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**PUBLIC
INTEREST
COMMENT**

OPERATION AND CERTIFICATION OF SMALL UNMANNED AIRCRAFT SYSTEMS

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As part of the FAA Modernization and Reform Act of 2012 (FMRA), Congress ordered the Federal Aviation Administration (FAA) to integrate unmanned aircraft systems (UASs)—sometimes referred to as drones—into the National Airspace System (NAS) by September 2015.

The Technology Policy Program (TPP) of the Mercatus Center at George Mason University is dedicated to advancing knowledge of the impact of regulation on society. It conducts careful and independent analyses employing contemporary economic scholarship to assess rulemaking proposals from the perspective of the public interest. As such, this comment on the FAA's proposed UAS rule does not represent the views of any particular affected party or special interest group but is designed to assist the administration as it carries out Congress's mandate to safely integrate UASs into the National Airspace System.

SUMMARY

In this notice of proposed rulemaking (NPRM), the FAA proposes to adopt rules to integrate some small UASs into the national airspace. While this action is welcome, we believe it is unduly cautious in some respects. As far as possible, we advocate an environment of “permissionless innovation” to reap the greatest benefit from our airspace. The FAA's rules do

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not foster this environment. In addition, we believe the FAA has fallen short of its obligations under Executive Order 12866 to provide thorough benefit-cost analysis. We point out some shortcomings in the FAA's regulatory evaluation. Finally, we conclude with assorted comments on the FAA's proposed rules, including areas in which we support the FAA's approach.

PERMISSIONLESS INNOVATION AS A GENERAL APPROACH

We are currently living in an age of wondrous innovation. Among the most promising developments is commercial UAS technologies, which have captured the public interest for their potentially life-altering prospects. The entire economy stands to benefit in some capacity from this rapidly developing field of technology.

The FAA's proposed rules for UAS integration and commercialization place significant restrictions on some of the most beneficial aspects of this new and exciting technology. If the United States is to be a world leader in unmanned technologies, the FAA must adopt a flexible regulatory approach to this field. An overly precautionary approach will discourage the many benefits associated with this rapidly evolving class of aerial technologies.

As Mercatus scholars noted in an April 2013 filing to the FAA, "Like the Internet, airspace is a platform for commercial and social innovation."¹ Indeed, some of America's most innovative Internet companies, including Google,² Amazon,³ and Facebook⁴ are already experimenting with UASs. But it is impossible to know now what additional creative applications await. Only time and the freedom to experiment with new and better ways of using these technologies will provide an answer to that question. Unfortunately, these companies have so far been exporting their development of these technologies abroad because of the uncertainty of the regulatory environment here in the United States.⁵

That is why humility and flexibility must be the touchstones of the FAA's approach to these issues. A recent book by Adam Thierer highlighted the benefits of adopting a policy disposition

1. Jerry Brito, Eli Dourado, and Adam Thierer, "Comments of the Mercatus Center to Federal Aviation Administration in the matter of Unmanned Aircraft System Test Site Program," Public Interest Comment, Mercatus Center at George Mason University, Docket No: FAA-2013-0061, April 23, 2013, <http://mercatus.org/publication/federal-aviation-administration-unmanned-aircraft-system-test-site-program>; Eli Dourado, "The Next Internet-Like Platform for Innovation? Airspace. (Think Drones)," *Wired*, April 23, 2013, <http://www.wired.com/opinion/2013/04/then-internet-now-airspace-dont-stifle-innovation-on-the-next-great-platform>.

2. Alistair Barr and Greg Bensinger, "Google Is Testing Delivery Drone System," *Wall Street Journal*, August 29, 2014, <http://online.wsj.com/articles/google-reveals-delivery-drone-project-1409274480>; Thomas Claburn, "Google Has Plans For Titan Drones," *Information Week*, April 15, 2014, <http://www.informationweek.com/mobile/mobile-devices/google-has-plans-for-titan-drones/d/d-id/1204456>.

3. Harrison Weber, "Amazon Seeks Approval to Test Drone Deliveries in 30 Minutes or Less," *Venture Beat*, July 11, 2014, <http://venturebeat.com/2014/07/11/amazon-seeks-approval-to-test-prime-air-drone-deliveries-in-30-minutes-or-less>.

4. Issie Lapowsky, "Facebook Lays Out Its Roadmap for Creating Internet-Connected Drones," *Wired*, September 23, 2014, <http://www.wired.com/2014/09/facebook-drones-2/>.

5. Adam Thierer, "Global Innovation Arbitrage: Commercial Drones and Sharing Economy Edition," *Technology Liberation Front*, December 9, 2014, <http://techliberation.com/2014/12/09/global-innovation-arbitrage-commercial-drones-sharing-economy-edition>.

of “permissionless innovation” in this and other areas.⁶ This phrase refers to the notion that experimentation with new technologies and business models should generally be permitted by default.⁷

Permissionless innovation has been the primary driver of entrepreneurialism and economic growth in many sectors of the economy, most notably the Internet and the digital economy.⁸ As an open and lightly regulated platform, the Internet allows entrepreneurs to experiment with new business models and offer new services without seeking the blessing of regulators beforehand.

Generally speaking, this same model can and should guide policy decisions in other sectors, including the nation’s airspace.⁹ While safety-related considerations can merit some precautionary policies, it is important that those regulations leave ample space for unpredictable innovation opportunities. In light of this imperative, our comments focus on whether several of the restrictions in the proposed rule pass benefit-cost analysis, particularly when the unpredictable nature of innovation is taken into account.

INADEQUATE COST-BENEFIT ANALYSIS

Executive Order 12866 §1(a) states:

Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, *agencies should assess all costs and benefits of available regulatory alternatives*, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and *qualitative measures of costs and benefits that are difficult to quantify*, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should *select those approaches that maximize net benefits* (including potential

6. Adam Thierer, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom* (Arlington, VA: Mercatus Center at George Mason University, 2014).

7. Adam Thierer, “Why Permissionless Innovation Matters,” *Medium*, April 24, 2014, <https://medium.com/challenging-the-status-quo/257e3d605b63>.

8. Vinton Cerf, “Keep the Internet Open,” *New York Times*, May 24, 2012, <http://www.nytimes.com/2012/05/25/opinion/keep-the-internet-open.html>.

9. L. Gordon Crovitz, “Drones Cleared for Takeoff,” *Wall Street Journal*, <http://online.wsj.com/news/articles/SB10001424052702304914904579441052310129582>, March 16, 2014, (“Washington’s refusal to allow drones to take off is a reminder that most industries in the U.S. remain hostage to slow-moving, risk-averse regulators. The freedom to innovate without asking permission should become the rule for all U.S. industries, not the rare exception.”); Eli Dourado, “‘Permissionless Innovation’ Offline as Well as On,” *Umlaut*, February 6, 2013, <http://theumlaut.com/2013/02/06/permissionless-innovation-offline-as-well-as-on/>. (“Advocates of the Internet are right to extol the permissionless innovation model—but they are wrong to believe that it need be unique to the Internet. We can legalize innovation in the physical world, too. All it takes is a recognition that real-world innovators should not have to ask permission either.”)

economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach. [emphasis added]

While the FAA's NPRM is accompanied by a regulatory evaluation that includes benefit-cost analysis, the analysis does not meet the standard required by Executive Order 12866. In particular, it fails to consider *all* costs and benefits of available regulatory alternatives.

ALTERNATIVES THE FAA CONSIDERED

- In Alternative 1, the FAA considered and rejected the possibility of allowing small unmanned aircraft to conduct **external-load operations**. The FAA states that the flight characteristics of aircraft carrying external loads pose additional risks and “may require” airworthiness certification. However, the FAA supplies no discussion of the benefits of allowing small unmanned aircraft to conduct external-load operations (without airworthiness certification).

We believe that UASs carrying external loads would displace those loads from being transported by automobiles and trucks, and could therefore transform a multi-billion-dollar industry. While the FAA is concerned about the risks of parcels being jettisoned by UASs, additional automobile traffic on our roads has safety costs as well. Consequently, it is a benefit to society that UASs carrying external loads would reduce the rate of automobile accidents.

Nationwide there are 1.11 motor vehicle fatalities per 100 million vehicle miles traveled.¹⁰ To date, there have not been any reports of fatalities due to jettisoned parcels from UASs. Accordingly, parcel-for-parcel, it may be safer to transport goods via UAS external-load operations than to do so in the current manner on delivery trucks.

On our reading of Executive Order 12866, the FAA is required to explicitly make this comparison (“assess all costs and benefits”). Furthermore, as UASs are already being used in other jurisdictions, such as Germany, to transport goods, the FAA should take advantage of the experience in those jurisdictions to inform its analysis.¹¹ It seems unlikely that other governments are putting their populations in unbearable danger from jettisoning parcels.

- In Alternative 4, the FAA considered and rejected permitting a UAS operator “to exercise his or her **see-and-avoid responsibilities through technological means**, such as onboard cameras.” The FAA determined that the technology required to substitute for human vision does not yet exist. Proposed Rule 107.31

10. <http://www.iis.org/iis/topics/t/general-statistics/fatalityfacts/state-by-state-overview>.

11. Alex Hern, “DHL Launches First Commercial Drone ‘Parcelcopter’ Delivery Service,” *The Guardian*, September 25, 2014, <http://www.theguardian.com/technology/2014/sep/25/german-dhl-launches-first-commercial-drone-delivery-service>.

would therefore require an operator or observer “to see the unmanned aircraft throughout the entire flight.”

Washington Post reports that during the present rule-making period, “[i]t’s likely that . . . companies will make significant advances in sense-and-avoid technologies, which could make flying outside of a pilot’s line-of-sight safe.”¹² Intel demonstrated technology at CES 2015 that enabled their unmanned aircraft to avoid obstacles and other unmanned aircraft.¹³ Other companies are working on artificial intelligence that will provide the drones with the ability to “process visual data in real-time to avoid a tree, bird or building in their path.”¹⁴ By the time this rulemaking is complete, it is likely that technology will be available to commercial UAS operators to safely integrate their aircraft into the airspace without a visual line-of-sight (VLOS) requirement.

If the rules require UASs to operate within VLOS constraints, some of the greatest benefits of this technology will never materialize. For example, it will be impracticable to use UASs for delivery via line of sight. If the operator must move along with the payload, then the operator might as well carry the payload himself and dispense with the UAS. The FAA has not considered the benefits of allowing UASs to operate beyond line-of-sight, only the risks. Consequently, we believe that here, too, the FAA is operating outside of the requirements of Executive Order 12866.

- In Alternative 5, the FAA considered and rejected allowing small UASs to operate outside the **hours of official sunrise and sunset**, and Proposed Rule 107.29 would forbid operating “a small unmanned aircraft system except between the hours of official sunrise and sunset.” Daylight-only operational constraints do not take account of the ability for advanced sensor suites to compensate, even in dark conditions, for diminished line-of-sight. Regulations dictating the need for fluorescent markers or blinking lights—much the same as one would find on moored balloons and kites operating at night under FAA regulations (14 CFR 101.17)—would likely suffice to ensure adequate safety during night operations.

Again, the FAA did not explicitly consider the benefits of allowing nighttime operation of UASs. Thermal imaging could make UASs more useful for search-and-rescue operations during the night, when the ambient temperature is most different from human body temperature. There may be other cases, such as agricultural use, where nighttime operation is preferable. We believe the FAA is required by law to consider these benefits.

12. Matt McFarland, “Why Drone Enthusiasts Can Be Optimistic about the FAA’s Proposed Rule on Line of Sight,” *Washington Post*, February 17, 2015, <http://www.washingtonpost.com/blogs/innovations/wp/2015/02/17/why-drone-enthusiasts-can-be-optimistic-about-the-faas-proposed-rule-on-line-of-sight>.

13. *Ibid.*

14. *Ibid.*

ALTERNATIVES THE FAA DID NOT CONSIDER

- The FAA asserts that UASs are “aircraft” under 49 U.S.C. 40102(a)(6)’s definition of “any contrivance invented, used, or designed to navigate or fly in the air.” As 49 U.S.C. 44101(a) provides that “a person may operate an aircraft only when the aircraft is registered,” the FAA asserts that **registration of UASs** is required by statute.

We question whether this is really necessary under the law. For example, despite the fact that ultralight vehicles are contraptions used to fly in the air, 14 CFR 103.7(c) holds: “Notwithstanding any other section pertaining to registration and marking of aircraft, ultralight vehicles are not required to be registered or to bear markings of any type.” If the FAA may authorize an exemption from this requirement for ultralight vehicles, then it might also consider whether similar treatment is possible for UASs. We note that the FAA’s reading of the statute in this NPRM appears to also ban unmarked and unregistered paper airplanes.

If the FAA determines that it has more flexibility with regard to registration than it initially stated, then it must consider all the benefits and costs of requiring registration of UASs. We note especially the costs in terms of discriminating against foreign operators and investment in the US UAS marketplace. The requirement to register aircraft in the United States has the effect of limiting “the scope of this rulemaking to U.S.-registered aircraft” (NPRM at 43-44). To the extent the United States hopes to become a hub for UAS research and investment—as it has been for the Internet and other modern technologies—these restrictions must be relaxed. Elimination of the registration requirement, therefore, would increase foreign participation in the domestic UAS market, a clear economic benefit.

- The FAA asserts that federal statute prohibits the transportation of property by air for compensation without an **air carrier operating certificate**, citing 49 U.S.C. 44711(a)(4). The FAA notes that related sections of the law, such as 49 U.S.C. 44711(a)(1), which requires an airworthiness certificate, and 49 U.S.C. 44711(a)(2)(A), which requires an airman certificate, “do not take into account the considerations associated with civil small UAS” (NPRM at 24), occasioning the FAA Modernization and Reform Act and this rulemaking. In footnote 8, the FAA baldly asserts that the requirements of 49 U.S.C. 44711(a)(4) are nevertheless outside of the scope of this rulemaking.

We question this interpretation. If 49 U.S.C. 44711(a)(1) and 49 U.S.C. 44711(a)(2)(A) are open for modernization and reform through this rulemaking as authorized by the FMRA, then so ought to be the adjacent 49 U.S.C. 44711(a)(4). Therefore, the FAA should consider the benefits and costs of continuing its practice of applying the air carrier designation to UASs that transport property for compensation.

We do not believe there are significant benefits to this practice. The costs are substantial: the continued delay of the integration of UAS delivery services into

the airspace. As noted above, these services operate safely and profitably in other jurisdictions, such as Germany. Therefore, we urge the FAA to modernize this practice by not requiring air carrier certification for UAS-based services for commercial transportation.

- Proposed § 107.35 requires that “A person may not act as an operator or visual observer in the operation of **more than one unmanned aircraft system at the same time.**” The FAA does not consider the benefits of allowing fully or partially autonomous UASs to operate on the basis of a single operator for multiple aircraft. Such a rule would drastically lower the cost of operating a large fleet of unmanned aircraft. Existing and developing technologies can more than compensate for the diminished concentration that operators might apply to each individual aircraft.
- Proposed § 107.39 prohibits the **operation of small unmanned aircraft over people not involved in the operation.** The FAA does not consider the benefits of allowing UAS operations over persons not involved in the operation. We anticipate that many creative and valuable uses of UASs will develop in urban areas, where greater density enables higher benefits from drone-based transportation of goods.

Moreover, the FAA overstates the risks of operation in populated areas. Upon loss of positive control, unmanned aircraft can be programmed to safely return to a base, or to simply hover in place. The risk to bystanders can therefore be mitigated without a ban on operation over uninvolved persons. The FAA should therefore consider an alternative where operations over nonparticipants is allowed.

The FAA has also failed to conduct another important requirement of federally mandated cost-benefit analysis. Pursuant to OMB’s *Circular A-4*, issued in September 2003 to operationalize Executive Order 12866,¹⁵ “[a] clear identification of a range of regulatory approaches” is required “including the option of not regulating.”¹⁶ Agencies must also consider other alternatives to federal regulation, such as “State or local regulation, voluntary action on the part of the private sector, antitrust enforcement, consumer-initiated litigation in the product liability system, and administrative compensation systems.”¹⁷

The FAA has ignored such alternatives. For example, the agency should consider whether tort liability is sufficient to ensure that operations over nonparticipants are conducted with efficient levels of safety. UAS operators could simply be held liable in court for damages that they cause through accidents, much as automobile drivers can be held liable for their damages. Traditionally, the common law has dealt with products liability and accident compensation in an evolutionary

15. See Office of Management and Budget, *Circular A-4* (2003), available at <http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a004/a-4.pdf>.

16. *Ibid.*

17. *Ibid.*

way through a variety of mechanisms, including strict liability, negligence, design defects law, failure to warn, and breach of warranty.¹⁸ There is no reason to think that new legal standards for UAS-related controversies cannot evolve gradually through a body of common law cases, as they have for many other technologies.¹⁹

OTHER MATTERS

- We support the FAA’s proposed **micro UAS classification scheme**. However, we believe that it is unnecessarily conservative in some aspects. For example, under the FAA’s current proposal, operation would be limited entirely to Class G airspace, more than 5 miles away from an airport. As the FAA states, this limitation “would significantly reduce the risk of collision with another aircraft” (NPRM at 58). If the FAA also allowed operation at lower altitudes in other airspaces and closer to airports, there would be minimal added risk of in-air collisions.

For example, operation below 100 feet above ground level (AGL) even 1 mile away from an airport would pose little additional risk. Assuming that aircraft use an approach slope of or greater than 1.085 degrees, this less-conservative restriction would avoid any chance of a collision. As approach slopes are usually around 3 degrees, it seems possible to safely integrate micro UASs into airspaces less than 5 miles from an airport.

In addition, the restriction on the use of automation for micro UASs, although recommended by ARC and in place in Canada, seems short-sighted. We anticipate that autonomous UASs will be safer than human-piloted UASs and that the economic benefits associated with future automated systems will be significant. Therefore, we would urge the FAA to reconsider this restriction.

- We support the Secretary’s determination that small UASs should not be subject to **airworthiness certification**.

- We support the FAA’s proposal not to require UAS operators to obtain a **commercial pilot certificate**. We fully agree with the statement that “requiring persons wishing to operate a small UAS to obtain a private or commercial pilot certificate imposes the cost of certification on those persons, but does not result in a

18. See John Villasenor, “Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation,” Brookings Institution, 2014, at 7-14, <http://www.brookings.edu/research/papers/2014/04/products-liability-driverless-cars-villasenor>, archived at <http://perma.cc/UH34-9C4R>.

19. John Villasenor, “Who Is at Fault When a Driverless Car Gets in an Accident?,” *The Atlantic*, April 25, 2014, <http://www.theatlantic.com/business/archive/2014/04/who-is-at-fault-when-a-driverless-car-gets-in-an-accident/361250>, archived at <http://perma.cc/NWV9-2RWR>. (“[W]hen confronted with new, often complex, questions involving products liability, courts have generally gotten things right. . . . Products liability law has been highly adaptive to the many new technologies that have emerged in recent decades, and it will be quite capable of adapting to emerging autonomous vehicle technologies as the need arises.”)

significant safety benefit because the process of obtaining the certificate does not equip those persons with the tools necessary to mitigate the public risk posed by small UAS operations” (NPRM at 27-28).

- We were surprised to see that the proposed rules are being put forward **pursuant to § 333, and not § 332**, of the FMRA. Section 332(b)(1) refers to § 333 as enabling “expedited operational authorization.” Meanwhile, it is § 332 that directs the FAA to conduct a rulemaking.

The FAA has a statutory obligation to permanently integrate civil UASs into the airspace by September 30, 2015, pursuant to § 332. We question whether the FAA is moving fast enough to meet this obligation.

- The NPRM fails to provide clear **guidance on UAS activities of an academic, noncommercial, and humanitarian nature**. Drones have already been widely used for a wide variety of such activities, including search-and-rescue efforts, newsgathering, and even political activism. Such activities have clear life-enriching benefits that the agency fails to identify. Worse yet, by leaving their legal status uncertain, it could discourage such activities in the future. In the case of noncommercial newsgathering operations, we would remind the agency that First Amendment values might be implicated by overly restrictive regulations on such activities.²⁰

CONCLUSION

Until now, the vast majority of innovation in the UAS space has been occurring overseas. UASs could be one of the first emerging technologies in decades in which the United States does not possess a global competitive advantage in innovation and deployment. In many other countries around the world, including France, Germany, Australia, and Japan, blanket permission is granted to small drones weighing less than five pounds. These countries are already reaping the economic benefits of commercial drones.²¹

The FAA must carefully consider the potential effect of UASs on the US economy. If it does not, innovation and technological advancement in the commercial UAS space will find a home elsewhere in the world. Many of the most innovative UAS advances are already happening abroad, not in the United States. If the United States is to be a leader in the development of UAS technologies, the FAA must open the American skies to innovation.

20. Cynthia Love, Sean Lawson, and Avery Holton, “News from Above: First Amendment Implications of the Federal Aviation Administration Ban on Commercial Drones,” *Boston University Journal of Science & Technology Law*, forthcoming.

21. Joan Lowy, “Other Countries Are Surpassing the US in Commercial Drone Flights,” Associated Press, PBS.org, 10 December 2014, <http://www.pbs.org/newshour/rundown/countries-surpassing-us-commercial-drone-flights/>.