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An Analysis of Federal Aviation Administration Enforcement Actions Against sUAS Operators

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Small uncrewed aircraft systems (sUAS), more commonly referred to as drones, are transforming the established practices of the aviation industry. Their unique capabilities coupled with their affordability resulted in a proliferation of sUAS activity (Government Accountability Office [GAO], 2018; Wingfield, 2014). According to the Federal Aviation Administration (FAA), there are nearly 870,000 UAS registered with the agency and more than 330,000 certificated UAS remote pilots (FAA, n.d.-a). As such, UAS "are the fastest growing segment of aviation in the United States" (FAA, 2023b, para. 1).

This bevy of sUAS activity has forced the FAA, UAS manufacturers, operators, existing airspace users, and ordinary citizens to grapple with the many challenges of integrating sUAS into the National Airspace System (NAS), including the potential threats associated with security, privacy, and safety. As one federal judge put it, sUAS "are fun and useful. But their ability to pry, spy, crash, and drop things poses real risks" (*Brennan v. Dickson*, 2022, p. 53). Indeed, as recently as 2019, sUAS were perceived by the public to be "risky machines that are for killing, disrupting privacy, or toys for hobbyists" (Aydin, 2019, p. 12). Still, the unique capabilities of sUAS provide for new, beneficial commercial applications of this technology, such as package deliveries, infrastructure monitoring and analysis, agriculture services, photography, and photojournalism (Elias, 2016; GAO, 2018; Ravich, 2019; Reger et al., 2018; Yoo et al., 2018).

Because they simultaneously offer beneficial applications and pose important risks, regulation of sUAS technology and operations is vital to maintaining safety in the NAS. In 2012, Congress expressly charged the FAA with addressing the burgeoning safety and security issues associated with sUAS operations. Specifically, the FAA was required to develop and implement a plan to integrate UAS into the NAS (Elias, 2016). Fast forward to 2016, the FAA fulfilled its congressional mandate by promulgating regulations governing commercial sUAS operations (GAO, 2023). These regulations are codified in Title 14 of the Code of Federal Regulations (14 C.F.R.) Part 107 (hereinafter "Part 107"), which details sUAS operational requirements (Operation and Certification of Small Unmanned Aircraft Systems, 2016; GAO, 2023).

Part 107 regulations carry the force of law, meaning a violation of any Part 107 regulation could have legal consequences (FAA, 2022b; FAA, 2023a). But, as Huang et al. (2021) observed, the mere existence of sUAS regulations does not promise regulatory compliance. So, what happens when there is not regulatory compliance? That is the focus of this study.

Problem

Small UAS operator compliance with Part 107 regulations is essential to maintaining safety in the NAS. Compliance can partially be ensured by enforcement. Yet the sheer volume of sUAS operations across the country "presents the [FAA] with a challenge in identifying people who don't follow the rules of the air or endanger the nation's airspace" (FAA, 2015a, para. 1). Indeed, as a 2018 report from the U.S. Department of Transportation's Office of Inspector General (OIG) asserted: "The [FAA] has issued some enforcement actions for UAS operators… However, many more violations are closed with no action due to a lack of operator data or are resolved without any pursuant enforcement actions" (OIG, 2018, p. 23). And presently, relatively little is known about how the agency has enforced its sUAS regulations since their advent, or how the agency enforced regulations against sUAS operators prior to the promulgation of Part 107.

Purpose

Given the importance of Part 107 compliance, understanding the FAA's process for sUAS enforcement is a significant part of recognizing how to safely conduct sUAS operations. Equally significant is understanding how the FAA has been enforcing regulations affecting sUAS operations up to this point because of the valuable lessons that may be learned to improve operator compliance and, ultimately, safety. Accordingly, the purpose of this study was to explore FAA enforcement actions—specific regulatory violations—and subsequent sanctions levied against individuals for exceedances of FAA rules with respect to UAS operations.

Research Questions

In this study, we sought to answer the following research questions:

1. Which regulations are most frequently prosecuted by the FAA in sUAS enforcement cases?
2. What is the timeline associated with sUAS enforcement cases?
3. What is a typical civil penalty for a sUAS enforcement case?

Literature Review

The advent of sUAS technology has led to multiple studies that have investigated different aspects of sUAS operations. The present literature derives from a variety of disciplinary perspectives. These include, among others, public

perception, safety and security, sUAS in higher education and curricula, employing sUAS for meteorological research, and utilizing sUAS for wildlife management and agriculture purposes (Adkins et al., 2020; Aydin, 2019; Kolarik et al., 2020; Loffi et al., 2016b; Luxhøj et al., 2021; Reddy et al., 2016; Rice et al., 2018; Seymour et al., 2017; Wallace et al., 2017; Wallace et al., 2018). There has been no shortage of sUAS-focused legal scholarship either. A modest sampling of sUAS issues analyzed from a legal perspective includes privacy, airspace, liability allocation in the event of a sUAS accident, and First Amendment considerations, among others (Gustafson, 2017; Kaminski, 2013; Page, 2018; Rule, 2015; Spanel, 2015; Tooley, 2023; Villasenor, 2013).

Limited existing literature, however, is akin to this study. Shortly after the promulgation of Part 107, Loffi et al. (2016a) outlined the FAA's regulatory enforcement process when discussing methods to ensure compliance with Part 107 regulations. They also examined the case of *Huerta v. Pirker*, a 2012 UAS enforcement action case. [The *Pirker* case is one of the 62 cases examined in this study.] Notably though, the incident at issue in *Pirker* occurred approximately five years prior to the enactment of Part 107 regulations. Loffi et al. (2016a) also considered the potential impact of the Aviation Safety Reporting System (ASRS) on FAA sUAS enforcement actions.

Koebler (2016a) reported the results of a Freedom of Information Act request concerning sUAS enforcement actions. This reporting summarized enforcement cases "involv[ing] 24 different people or companies" which at that time, according to Koebler (2016a), were "the entirety of… [FAA] enforcement efforts against [UAS] pilots thus far" (para. 2). Koebler (2016b) observed the FAA had not initiated any enforcement actions against companies for failing to comply with an exemption process which was in place at the time. It is important to note this reporting occurred before Part 107 regulations went into effect. Thus, none of the cases included in the Keebler (2016b) report involved Part 107 regulatory violations. The current study provides an updated analysis which includes, as described in the methodology section, 62 enforcement action cases occurring between 2012 and 2020, and an analysis of sUAS operator violations of Part 107 regulations.

In 2018, the U.S. Department of Transportation's OIG (2018) issued a report observing the "FAA's UAS oversight efforts have primarily focused on outreach and education with limited enforcement action, despite the growth of the industry" (p. 4). The OIG (2018) report also acknowledged that, at least at the time it was written, a "lack of FAA clarification, guidance, and strong enforcement when warranted may result in many UAS operators continuing to operate outside the confines of the rule while believing they are actually operating in compliance with the rule" (p. 23).

Along this vein, Ravich (2019) suggested the FAA has not been very active in pursuing enforcement actions against UAS operators, arguing "nonenforcement" has been "the… norm" (p. 45) and citing to reports by Koebler (2016a; 2016b). Ravich (2019) observed "the FAA's resources… are stretched thin by the many thousands of manned operations taking place each day" (p. 38), and argued, "The FAA's nonenforcement—including the promulgation of standalone drone rules—may be a consequence of agency paralysis" (p. 39). Ravich (2019) also criticized the agency's actions in *Pirker*, suggesting:

> the FAA's enforcement against a remotely piloted operation on the basis of regulations intended for manned flight… represented "a departure from the norm, suggesting that the sanction was not the result of rationed and reasoned decision making, but instead was improperly used as a political tool" (p. 44)

Huang et al. (2021) investigated regulatory compliance with Part 107 via a survey of sUAS users. Survey results found that 53% of recreational sUAS pilots and 85% of commercial sUAS pilots comply with the FAA's sUAS registration regulation; 77% of recreational sUAS pilot and 93% of commercial sUAS pilots comply with the FAA's maximum flight altitude regulation (Huang et al., 2021). In addition, Huang et al. (2021) proffered multiple policy recommendations, including establishing sUAS "regulations that are specific to urban vs. rural contexts" (p. 8) and an increased focus on recreational UAS operations.

Finally, Rupprecht and Simoneau (2021) conducted an initial review of the enforcement cases used in this study. Among other things, this reporting found there are three key regulatory areas where the FAA has been actively prosecuting remote pilots: (1) airspace violations, (2) flights over humans, and (3) loss of control situations (Rupprecht & Simoneau, 2021). Using the same dataset, the present study applies a deeper analysis, and thereby builds on this earlier work.

Considering this existing literature, it is clear FAA enforcement of Part 107 regulations remains a relatively unexplored area of sUAS research. Namely, there is a gap in the existing literature with respect to examining the extent to which the FAA has invoked its regulatory enforcement power against sUAS remote pilots. Indeed, beyond a handful of articles and official documents from the FAA (e.g., FAA, 2015a; FAA, 2022e; FAA, 2023c;FAA & DOT, 2023), relatively little is known about how the FAA has been enforcing Part 107 regulations since their promulgation in 2016. This study seeks to begin filling this gap in the academic literature.

Source of the FAA's Regulatory Power

To properly examine the enforcement of Part 107 regulations, it is first important to understand how the FAA is able to promulgate and enforce regulations and the FAA's regulatory enforcement process. Understanding the source of the FAA's regulatory power starts with understanding the U.S. Constitution—the U.S. legal system's foundational document that gives the entire Federal Government its power to operate. At its core, the Constitution was written to establish a limited government structure with checks and balances. This was achieved by creating three distinct branches of government, separating powers among those three branches to provide balance, and establishing checks on those powers (Rosenberry, 1929).

Under the Constitution's *separation of powers* framework, lawmaking power is left to the legislative branch, that is, Congress (Rosenberry, 1929). With this power, Congress may establish, and delegate power to, administrative agencies (Feldman, 2016). This occurs when Congress enacts an enabling statute [sometimes called enabling legislation or an enabling act]. The enabling statute is simply the law passed by Congress, and signed by the President, that creates an administrative agency and outlines its powers "to carry out various delegated tasks" (Garner, 2019, p. 1704). At the time of this writing, the FAA's enabling statute is found at Title 49 of the United States Code (49 U.S.C.).

In the FAA's enabling statute, Congress has vested the agency with a broad mission to "promote safety in civil aeronautics" (FAA, 2022b, p. 2–1). To meet this mission, the agency has been granted authority by Congress to promulgate federal regulations to govern aviation operations. Crucially, too, the agency has been granted both the authority and responsibility to *enforce* these federal regulations (FAA, 2022b).

This system—where Congress creates the FAA, and the agency promulgates and enforces federal regulations—is part of the U.S. legal system's *administrative law* framework. In the words of Supreme Court Justice Felix Frankfurter, "administrative law deals with the field of legal control exercised by law-administering agencies other than courts, and the field of control exercised by courts over such agencies" (Frankfurter, 1927, p. 615). According to Black's Law Dictionary (Garner, 2019):

> Administrative law is divided into three parts: (1) the statutes endowing agencies with powers and establishing rules of substantive law relating to those powers; (2) the body of agency-made law, consisting of administrative rules, regulations, reports, or opinions containing findings of fact, and orders; and (3) the legal principles governing the acts of public agents when those acts conflict with private rights. (p. 55)

Most relevant here are parts one and two. The FAA's enabling statute and the various laws passed by Congress directing the agency's UAS regulatory tasks are an example of part one. And Part 107 regulations—the agency-made rules governing sUAS operations—are an example of part two. This study focuses on administrative law in the context of the FAA's sUAS regulations and their enforcement. Note this subject is distinct from criminal and civil law. The FAA's regulatory enforcement power is different from the government's power to bring criminal charges against and individual, or a private party's authority to bring a civil suit against another private party.

Evolution of Part 107 Regulations

In response to growing concerns about the risks associated with increasingly accessible sUAS technology, in 2012 Congress passed the FAA Modernization and Reform Act (FMRA, 2012) which required the development of "a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system" (p. 63). If it was determined sUAS could operate safely in the NAS, §333 of the FMRA stipulated the Secretary of Transportation was required to "establish requirements for the safe operation of such aircraft systems in the [NAS]" (FMRA, 2012, p. 66).

Initially, regulation of sUAS operations commenced under section (§) 333 of the FMRA. This section permitted operators to fly sUAS for commercial purposes, exempting them from certain provisions of Title 14. This exemption process was dubbed a *section 333 authorization* (Hamilton & Nilsson, 2020). But this process was not designed to be permanent. As the FAA began issuing section 333 authorizations for sUAS operations, the agency also began work on a Notice of Proposed Rulemaking (NPRM) to establish a final set of regulations governing sUAS operations in the NAS (Hamilton & Nilsson, 2020). The NPRM, titled *Operation and Certification of Small Unmanned Aircraft Systems,* was issued February 23, 2015. It received more than 4,600 public comments which, in accordance with the Administrative Procedure Act, were considered by the FAA before the agency promulgated its final version of the rule. The final rule—Part 107—went into effect August 29, 2016 (Operation and Certification of Small Unmanned Aircraft Systems, 2016).

Part 107 was amended in January 2021, providing expanded provisions for routine operations over people and night flying (Rupprecht, 2022b). While there may be a perception that all drone operations must be conducted under Part 107, there are some exceptions that include model aircraft (as specified in 49 U.S.C. § 44809), public aircraft operations (see 49 U.S.C. §§ 40102(a)(41) and 40125), and air carrier operations (including operations under 14 C.F.R. Parts 121 and 135). All

other commercial operations must be conducted in accordance with Part 107 regulations (Rupprecht, 2022a).

FAA Regulatory Enforcement

The FAA enforcement process begins with an investigation of an apparent regulatory violation. The agency must investigate all regulatory violation reports, as required by Congress. This investigation is conducted by an aviation safety inspector (Pearson & Riley, 2015). Their role "is to gather all evidence that tends to either prove or disprove the apparent violation being investigated, or that tends to show whether a person is qualified to hold FAA-issued certificates, ratings, approvals, authorizations, licenses, or permits" (FAA, 2022b, p. 4–1). At the conclusion of the investigation, the inspector will make a recommendation for what action is warranted. In some cases, no action, or administrative action—such as a warning letter or remedial training—is taken. In others, the inspector may determine an enforcement action is appropriate and transfer the case to the agency's legal counsel for the initiation of a legal enforcement action (Yodice, 2014; Pearson & Riley, 2015).

When the latter occurs, the inspector compiles an Enforcement Investigative Report and sends it to the appropriate FAA counsel (Yodice, 2014). For legal enforcement actions, the agency has several sanction options. Broadly, there are two categories of FAA sanctions: "(1) sanctions for punitive and deterrent purposes; and (2) sanctions for remedial purposes" (FAA, 2022b, p. 2–5). According to the agency, "[s]anctions for punitive and deterrent purposes include fixed-term certificate suspensions and civil penalties. Sanctions for remedial purposes include revocations and indefinite suspensions" (FAA, 2022b, p. 2–5). The UAS enforcement action cases analyzed in this study involve both categories and, more specifically, certificate actions and civil penalties.

Certificate Actions

Under federal law, the FAA has the power to amend, modify, suspend, or revoke any certificate, or part of a certificate, it issues (FAA, 2022b). This form of sanction is referred to as *certificate action*. There are two types of certificate action: (1) certificate *suspension* and (2) certificate *revocation* (FAA, 2022b). When an aviator's certificate is suspended, the sanction is temporary in nature, and the aviator may use their certificate following the expiration of the suspension period. The FAA uses sanction guidance, set forth in FAA (2022b), to determine the length of the suspension. The agency might, for example, order a 90-day certificate suspension for a given event. At the end of that period, the aviator is free to exercise the rights and privileges of their certificate again—in other words, they get it back.

Certificate revocation is more serious. When an aviator's certificate is revoked, the certificate must be surrendered to the FAA and the aviator permanently loses the authority to exercise the rights and privileges of their certificate as it "is no longer valid" (FAA, 2022b, p. 7–4). Still, the aviator may re-apply for the certificate, but usually must wait at least one year to do so (FAA, 2022b). There are specific instances, pursuant to federal law, requiring the FAA to revoke a certificate. These instances primarily involve individuals with pilot certificates who are involved in criminal offenses. Additionally, under federal law, if the holder of an FAA issued certificate is suspected by the Transportation Security Administration to pose a risk or threat of air piracy or terrorism, therefore threatening airline and/or passenger safety, the FAA is required to impose certificate action (FAA, 2022b).

Civil Penalties

Civil penalties are monetary fines imposed by the agency in response to a regulatory violation (FAA, 2022b). Under federal law, the FAA levies a civil penalty action as a sanction in addition to certificate action, or instead of certificate action. Civil penalty action is generally applied when the alleged violator is a business entity (Pearson & Riley, 2015) or does not hold an FAA-issued certificate. As shown in the findings and discussion section, many UAS enforcement action cases involve multiple regulatory violations and, consequently carry higher civil penalties.

The Enforcement Process

In non-emergency cases, if the FAA elects to initiate a legal enforcement action for a regulatory violation, the agency will issue "a notice proposing either a certificate action or civil penalty" (FAA, 2022b, p. 8–17). In addition to the proposed sanction, this document provides a narrative fact pattern of the event at issue and lists the specific regulations that were violated. The violator is allotted 15 days to respond to the notice. In their response, the violator may request an informal conference with FAA counsel and/or provide information to the agency in an effort to mitigate the proposed sanction (FAA, 2022b). Often, during the informal conference, a settlement agreement may be reached between the parties (Pearson & Riley, 2015).

After this informal conference, if a settlement agreement is not reached or under certain other conditions, the FAA "counsel issues an appealable document" (FAA, 2022b, p. 8–17). An appealable document may include, for example, a Final Notice of Proposed Civil Penalty, Order of Suspension, or Order of Assessment. Like the initial notice, as described by the FAA, the "appealable document

ordinarily tracks the original notice, but reflects counsel's reevaluation of the case in response to any additional information submitted by the apparent violator" (FAA, 2022b, p. 8–17). In other words, it may reflect the terms of a settlement agreement between the two parties—the FAA and the pilot—and includes an express order of sanction. Unless the pilot elects to appeal, this usually represents the final step in the process and, often, the end of the case. Initial notices and appealable documents, including those reflecting the terms of settlement agreements, are all analyzed in this study.

For emergency cases, the FAA follows a different process. In these instances, the agency issues an emergency order, and the certificate is *immediately* suspended or revoked. Emergency actions are taken when the FAA "finds that an emergency exists and safety in air commerce or air transportation requires such action" (FAA, 2022b, p. 7–3). Emergency orders are included in this study's analysis.

It is important to note the FAA enforcement process is, of course, more complex than the brief overview offered here. To be concise and readable, only directly relevant information has been included. A comprehensive overview of the FAA's enforcement process is contained in FAA Order 2150.3C CHG 10: *FAA Compliance and Enforcement Program* (FAA, 2022b)—which is the most current version of FAA Order 2150.3C at the time of this writing.

Methodology

This study utilized a historical research approach, with a mixed-methods procedure, to analyze primary source material. We obtained permission from Embry-Riddle Aeronautical University's Institutional Review Board to conduct this study.

Sample

We examined records of available FAA enforcement actions levied against sUAS operators during the period 2012–2020. We submitted a Freedom of Information Act (FOIA) request to the FAA on July 20, 2020. The agency responded on February 9, 2021, with 505 pages of documents. The provided documents contained data on enforcement actions that were issued by the agency between 2012 and 2020. This collection included notice and appealable documents issued by the FAA in UAS enforcement action cases (e.g., (1) *Order Assessing Civil Penalty*, (2) *Notice of Proposed Civil Penalty*, (3) *Notice of Proposed Certificate Action*, (4) *Settlement Agreement*).

Procedures

An initial review of the data provided in the FOIA response was conducted to identify enforcement actions relevant to the study's scope. In doing so, we filtered the initial dataset, removing data points for cases irrelevant to answering the study's research questions and data that was incomplete. These included (1) enforcement actions levied against organizations rather than individuals (n = 3); and (2) enforcement actions where only the settlement agreement and no other information was provided (n = 2). Enforcement actions with incomplete information were also removed from the dataset. The remaining documents were individually reviewed to verify no errors or duplicates were present.

Upon completing this initial review, a total of 62 enforcement actions (cases) were selected for inclusion in the study. Using Microsoft Excel, these cases were organized into a database for analysis. We assigned each enforcement action (data point) a sequential case file number, in no particular order, from 1 to 62. Then, for each case, we collected and manually recorded the (1) FAA case number; (2) date of incident; (3) date of proposed penalty; (4) date of final notice of proposed penalty, if it was provided; (5) date of order assessing penalty; (5) the proposed penalty; (6) the final, or settled, penalty; (7) the FAA enforcement division; (8) the total number of regulatory violations; (9) the specific regulations violated; and (10) a short description of the facts which led to the regulatory violation.

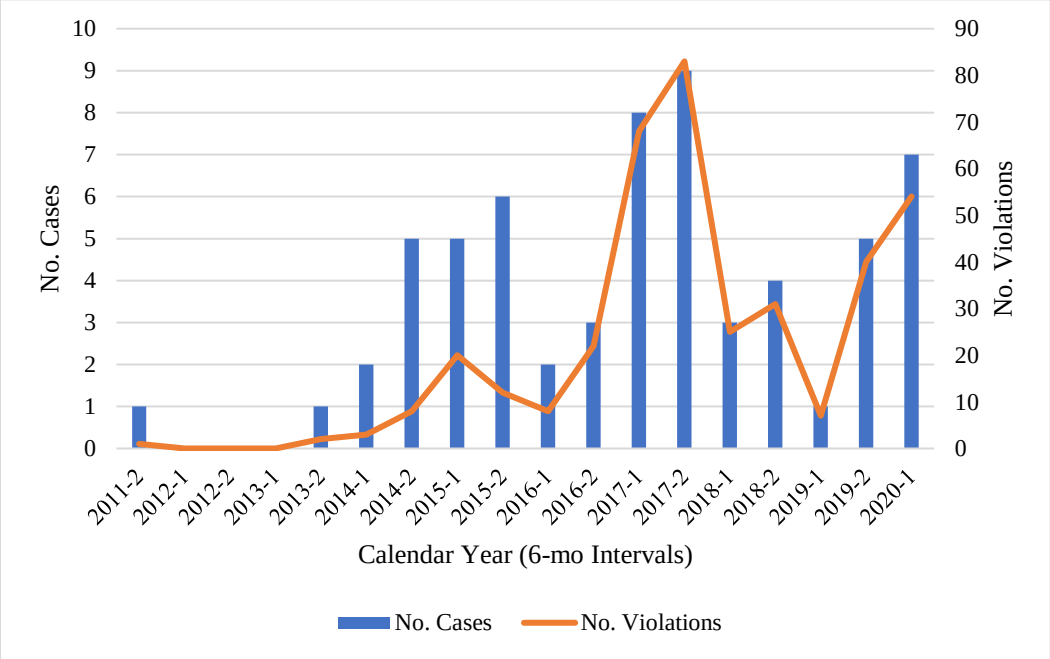
Findings & Discussion

Of the 62 enforcement cases available for final analysis, one enforcement case contained both an order of certificate action and civil penalty; five cases contained only an order of certificate action; 55 cases contained only civil penalties. One case contained an order of civil penalty but was withdrawn with no penalty.

In total, the cases comprised 384 regulatory violations. As shown in Figure 1, relatively few incidents requiring enforcement action occurred between 2011 and early 2014, with incidents spiking in 2015. Incidents diminished in 2016, with another spike in incidents in 2017, presumably following the promulgation of Part 107 regulations. Incidents have varied in frequency from 2018 onward. The number of violations is closely related to the number of cases at a ratio of approximately ten-to-one.

Figure 1

*Bar-Graph of Number of sUAS Enforcement Cases & Violations**



*Based on initial incident date.

Of the available cases involving only certificate action (n = 5), two contained emergency orders of revocation. Both of these cases involved incidents occurring in early 2020. Both cases involved serious infractions of sUAS operational regulations, including the violation of a Temporary Flight Restriction (TFR) for national defense (with a posted Notice to Air Missions [NOTAM]) and penetration of Class B airspace at nighttime. Three additional enforcement cases assessed certificate suspensions. The first case involved flight into a TFR with a posted NOTAM, yielding a 170-day certificate suspension; the second case involved unauthorized flight over people by an operator with a remote pilot certificate (120-day suspension); and the third case involved unauthorized flight over people (90-day suspension).

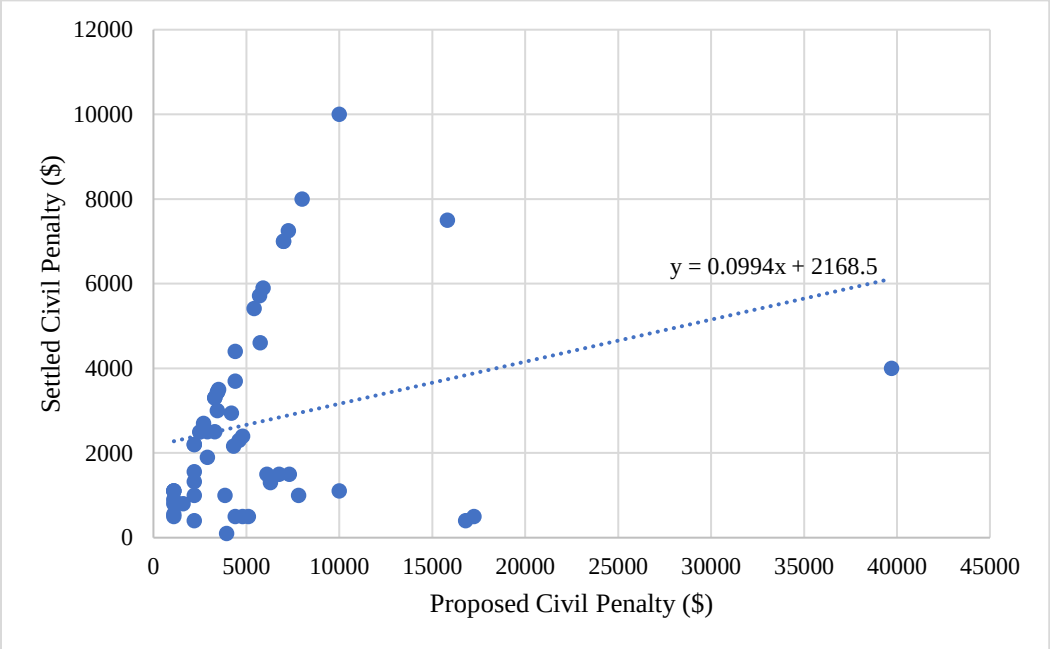
One case contained *both* sanctions of a certificate action and civil penalty. Occurring in 2015, the case involved flight of a sUAS which flew into the Washington D.C. Special Flight Rules Area (SFRA). This case resulted in both a $3,000 civil penalty and revocation of the operator's student pilot certificate. This case was excluded from the remaining analysis.

An analysis of the civil penalty cases (n = 55) was conducted to evaluate if the size of initial civil penalties changed over time. Although the dataset contained

five outliers, initial civil penalty values do not seem to have shifted over the course of the dataset. A Pearson Correlation test was performed yielding a weak, positive association, with an *r*-value of .26. Correlation testing was not statistically significant; however, significance testing results ($p = .06$) barely exceeded the alpha threshold ($p < .05$).

Figure 2

Scatterplot of Proposed Civil Penalty to Settled Civil Penalty

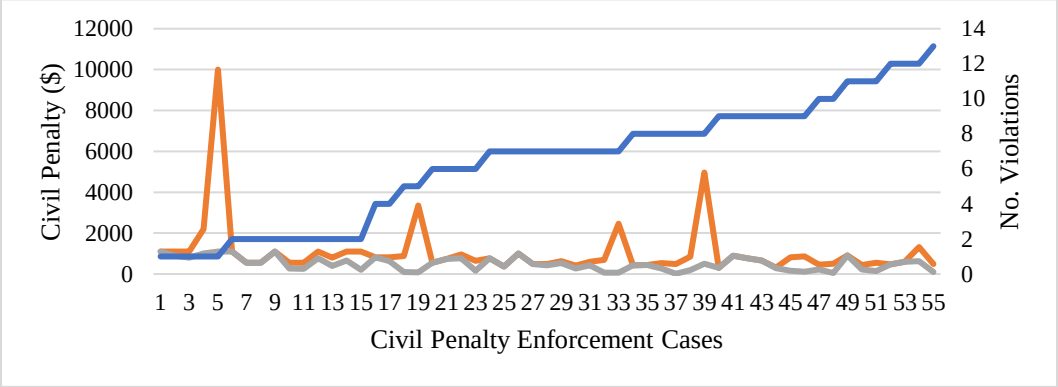


We also examined the relationship between the quantity of regulatory violations, proposed, and settled civil penalties. Pearson correlation testing between these variables yielded a significant, weak positive association between the number of regulatory violations and the proposed civil penalty ($r(38) = .34$, $p = .012$). Once civil penalties were settled, the relationship with the number of regulatory violations strengthened, yielding a significant, moderate positive association ($r(38) = .511$, $p < .001$).

We evaluated enforcement cases by calculating the assessed civil penalty relative to the quantity of assessed violations. The mean proposed rate for civil penalty violations was $1,068 per violation (*SD* = $1,433), with a median of $733 (*IQR* = $524, $1,050). The mean settled rate for civil penalty cases was lower at $498 per violation (*SD* = $318), with a median of $476 (*IQR* = $224, $770). Results are presented in Figure 3.

Figure 3

Mean Civil Penalty Assessed Per Violation



It is notable from Figure 3 that four cases show significantly higher initial proposed penalty rates per violation than the remainder of the dataset. Upon further examination, it was not completely clear why these four cases yielded a substantially higher civil penalty than other cases. While the four cases represented egregious violations—unauthorized commercial use of a sUAS, flight into controlled airspace, violation of a TFR, and operation without a remote pilot certificate—they did not appear to us to present a significantly-higher risk than other cases in the sample. It is notable that TFR violations yield high proposed civil penalties, likely due to the significant safety risks associated with unauthorized flight through this special use airspace. We acknowledge that FAA enforcement actions and recommended penalties are selected through careful consideration of a litany of factors and are guided by recommendations contained in FAA (2022b), FAA Order 2150.3C CHG 10: *FAA Compliance and Enforcement Program*.

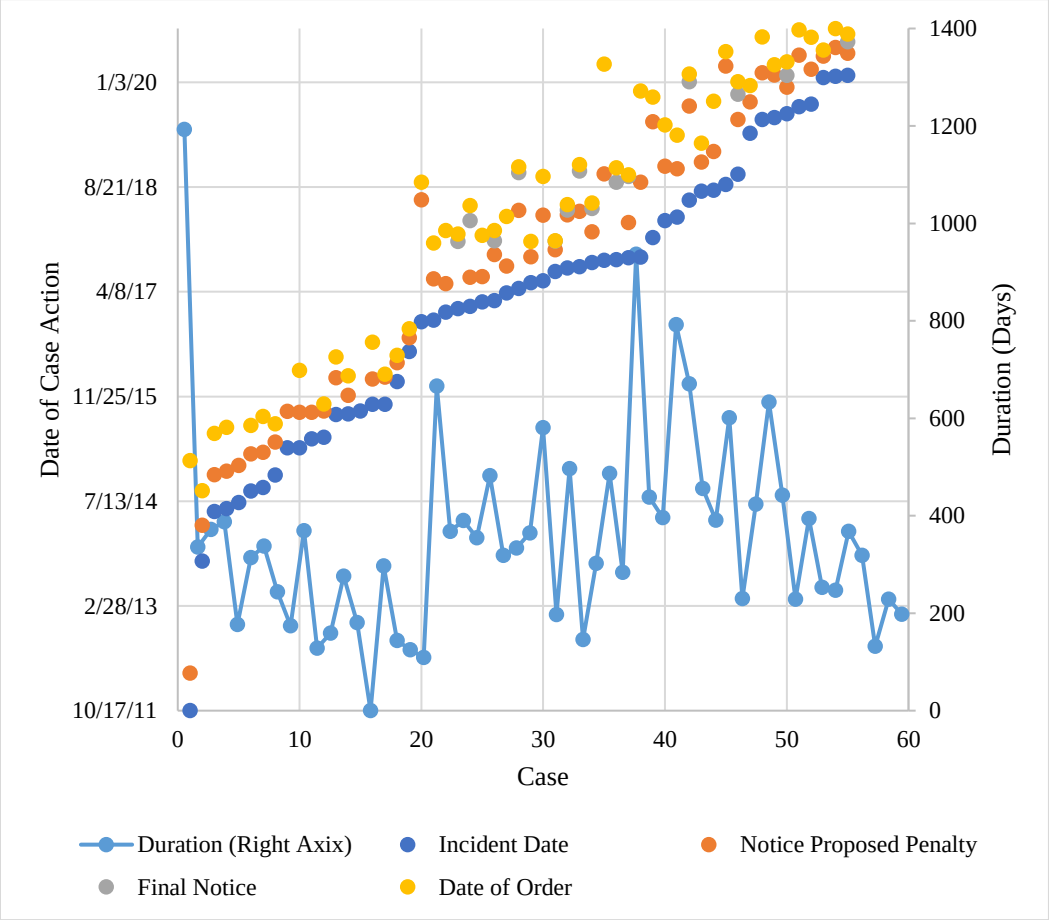
We further assessed the timeline associated with each enforcement case. For certificate action cases (n = 5), the duration varied from a minimum of 142 days to a maximum of 207 days. The mean case duration was 170 days (SD = 11) with a median of 167 (IQR = 61, 174.5). We caution that the small number of enforcement cases involving certificate actions may make these values unreliable for inference.

For civil penalty cases (n = 55), the duration of cases varied from a minimum of 109 days to a maximum of 1,193 days (3 years, 3 months, 8 days). The mean case duration was 368 days (SD = 206), with a median of 337 days (IQR = 229, 435). Results of case phases and duration is presented in Figure 4. Here, the incident date refers to the specific day the incident or event resulting in a regulatory violation occurred. In cases where there were multiple event dates, the most recent date was selected. As detailed in the literature review, upon completing an investigation of the alleged violation, if the FAA determines civil penalty or certificate action is the appropriate sanction, it will issue a notice proposing a

penalty. This document formally initiates the enforcement action (FAA, 2022b). In some cases, as described in the literature review, the FAA will issue an appealable document. This is described in Figure 4 as a *final notice*. It is notable from the data contained in Figure 4 that the duration of early cases was generally much longer than in later cases—particularly those enforcement cases filed after the promulgation of Part 107.

Figure 4

Phases & Duration of Civil Penalty Cases



A census of 14 C.F.R. Part 107 violations revealed that the most-frequently charged provisions included violations of the qualifications for manipulation of sUAS flight controls (n = 36, 11.4%), followed closely by requirements to hold a remote pilot certificate (n = 33, 10.4%). This seems to indicate the FAA is focused heavily on addressing potential hazards posed by unqualified and non-certificated individuals conducting sUAS flight operations. Violations of 14 C.F.R. § 107.23

[Hazardous Operation] seem to be applied in much the same manner as 14 C.F.R. § 91.13 [Careless or Reckless Operation], as a supplementary violation to other primary violations. Other common themes included failure to register the sUAS (*n* = 27, 8.5%); prevention of undue hazards to aircraft, people, or property (*n* = 20, 6.3%); compliance with sUAS regulations (*n* = 19, 6.0%); preflight assessment and knowledge requirements (*n* = 24, 7.6%); and aeronautical knowledge recency requirements (*n* = 21, 6.6%). See Table 1.

Violations of other non-Part 107 provisions of Title 14 primarily include operation in Class B Airspace (*n* = 11, 16.4%), with a similar number of violations for operating within the Washington D.C. SFRA (*n* = 10, 15.0%). Small numbers of violations are noted for operating within other classes of controlled airspace, operation during a TFR, operations during major sporting events, operations in accordance with special security instructions, and related provisions. It appears the FAA is primarily utilizing Part 107 violations to address unsafe *operational* practices, whereas other non-Part 107 provisions are used to address *geographic-specific restrictions* related to airspace, special use airspace, and other areas with sUAS-specific operating limitations. See Table 2.

Table 1

Census of 14 C.F.R. § 107 Violations by Type

Violations	Description	No. Violations	Proportion
107.7(a)(2)	Presentation of Remote Pilot Certificate & Identification	1	0.3%
107.12(a)	Qualifications for Manipulation of Flight Controls	36	11.4%
107.12(b)	Requirement to hold Remote Pilot Certificate	33	10.4%
107.13	Requirement for sUAS Registration	27	8.5%
109.19	Remote Pilot in Command duties	1	0.3%
107.19(c]	Prevent Undue Hazards to people, aircraft, or property	20	6.3%
107.19(d)	Ensures sUAS operation complies with regulations	19	6.0%
107.23	Hazardous operation of sUAS	2	0.6%
107.23(a)	Careless or reckless operations of sUAS	35	11.0%
107.25(b)	Operation of sUAS from moving land or water vehicle	1	0.3%
107.27	Alcohol or drugs	1	0.3%
107.29	Operation at night	1	0.3%
107.29(a)	Operation at night requirements	8	2.5%
107.31	Visual Line of Sight of Aircraft Operation	1	0.3%
107.31(a)	Uncorrected requirement to see aircraft	9	2.8%
107.31(b)	Exercising VLOS requirements	1	0.3%
107.37(a)	Yield right-of-way to aircraft	2	0.6%
107.37(b)	Avoidance of collision hazards with aircraft	3	0.9%
107.39	Operation over human beings	15	4.7%
107.39(a)	Operation over humans participating in sUAS operation	4	1.3%
107.39(b)	Operation over humans located in covered structure or vehicle	1	0.3%
107.41	Operation in certain airspace	15	4.7%
107.45	Operation in prohibited or restricted areas	8	2.5%
107.47	Flight restrictions in proximity of certain areas designated by NOTAM	14	4.4%
107.49(a)	Preflight assessment requirements	24	7.6%
107.49(b)	Responsibility to inform participants of flight operational details	1	0.3%
107.49(d)	Requirement to ensure adequate power for sUAS operation	1	0.3%
107.51(b)	Operational altitude limitations of sUAS	10	3.2%
107.65	Aeronautical knowledge recency requirements	21	6.6%
107.65(a)	Passing of Aeronautical knowledge test	2	0.6%
	Total 14 C.F.R. Part 107 Violations	**317**	**100.0%**

Table 2

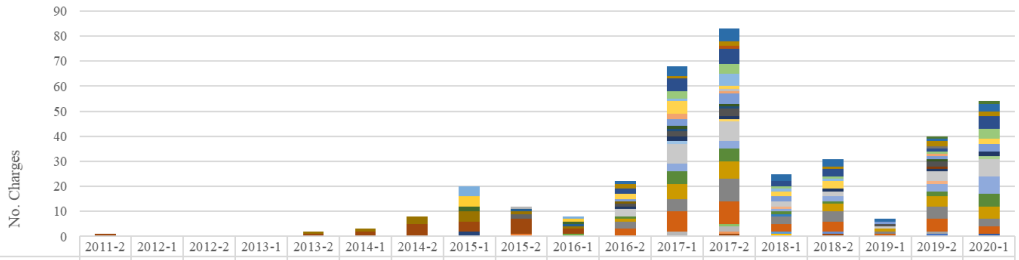
Census of Other (non-Part 107) Violations by Type

Violation	Description	No. Violations	Proportion
49 U.S.C. §46320(a)	Interference with wildfire suppression, law enforcement, or emergency response	1	1.5%
14 C.F.R. §47.3(b)	Requirement for registration	1	1.5%
14 C.F.R. §48.15(a)	Requirement to register	1	1.5%
14 C.F.R. §48.200(a)	Requirement to display registration unique identifier	1	1.5%
14 C.F.R. §48.205	Display and location of unique identifier	1	1.5%
14 C.F.R. §73.13	Prohibition to operate aircraft in a restricted area	1	1.5%
14 C.F.R. §73.83	Prohibition to operate aircraft in a prohibited area	2	3.0%
14 C.F.R. §91.13(a)	Prohibition to operate an aircraft in a careless or reckless manner	23	34.3%
14 C.F.R. §91.129	Requirements for Operation in Class D Airspace	2	3.0%
14 C.F.R. §91.131(a)	Operating Rules for Operation in Class B Airspace	11	16.4%
14 C.F.R. §91.131 (a)(1)	Requirement for receiving an ATC clearance before operating aircraft in Class B airspace	2	3.0%
14 C.F.R. §91.133 (a)	Prohibition to operation of an aircraft within a restricted area	3	4.5%
14 C.F.R. §91.137(c)	Prohibition to operate in a Temporary Flight Restriction area with NOTAM	1	1.5%
14 C.F.R. §91.145 (d)	Requirements for operation of aircraft near aerial demonstrations and major sporting events, with NOTAM	1	1.5%
14 C.F.R. §91.203 (a)	Civil aircraft certification requirements	5	7.5%
14 C.F.R. §93.337	Restrictions for operation in DC Special Flight Rules Area (SFRA)	5	7.5%
14 C.F.R. §93.339 (a)	Requirements for operation in DC Special Flight Rules Area (SFRA)	5	7.5%
14 C.F.R. §99.7	Compliance with Special Security Instructions	1	1.5%
	Total Violations	**67**	**100.0%**

When examining the trends of enforcement violations over time, in the early years preceding the release of Part 107, the FAA relied heavily on 14 C.F.R. § 91.13(a), prohibiting aircraft operation in a reckless manner, to address violations of sUAS regulations. To a lesser extent, the provisions of 14 C.F.R. § 91.131(a), Operating Rules for Operating in Class B Airspace, were also exercised. Violations involving 14 C.F.R. Part 107 grew heavily in 2017, before abating in 2018, with slight growth year-over-year until 2020. With the promulgation of Part 107 rules, violations of non-Part 107 regulations became less frequently used. See Figure 5.

Figure 5

Enforcement Violation Trends Over Time (Incident Dates, Six-Month Intervals, 2011-2020)



	2011-2	2012-1	2012-2	2013-1	2013-2	2014-1	2014-2	2015-1	2015-2	2016-1	2016-2	2017-1	2017-2	2018-1	2018-2	2019-1	2019-2	2020-1
107.65(a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
107.65	0	0	0	0	0	0	0	0	0	0	1	4	5	3	3	1	1	3
107.51(b)	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	0	2	2
107.49(d)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
107.49(b)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
107.49(a)	0	0	0	0	0	0	0	0	0	0	2	5	6	2	3	0	1	5
107.47	0	0	0	0	0	0	0	0	0	0	0	3	4	1	1	0	1	4
107.45	0	0	0	0	0	0	0	0	0	0	0	1	5	1	1	0	0	0
107.41	0	0	0	0	0	0	0	0	0	0	2	5	1	2	3	0	0	2
107.39(b)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
107.39(a)	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0
107.39	0	0	0	0	0	0	0	0	0	0	1	3	4	2	0	1	1	3
107.37(b)	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
107.37(a)	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
107.31(b)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
107.31(a)	0	0	0	0	0	0	0	0	0	0	1	2	3	0	0	1	2	0
107.31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
107.29(a)	0	0	0	0	0	0	0	0	0	0	1	2	1	0	1	0	1	2
107.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
107.27	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
107.25(b)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
107.23(a)	0	0	0	0	0	0	0	0	0	0	3	8	8	2	2	1	4	7
107.23	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
107.19(d)	0	0	0	0	0	0	0	0	0	0	0	3	3	1	2	0	3	7
107.19[c]	0	0	0	0	0	0	0	0	0	0	1	5	5	1	1	0	2	5
109.19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
107.13	0	0	0	0	0	0	0	0	0	0	1	6	7	0	3	1	4	5
107.12(b)	0	0	0	0	0	0	0	0	0	0	3	5	9	3	4	1	5	3
107.12(a)	0	0	0	0	0	0	0	0	0	0	3	8	9	3	4	1	5	3
107.7(a)(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
99.7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
93.339(a)	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0
93.337	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0
91.203(a)	0	0	0	0	0	0	0	0	1	0	0	2	2	0	0	0	0	0
91.145(d)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
91.137[c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
91.133(a)	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
91.131(a)(1)	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
91.131(a)	0	0	0	0	1	1	3	4	1	1	0	0	0	0	0	0	0	0
91.129	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
91.13(a)	1	0	0	0	1	2	5	4	6	2	0	0	1	0	1	0	0	0
73.83	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
73.13	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
48.205	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
48.200(a)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
48.15(a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
47.3(b)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
46320(a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Conclusions

Which Regulations are Most Frequently Prosecuted by the FAA in sUAS Enforcement Cases?

We determined that in the years prior to implementation of Part 107 regulations, violations of 14 C.F.R. 91.13(a) [careless & reckless operation] and 14 C.F.R. 131.131(a) [operating rules for operation in Class B airspace] were most commonly levied against sUAS violators. This trend would shift in late 2016, as the FAA implemented the Small UAS Rule. After 2016, careless and reckless operations were charged under 14 C.F.R. 107.23(a). Other common violations include 14 C.F.R. 107.12(a), requirements for manipulating sUAS flight controls; 14 C.F.R. 107.12(b), requirement to hold a remote pilot certificate; 14 C.F.R. 107.13, requirement for UAS registration; 14 C.F.R. 107.49(a) preflight assessment requirements; and 107.19(c), prevention of undue hazards to people, aircraft, and property. We assess that the FAA is primarily focused on enforcing only the most serious of sUAS violations, involving: (1) a grave threat to the safety of the NAS, (2) inadequate operator qualification, (3) a failure to register aircraft, or (4) a failure to perform required preflight duties to ensure safe operations.

What is the Timeline Associated with sUAS Enforcement Cases?

We lacked context to provide a complete assessment of factors affecting sUAS enforcement cases. But still, several observations about enforcement case timelines were made. Enforcement cases involving certificate actions were concluded relatively swiftly, with most cases concluding within a mean of 170 days and a median of 167 days. For enforcement cases involving civil penalties, the mean duration was 368 days and a median of 337 days. Based on these findings, it is reasonable that respondents can expect certificate actions cases to be concluded within approximately 6 months and civil penalty cases to be concluded within a year of the date of incident. Considering the complexity of investigating these cases, coupled with the relatively robust due-process protections for respondents, it is our opinion that this timeline is relatively swift. We reiterate that enforcement cases involving certificate actions were limited, which may limit inference.

What is the Typical Civil Penalty for a sUAS Enforcement Case?

We calculated that respondents were initially assessed a mean of $1,068 for each violation, with a median of $733 per violation. The settlement rate, or the average amount actually paid by the respondent was much lower—a mean of $498 per violations, with a median of $476 per violation.

When compared with FAA (2022b) guidance for enforcement actions, it seems the FAA is taking a relatively soft-handed approach to correcting sUAS violations. According to the Sanction Range Table, individuals acting as an aviator should receive civil penalties ranging from a minimum of $100 to a maximum of $1,644 (FAA, 2022b). Additionally, the FAA has established tempered sanctions to limit the extent of civil penalties resulting from multiple regulatory violations for a single act, provided the act was careless, and not reckless or intentional (FAA, 2022b). For individuals acting as an aviator, this ranges from a minimum civil penalty of $5,000 to a maximum of $20,000, dependent on the severity level of the violations (FAA, 2022b).

Assumptions & Limitations

This study was subject to several assumptions and limitations. First, data for enforcement cases involving certificate actions were extremely limited; and, we warn against making inferences from this data. Additionally, study findings are based on *historical* FAA enforcement cases, which may not necessarily represent or predict future enforcement cases. Moreover, the cases analyzed here were limited to concluded matters. Nothing in the dataset included documents related to pending litigation and it is unknown how many, if any, of those were outstanding. And relatedly, the dataset used for this study was exclusively obtained from FAA records and contained only case summaries. Records did not include any materials, statements, or other information from the respondent. We assumed information received from the FAA was accurate, complete, and contained a factual representation of the case. While case summary information was assumed to be factual, cases may lack complete context, alternative perspectives, or rationale/justification. We further assumed the FAA utilized a consistent, systematic process for evaluating case facts, assessing violations, and determining and assessing civil penalties or other sanctions. Finally, we presume the severity, value, or extent of levied sanctions in enforcement cases were reasonably correlated to the level of risk the action(s) of the respondent placed on the National Airspace System, as assessed from the perspective of the FAA.

Recommendations

Based on this study's analysis, we suggest three recommendations. First, the FAA should consider increasing public outreach efforts regarding its enforcement processes and data for UAS noncompliance. Consider, for example, the agency's recent approach to unruly airline passengers. Since a proliferation of unruly passenger incidents, beginning in 2021, the FAA has consistently publicized its efforts to enforce applicable federal regulations against unruly airline

passengers. This has included press releases with descriptions of the cases, fines levied, and specific facts leading to enforcement actions—for example, FAA (2021), *FAA fines against unruly passengers reach $1M*, and FAA (2022d), *FAA levies largest fines ever against two unruly passengers*. The agency has been especially transparent about a variety of unruly passenger enforcement related statistics, including the number of reports, investigations initiated, enforcement actions initiated, and civil penalty amounts (see FAA, n.d.-b). Considering the uniquely accessible nature of sUAS and the public's interest in their operation, the FAA should adopt this, or a similar, approach to sUAS enforcement transparency. Doing so may lead to a substantial improvement in public awareness of the agency's views towards sUAS noncompliance.

Second, and along this vein, the FAA should consider incorporating educational material about the enforcement process and expressly describing potential consequences for noncompliance into Part 107 initial and recertification training curricula. It is helpful for operators to be aware of the consequences for noncompliance. As then-U.S. Secretary of Transportation Anthony Foxx remarked in 2015, "Make no mistake: unmanned aircraft enthusiasts are aviators, and with that title comes a great deal of responsibility" (FAA, 2015b, para. 3). Part of ensuring awareness of such responsibility is informing operators, at the outset, of the rules and processes that govern—and ensure compliance with—all applicable sUAS federal aviation regulations.

Third and finally, future research should examine the FAA's use of its Compliance Philosophy in UAS enforcement cases. Under the FAA's Compliance Philosophy, the agency emphasizes "a non-enforcement approach… to ensure correction of regulatory noncompliance arising from flawed systems and procedures, simple mistakes, lack of understanding, or diminished skills" (FAA, 2022c, p. 1). In the agency's view, such actions "can be most effectively corrected through root cause analysis and training, education, or other appropriate improvements to procedures or training programs" (FAA Safety Team, n.d., p. 2). Unlike the cases analyzed in this study, "A compliance action does not involve adjudication and is *not* [emphasis added] a finding of violation" (FAA, 2022c, p. 1). Compliance Philosophy is an important component of the FAA's approach to regulatory noncompliance, but little is known about how the agency has applied this approach in the context of sUAS regulatory violations. While the cases analyzed in this study constituted regulatory violations worthy of legal enforcement action, there may be many other instances of sUAS noncompliance resulting from "flawed systems and procedures, simple mistakes, lack of understanding, or diminished skills" (FAA, 2022c, p. 1). And while this study found the FAA has consistently reduced the sanction as the result of a settlement agreements, nothing in this study's dataset reveals the extent to which the FAA has applied Compliance Philosophy principles to instances of sUAS operator noncompliance as. Indeed,

such analysis was outside this study's scope. Future research should seek to investigate this topic.

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