet airliner[256] helped instigate aviation regulation reform in 1957 and 1958,[257] Amazon can prove the drone's safety and reliability in commerce as a means of instigating regulatory reform.

In sum, commercial drones delivering packages to consumers' doorsteps is a feasible goal, but Amazon simply needs regulatory support from the FAA. The current regulations stifle drone commerce and innovation rather than promoting it. Large-scale drone commerce fits within the FAA's historic regulatory scheme, and the FAA should pursue more aggressive drone regulation to enable drone commerce. We may be behind schedule, but drones are on the horizon.

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cannot well look to the seat engineer to save their lives. Those are the freak accidents, though. Instead the passenger seats are designed to keep passengers safe in instances where the aircraft is not instantaneously destroyed, such as crash landings. *See* Ruby Cazalda, *Controlled Impact Demonstration (CID), NAT. AERONAUTICS & SPACE ADMIN.* (Aug. 20, 2015), https://www.nasa.gov/centers/dryden/multimedia/imagegallery/CID/CID_proj_desc.html [https://perma.cc/2KK7-792K].

253. *See* Amazon, *Revising the Airspace Model for the Safe Integration of sUAS*, *supra* note 162; Press Release, DHL, *supra* note 162.

254. *See On the Road*, *supra* note 239.

255. *See* FAA Reform Act, § 332(b)(1).

256. Boeing flew their prototype at Seafair in Seattle during August of 1955. *See* SAM HOWE VERHOVEK, JET AGE 25, 35 (2010).

257. *See* H.R. Doc. No. 85-406.