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Addressing the Regulator's Dilemma: A SELF DRIVE Framework for Balancing Safety and Innovation

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The SELF DRIVE Act prioritizes public safety over adherence to outdated requirements, giving innovators greater freedom to field-test new autonomous vehicle designs. Its underlying principles provide a framework for the intelligent regulation of rapidly growing technologies; regulators and policymakers hoping to encourage growth and innovation would do well to apply SELF DRIVE principles to other emerging industries, including the drone industry.

Suppose you've built a better mousetrap, and you're very proud of it. Rather than a simple spring-loaded bar, it has a net woven of carbon fiber. It detects the little critters through an intricate infrared sensor system. Your invention works wonderfully. It's a technological marvel. You're sure it will go on to revolutionize the way people everywhere rid their houses of pests.

However, as you begin to field-test your new product, you discover that the government has enacted strict mousetrap-testing regulations. They were created several decades ago, and they haven't truly been updated since.

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There are still requirements for how powerful the spring-loaded bar must be and for the maximum size of the weight-sensitive trigger—your invention, of course, has neither.

"Those are great regulations," you say to yourself. "But they were made for something else entirely! My mousetrap is safer, more humane, and more modern than those old spring traps, but these laws are keeping me from bringing my product to market."

You are not alone in your frustration. In fact, in technology sectors that are much larger than mousetraps—such as autonomous vehicles and drones—well-meaning but poorly created regulations can stifle innovation by trying to force new industries into old regulatory frameworks.

The autonomous vehicle industry is a prime example of a field that currently lies stranded in regulatory no man's land. The testing of these vehicles touches on highly debated and important topics ranging from cybersecurity and data privacy to highway safety. In the absence of a clear national protocol, many states have addressed these concerns by adopting their own regulations, which vary drastically. If you'd like to test an autonomous vehicle in New York, you'll need to pay for your own state police escort, something no other state demands.[2] And be sure to have a human operator ready to take the wheel—unless you're in Texas, where it's not required.[3]

The drone industry currently finds itself in similarly challenging circumstances. Drones offer a groundbreaking solution to problems in a wide variety of fields, including product delivery, mapmaking, and emergency response; however, regulations have stymied the industry's growth in the United States. In Part I, I discuss the challenges that are currently faced by autonomous vehicle and drone manufacturers, whose round-peg products are being forced into square-hole laws.

Fortunately, regulators and innovators are working

2 Public Protection and General Government (PPGG) Bill, Assemb. 3005, 2017 Assemb., Leg. Sess. (N.Y. 2017).

3 S. 2205, 85th Leg., Reg. Sess. (Tex. 2017).

together toward smarter, more flexible regulations. In Part II, I address the SELF DRIVE Act,[4] a piece of legislation approved in the House of Representatives in September of 2017, which would give manufacturers and researchers more latitude in testing their autonomous vehicles. The bill is currently awaiting a decision in the Senate. In this section, I claim that Congress should pass the SELF DRIVE Act, which will give innovators greater freedom to field-test new technologies by prioritizing public safety over adherence to outdated requirements.

I then argue, in Part III, that Congress should build on the successes of the SELF DRIVE Act by creating drone regulations based on the central principles of the Act. The Act emphasizes design safety, allows for more extensive testing of safe innovations, and lays groundwork for adaptive regulations. I demonstrate why these principles can and should be applied in drone regulation. Finally, I conclude in Part IV with a discussion of these same principles in light of other emerging industries.

I. Regulatory Effects on Innovation

To understand the importance of the SELF DRIVE Act and the necessity of similar legislation, it is instructive to first consider the effects that government regulation has on the technology sector, and particularly on emerging industries within that sector.

An emerging industry is one centered around an innovation, design, or idea that is new and holds transformative potential. The Internet, the smartphone, and the personal computer were all, at one point, new technologies that served as foundations of emerging industries which have since matured. In our modern society, hardly any aspect of our lives is untouched by recent advances in the relentless march of technological progress. The Internet of Things, autonomous vehicles, machine learning, and blockchain are

4 While I do feel strongly about the Act, the capitalization is not my own: the full title of the legislation is the Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act.

all nascent technologies driving emerging industries today.

The reliance by new industries on these emerging technologies creates a need for intelligent regulation of the technologies. The initial years of a technology's adoption are a critical period, during which regulation that allows for effective research and development is essential to the industry's success. Lawmakers and regulators create the rules for testing and deployment of new technologies, and these regulations can have unforeseen or unintended consequences—consequences that can cripple an industry or delay its growth.

The drone industry has experienced the stifling effects of early, aggressive regulation. As commercial drones were becoming more popular and more capable in the early 2000s, Congress created a policy stipulating that, to operate a commercial drone, a business needed a public sponsor (such as a public university) and a Certificate of Authorization; such certificates were approved only after substantial delays, if at all. With the FAA Modernization and Reform Act of 2012, Congress gave the FAA a mandate to update their commercial drone policies by 2015, a deadline the FAA missed.[5] During that time, innovators turned to overseas markets to develop their products. When the FAA granted an exemption to Amazon after delaying for nearly a year, the technology giant's vice president for global public policy, Paul Misener, told a Senate committee that the exemption was too little, too late. "We don't test [that design] any more," he testified. "We've moved on to more advanced designs that we already are testing abroad."[6] His next statement carries a caution to legislators hoping to maintain innovation and production on

5 FAA Modernization and Reform Act of 2012 § 332(a)(3) ("[The FAA must] provide for the safe integration of civil unmanned aircraft systems into the national airspace system as soon as practicable, but not later than September 30, 2015.").

6 Rupert Neate, *Amazon warns Congress: US risks being left behind in delivery drone business*, The Guardian (Mar. 24, 2015), https://www.theguardian.com/technology/2015/mar/24/amazon-congress-delivery-drone-faa-regulation.

American soil: "Nowhere outside of the United States have we been required to wait more than one or two months to begin testing."[7]

The Congress-required policy update was eventually issued by the FAA, but the rule change left untouched multiple policies that make widescale commercial adoption of drones simply infeasible. Unless granted a special exemptions, drones can't fly above 400 feet; they can't be used at night; they must be kept within sight during operation. Without greater opportunities for testing and operation, the drone industry continues to fight against regulatory resistance, at great cost: this legal battle delays the arrival of a drone-delivered boost to the US economy, estimated at $82 billion in the first decade alone.[8]

Despite the regulatory missteps endured by some industries, others have been given chances to prosper under less-obtuse regulations. The commercial human spaceflight industry has had a series of successful breakthroughs during the current "regulatory learning period"—a limitation on regulation, imposed by the Commercial Space Launch Amendments Act of 2004, that has given SpaceX and other companies enough leeway to test their new technologies with minimal government interference. As a consequence of that regulatory decision, the sector has flourished; SpaceX recently executed a successful launch of the most powerful operational rocket in the world.[9] While such a hands-off approach may not be the most appropriate course of action for autonomous vehicles or drones, which more directly affect public safety, those industries should also have thoughtfully structured and adapted regulations.

7 *Id.*

8 *Id. See also* Hans Joachim Heider, Michael Schallehn, Christoph Schlegel & Klaus Stricker, *An Autonomous Car Roadmap for Suppliers,* Bain & Co*. (Mar. 2, 2017),* http://www.bain.com/publications/articles/an-autonomous-car-roadmap-for-suppliers.aspx ("[T]he global market for autonomous driving and assistive safety and comfort features will be between $22 billion to $26 billion annually by 2025.").

9 *Falcon Heavy*, SpaceX, http://www.spacex.com/falcon-heavy (last visited Feb. 8, 2018).

Regulatory mistakes of the recent past heighten expectations for the SELF DRIVE Act, which is currently being deliberated in Congress. The Act promises to avoid the misregulation of the autonomous vehicle industry, a highly competitive and booming sector.

II. Passing the SELF DRIVE Act

The SELF DRIVE Act presents an opportunity for legislators to take a step forward toward smarter regulations. By offering less-stringent regulations to manufacturers who meet certain safety and performance standards, the legislature can doubly serve the public interest: first, through ensuring safety, and second, through incentivizing the testing and development of technologies with profound societal benefit.

The SELF DRIVE Act standardizes regulations of highly automated vehicles (HAVs)[10] across states, replacing the mess of inconsistent (or nonexistent) state regulations with a single, uniform, federal standard.[11] In addition, the Act contains important principles that should be followed as precedent in other technology industries. In this Part, I present three key ideas embedded in the SELF DRIVE Act that would contribute to its success; in the next, I will suggest how these ideas should be implemented in the drone industry.

10 "Highly automated vehicles" is the term used in the language of the SELF DRIVE Act to refer to what may in other contexts be called autonomous vehicles, self-driving vehicles, or driverless vehicles; for consistency with the legislation, HAV will be the term used here in the discussion of the bill.

11 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 3(1) (at proposed 49 U.S.C. § 30103(b)(1)) ("No State . . . may maintain, enforce, prescribe, or continue in effect any law or regulation regarding the design, construction, or performance of highly automated vehicles . . . unless such law or regulation is identical to a standard prescribed under this chapter.").

A. Safety First

The first key SELF DRIVE principle is the prioritization of safety. Opponents of the rapid adoption of HAV technology argue that the technology simply isn't safe enough yet, and that HAVs cannot be allowed on public roads until a more certain guarantee of their safety can be given. Regulators seemingly face a difficult dilemma, then: allow an unproven technology to potentially cause public harm through its premature adoption, or delay indefinitely its emergence through overly prohibitory regulation? The SELF DRIVE Act creatively solves that problem by permitting HAV manufacturers to test and validate new vehicles after they have sufficiently shown that the vehicles are safe.

The SELF DRIVE Act requires that HAV manufacturers document and submit to federal regulators their efforts at ensuring safety of HAVs and automated driving systems, as well as the results of those efforts. Any entity involved in HAV development must report "test results, data, and other contents . . . in order to demonstrate that such entity's vehicles are likely to maintain safety, and function as intended and contain fail safe features."[12] That is, in order to qualify their vehicles under updated federal motor vehicle safety standards, HAV manufacturers must prove to the Department of Transportation, after performing their own testing, that their vehicles are reliable and safe.

The creation of a method for that vehicle safety evaluation is also described in the Act, which provides a mandate that the Secretary of Transportation create a "rulemaking and safety priority plan."[13] That plan in part, must "identify elements [of the HAV] that may require performance standards

12 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 4(a) (at proposed 49 U.S.C. § 30129(a)(1)(B)).

13 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 4(a) (at proposed 49 U.S.C. § 30129(b)(1)).

including human machine interface, sensors, and actuators."[14]

Modern vehicle safety extends beyond crashworthiness and physical protections; as the capacity for computerized control of vehicles increases, so does the opportunity for malignant control or hijacking of those vehicles by third-party hackers. Accordingly, the SELF DRIVE Act additionally requires that manufacturers submit a cybersecurity plan for "identifying, assessing, and mitigating reasonably foreseeable vulnerabilities from cyber attacks."[15]

The safety regulations included in the SELF DRIVE Act ensure that HAVs won't be tested on public roads until their manufacturers can prove, to the satisfaction of the requirements created by the DOT, that the automation does not create an additional hazard to the general public. That safety hurdle goes a long way toward assuaging the fears of the technology's opponents and increasing the general public's trust of the technology.

B. Leaving Old Rules Behind

The SELF DRIVE Act also prepares automated driving technology for full adoption by allowing for the testing and development of HAVs that are unlike the vehicles we see today in key ways. Future HAVs with no human operator will have no need for human-operable features such as steering systems, pedaled acceleration and braking systems, or mirrors. Legislation that attempts to fit HAVs into the regulatory frameworks of traditional vehicles will find itself burdening a promising young industry with vestigial requirements. The SELF DRIVE Act makes important strides toward freeing the HAV industry from unnecessary mandates.

To accomplish this aim, the Act expands the existing safety standard exemption system: under its new rule,

14 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 4(a) (at proposed 49 U.S.C. § 30129(b)(2)(B)).

15 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 5(a) (at proposed 49 U.S.C. § 30130(a)(1)(A)).

HAV manufacturers can apply to be exempt from particular safety standards after demonstrating that their replacement feature (or the vehicle as a whole) is at least as safe as the standard feature (or a nonexempt vehicle). The Secretary of Transportation is permitted to issue such exemptions if "the exemption would make easier the development or field evaluation of" an HAV or an autonomous feature.[16] The maximum number of yearly safety standard exemptions is raised to 100,000, a 40x increase over the current restriction.[17]

To qualify for an exemption, an HAV manufacturer must—beyond justifying the necessity of such an exemption for "development or field evaluation"[18]—submit an extensive application. A "detailed analysis that includes supporting test data, including both on-road and validation and testing data"[19] must be included.

In other words, the SELF DRIVE Act offers an incentive and a compromise. An HAV manufacturer that develops an innovation contrary to current safety standards can test the new design on its own; once enough data have been gathered to prove that the updated feature or vehicle is as safe or safer than it would have been under the safety standard, federal regulators will allow the HAV to be driven and field-evaluated on public roads.

This new regulatory system, made malleable by a strict but encompassing exemption program, keeps the roads at least as safe as they are now; it gives HAV manufacturers reason to test and prove the safety of their vehicles; and it provides room for those same manufacturers to push the boundaries of automated technology in a prudent, protected way.

16 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 6 (at proposed 49 U.S.C. § 30113(b)(3)(B)(v)).

17 *Id.* at proposed 49 U.S.C. § 30113(d)(3).

18 *Id.*

19 *Id.* at proposed 49 U.S.C. § 30113(c)(5)(B)).

C. Room to Grow

The third important principle embodied in the proposed SELF DRIVE Act is foresight: the Act acknowledges the quickly evolving nature of the emerging industry and establishes a structure for regulation to keep up with the anticipated changes.

An HAV Advisory Council is established within the National Highway Traffic Safety Administration to "undertake information gathering activities, develop technical advice, and present best practices or recommendations to the Secretary" on a variety of current issues in autonomous driving, from environmental impacts to cybersecurity.[20] The Council's recommendations are also passed to subcommittees of both the House and the Senate. In addition, multiple segments of the SELF DRIVE Act stipulate that the rules determined by the Secretary of Transportation be reviewed and updated, as necessary, at fixed intervals.[21]

The challenge of predicting the advent or growth of new industries makes technology regulation difficult. Regulators need to include room for growth and flexibility in their legislation so that the implementation of the regulations can develop alongside the industry. Ideas such as the HAV Advisory Council provide a method by which the regulation can be accompanied, evaluated, and changed when made necessary by unforeseen consequences or adapting industrial circumstances.

D. An Imperfect Solution

The SELF DRIVE Act is not a perfect piece of legislation, and it does not solve all of the issues currently facing the autonomous

20 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 9(e).

21 *See* SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 4(a) (at proposed 49 U.S.C. § 30129(a)(3)) ("Not later than 5 years after the date on which the final rule is issued under paragraph (1), and not less frequently than every 5 years thereafter, the Secretary shall—(A) review such rule; and (B) update such rule if the Secretary considers it necessary.").

driving industry. The Act leaves ambiguity in some areas, such as in determining exactly which HAV features need to be reported on by manufacturers in their safety assessment certifications. In addition, regulators in the Department of Transportation are under high pressure to determine what constitutes a truly safe vehicle.

However, despite its weaknesses, the Act presents an immediate remedy to critical problems facing an important industry. By incentivizing safety, allowing exploration, and anticipating evolution, the SELF DRIVE Act removes roadblocks in the path of the HAV industry and pushes it forward into the next phase of growth, development, and impact.

III. Applying SELF DRIVE to the Drone Industry

The underlying principles of the SELF DRIVE Act should serve as guidelines for regulation of other emerging technology industries. In this Part, I suggest some methods of implementation of SELF DRIVE principles in the drone industry. Following the convention of relevant legislation, I use the term unmanned aviation system (UAS) to refer to a drone or a plurality of drones.[22]

A. UAS Safety

As in the HAV industry, and generally in the technology sector, safety should be of highest concern when considering the regulation of UAS. How can the principles of SELF DRIVE create UAS regulations that compel manufacturers to value safety?

To begin, UAS manufacturers must be required to submit safety plans and reports to the FAA, in the same way that HAV entities submit similar reports to the DOT.

22 FAA Modernization and Reform Act of 2012 § 331(9) ("The term 'unmanned aircraft system' means an unmanned aircraft and associated elements (including communication links and the components that control the unmanned aircraft) that are required for the pilot in command to operate safely and efficiently in the national airspace system.").

Manufacturers must be able to demonstrate to the federal government that their machines "are likely to maintain safety, and function as intended and contain fail safe features."[23]

The FAA must more specifically define which features are regulated. It should look to the example of the National Highway Traffic Safety Administration, which in September 2017 released a document entitled "Automated Driving Systems: A Vision for Safety 2.0."[24] This federal guidance describes 12 "ADS Safety Elements," covering the most pressing technical issues facing automated driving systems.[25] For each of the 12 elements, it provides implementation suggestions and defines standards. Among the enumerated safety elements are many with analogous utility in the UAS industry.

UAS legislation must require that, for their UAS designs to be qualified as safe, manufacturers be able to report on key questions relevant to those safety elements, including:

- Operational Design Domain: Where, when, and under what conditions is the UAS able to operate? For example, can it be flown at nighttime? In rainy weather? Over urban landscapes?
- Object and Event Detection and Response: How does the UAS recognize and react to stationary objects, such as buildings or trees, during normal flight? How does it behave during foreseeable collision events, such as a bird or other UAV entering its path of flight?
- Fallback (Minimal Risk Condition): What is

23 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 4(a) (at proposed 49 U.S.C. § 30129(a)(1)(B)).

24 U.S. DEP'T OF TRANSP., AUTOMATED DRIVING SYSTEMS: A VISION FOR SAFETY 2.0 (2017), https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf.

25 *See id.* at 5-15.

the UAS response to a sudden emergency or to a situation in which it is unable to operate safely? How does it respond to sudden loss of communication with its controller, if applicable? In an unexpected scenario, will it descend slowly and safely? Will it hover in place while power remains?

- Cybersecurity: How does the UAS react to attempted control by an unauthorized third party? What hardware and software protections are in place to prevent takeover?

By mandating that UAS manufacturers test and report on the safety of their UAS, similarly to the SELF DRIVE Act, new regulation can ensure the protection of the public.

B. Trusting Safe UAS

The exemption system implemented by the SELF DRIVE Act legislates a measure of trust between regulators and innovators: in return for proving a certain standard of safety, manufacturers will be allowed a longer leash to design, invent, and test. The UAS industry deserves a similar treatment.

Current UAS regulations have constructed a delay-prone exemptions process under 14 C.F.R. Part 107 Subpart D, which authorizes the Administrator of the FAA to "issue a certificate of waiver authorizing a deviation" from any of a select set of UAS regulations.[26] In order to receive such a waiver for "a proposed small UAS operation," a manufacturer must supply a "complete description of the proposed operation and justification that establishes that the operation can safely be conducted under the terms of a certificate of waiver."[27] This stipulation is both overly constraining and dangerously vague.

26 14 C.F.R. § 107.200(a) (2017).

27 14 C.F.R. § 107.200(b) (2017).

The language of the law calls for a waiver only for a certain proposed UAS operation, which limits manufacturers: they are required by law to describe exactly the function of the UAS and the operation it will perform in order to receive a waiver. There is little room for adaptation during testing. And calling for a "justification" that the proposed operation can "safely be conducted" is broad: what is included in this justification? Should testing and analysis data be shared? Should prototypes and working UAS demonstrations be required, or are designs and models enough?

Both of these issues can be settled by a single solution: before granting an exemption, require that UAS manufacturers demonstrate, through testing and data, that their machine meets the safety requirements described above. Once those requirements are satisfactorily met, along with any additional requirements determined by the FAA, a waiver should be given—but without limiting the exemption to a single predetermined operation. Once a manufacturer has performed exhaustive internal testing and experimentation on its design, and demonstrated its safety to the FAA, the FAA should offer exemptions for any reasonable operation.

C. Planning for Expansion

Like HAVs, the UAS industry is poised for rapid growth as innovators find more uses for the technology in both recreation and commercial purposes. The evolution of the industry will warrant consistent review and revision of its regulations.

An October 2017 Presidential Memorandum established a UAS Integration Pilot Program, in which the FAA is instructed to "test and evaluate various models of State, local, and tribal government involvement in the development and enforcement of Federal regulations for UAS operations."[28] The Memorandum creates a process by which governments apply

28 Memorandum on Unmanned Aircraft Systems Integration Pilot Program, 2017 Daily Comp. Pres. Doc. (Oct. 25, 2017), https://www.whitehouse.gov/presidential-actions/presidential-memorandum-secretary-transportation. *See* Sec. 2(b)(i).

to participate in the Pilot Program and allows for exemptions as prescribed in 14 C.F.R. Part 107 and described above.

The Memorandum is a sign of progress toward intelligent UAS regulation; one principal purpose of the document is to "inform the development of future Federal guidelines and regulatory decisions on UAS operations nationwide."[29] However, the regulatory experimentation created by the Memorandum raises serious concerns.

First, the Memorandum's actions are not broad enough in their scope. The UAS industry has lost years already waiting for regulatory action, and piecemeal construction of new regulations, jurisdiction by jurisdiction—the Pilot Program is required to enter into agreement with only five jurisdictions in its first six months—is not enough. A sweeping adoption of definite regulations, as implemented by the SELF DRIVE Act for HAVs, is required to kickstart the emerging industry. Additionally, the regulation runs the risk of creating a tangle of distinct regulations, such as the mess in which HAV manufacturers currently find themselves, stumbling to determine state- or city-specific rules. A strong central policy is essential for continuity in new technology.

To further encourage expansion, new UAS regulations should establish an advisory council, like the one created by the SELF DRIVE Act, to allow for UAS regulators to adjust exemption requirements. The council will allow for the anticipation of future uses of the technology, through research done by council members and affiliates.

The SELF DRIVE council comprises a "diverse group" of researchers, government authorities, safety and consumer advocates, engineers, labor organizations, environmental experts, and anyone else the Secretary of Transportation chooses.[30] This diversity of experience and background is also essential on a UAS regulations advisory council in order to anticipate

29 *Id.* at Sec. 2(b)(ii).

30 SELF DRIVE Act, H.R. Res. 3388, 115th Cong. § 9(b).

and react to the broadest array of industry developments.

IV. Looking Forward, Looking Outward

To stimulate growth in the HAV industry, Congress should pass the SELF DRIVE Act. The Act is committed to safety as a first priority; it provides innovative entities opportunities to research, test, and develop new HAV designs; and its flexibility and forward-thinking design will guide industry regulation beyond only the near future.

Perhaps most importantly, the Act serves as a benchmark for the regulation of other industries. Here, I have suggested that the UAS industry receive the same regulatory treatment that the SELF DRIVE Act could give autonomous vehicles, and I've indicated how several of the key principles of the Act should be applied in considering such regulation.

However, the positive effect of the SELF DRIVE Act will be maximized as legislators, regulators, and innovators alike consider that drones are only one of numerous industries that stand to gain from safe, smart, flexible legislation. SELF DRIVE principles need to be applied to regulation of other emerging technologies. Examples of emerging fields that could benefit from SELF DRIVE-like regulation include the sharing economy and peer-to-peer exchange; the Internet of things; smart infrastructure; and 3-D printing.

Predicting which industry will be the next game changer is not the task of legislators and regulators; however, theirs is the responsibility to shape our regulatory framework in such a way that allows for innovators and actors in the technology space to push society into the future. The SELF DRIVE Act is a clear step toward that ideal.