Context Note

Purpose:

The purpose of this document is to increase awareness of the challenges facing UAV implementation in the precision agriculture industry and to discuss possible solutions. Although many drone enthusiasts understand how FAA policies affect consumer UAVs, few of them realize how the same legislation reduces efficiency and usability in the agricultural sector. Discussions over possible changes in policy are constantly ongoing in order to keep introducing new ideas. Therefore, the inclusion of additional content to this conversation will have a wide viewership and make the real-world effects of the FAA's uncompromising stance more visible.

I will achieve this purpose by including evidence which supports the idea that the FAA has made it very difficult to introduce new vehicles into the market, specifically in regards to the Yamaha RMax. Additionally, I will then discuss a potential solution which can quickly be implemented and will be favorable to the customers. I will propose that it would be best for companies to make smaller drones guaranteed to pass FAA legislation but which have a unified software package and user interface so that they can process data more efficiently. They will also be easier to install and debug. I will use several drones which have been approved by the FAA as evidence that this proposal will work well for all involved parties.

Genre:

The genre of this document will be an online article. This is the best means to convey the information desired because although the document will not be a formal research paper, it will still have some technological sophistication. In addition, drone communities are found almost exclusively online due to the existence of forums, blogs, and journals documenting aviation advice. Other options, such as brochures and videos, would be too focused on imagery when the primary content of the document is discussing legislation in written form. Although videos are another popular format through which to discuss drones, they are generally used mostly for project design and usage. Since the purpose of this document regards UAV legality rather than UAV design, an article can better express the content that is important to the audience.

Motive:

The motive of this document is to convince the audience that the most pressing issues facing the industry today are FAA restrictions, specifically on UAVs in precision agriculture. Although civilian drones can be useful for a number of reasons, they are mostly purchased for entertainment. In contrast, drones in agriculture can ease the burden of human labor and increase

crop yield. UAVs in agriculture have no serious drawbacks, so it is more beneficial to at least introduce UAVs in a meaningful way to the consumer base. To achieve this, horizontal integration will be described as a technique which can quickly lead to progress on the implementation front while remaining favorable to the designers.

Audience:

The audience of this document will be the viewership of newatlas.com, a website catering to general technology enthusiasts. Although this article can be placed on any number of drone-specific websites, the purpose of the paper regards more than just UAV technology. It relates to topics in precision agriculture as well as legal discourse, and so it is slightly more varied in its subject matter. The website newatlas.com deals with such variegated topics which pertain to a number of different fields. It has also published articles on drones in the past which have similar purpose and persona to my intention for this document. The readership of this website would therefore be general technology enthusiasts. This paper will not be extremely technical, so it will not be limited to only UAV hobbyists. Their major interest is how the civilian population will use these drones, so the paper will be oriented mostly towards user benefits as opposed to corporate or governmental interests. The paper is indirectly also aimed at defense companies which control most UAV manufacturing within the US, but as this is an informal article and not a proposal, the best way to reach those corporations is to raise awareness in the community which forms most of their consumer base.

Persona:

The persona I will be adopting for this document is less formal than a technical paper, but still suitable for an assertive tone in an article. The language of these documents is confident, to indicate that all approaches to the problem have been considered. Second-person POV will be used in order to bridge an area between informal and formal language. Data will also be used the throughout the paper with the purpose of conveying the significance of the subject matter. Hyperlinks will be used in place of formal citations, as they are more interactive and easier to follow. They will be marked by standard hyperlink format, with blue text and underlined font. In addition, graphics will also be attached, only as visual aids to points directly preceding their location in the article.

Overall, the document will be in the format of most online articles. It will have a large, bold headline followed by the author's name and date and an initial image. Paragraph length will vary, as it is often easier to follow text which does not appear to be entirely uniform. There will

be several subheadings to also aid with that goal, indicated by a larger text size. Multiple colors will not be used, but italics or bold highlights may be used at certain points to indicate significance.

Citations:

1. DJI. (2017, March). “Availability of the DJI Agras MG-1S.” Retrieved from https://www.dji.com/newsroom/news/availability-of-the-dji-agras-mg-1s
2. E. Borgogno Mondino & M. Gajetti (2017). “Preliminary considerations about costs and potential market of remote sensing from UAV in the Italian viticulture context.” *European Journal of Remote Sensing, 50*(1), 310-319
3. Freeman, P.K., & Freeland, R.S. (2014, December). “Politics & technology: U.S. polices restricting unmanned aerial systems in agriculture.” *Food Policy, 49*(1), 302-311
4. Freeman, P.K., & Freeland, R.S. (2015, December). “Agricultural UAVs in the U.S.: potential, policy, and hype.” *Remote Sensing Application: Society and Environment*, *2*, 35
5. Hanlon, M. (2004, June). “Yamaha's RMAX - the worlds most advanced non-military UAV” *New Atlas*. Retrieved from https://newatlas.com/yamahas-rmax-the-worlds-most-advanced-non-military-uav/2440/
6. Marinello, F., Pezzuolo, A., Chiumenti, A., & Sartori, L. (2017, May 27). Technical Analysis of Unmanned Aerial Vehicles (Drones) for Agricultural Applications.
7. Martinez, K. (2019). “Best Agricultural Drones 2019 – Reviews and Specs.” *Dronethusiast*.
8. (n.d.). Percentage of Small Medium and Large Farms in the U.S. Retrieved from https://www.usfarmdata.com/percentage-of-small-medium-and-large-farms-in-the-us
9. (n.a.) (2013, April). “Field work” *The Economist*. Retrieved from https://www.economist.com/asia/2013/04/13/field-work
10. (n.a.) (2018, March). “Yamaha R-MAX (Rotary-MAX).” *Military Factory*. Retrieved from https://www.militaryfactory.com/aircraft/detail.asp?aircraft_id=1945
11. Szondy, D. (2013, June). “UC Davis investigates using helicopter drones for crop dusting.” Retrieved from https://newatlas.com/uav-crop-dusting/27974/

UAVs in Agriculture: The Most Significant Current Issue in the Drone Industry

By: Parth Parekh
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UAVs are internationally well-known for a variety of reasons, both good and bad. While many civilians associate the term with the small, portable devices which can be bought cheaply and have wildly different functionality from model to model, governments more traditionally associate it with warfare applications. The Unites States, in particular, is focusing on developing drones for military usage, as they are perfect devices for missions that would otherwise endanger pilots. Therefore, the US government views the UAV industry in general as a defense industry, and has introduced wide-ranging restrictions on civilian drones while awarding manufacturing contracts only to large defense companies, such as Lockheed Martin and Boeing. Every drone enthusiast knows this well. Products launch internationally but are delayed for years in the US.

The discussion today, though, specifically concerns UAVs in the agriculture industry. Although drones for civilian applications are important, we are not the audience most expectant for the day when the FAA loosens their laws. Every year that UAVs are not implemented in agriculture, the US is estimated to lose upwards of $10 billion. This is no small number to the farmers who make up the majority of the agricultural industry. In addition, UAVs greatly increase crop yield and optimize growth potential; their benefits are nearly limitless.

The Problem: The FAA

In stark contrast to the FAA's position on the matter, the majority of published research clearly indicates that innovation in precision agriculture will lead to much higher crop efficiency. UAVs have a number of attractive qualities. Their focus on a small area can capture images with much higher resolution than satellites are capable of. They can process data such as crop and soil quality in-flight and subsequently determine risk mitigation plans. The post-processing of data by hand upon the drone's return can lead to observations of crop type, land mapping, and biomass totals. In addition, they can greatly ease physical human labor because they are highly efficient at crop spraying operations, which can take many long hours to do otherwise.

However, the FAA does not see it this way. What they see are drones capable of carrying liquid chemical payloads around and intruding on federal airspace. In addition, they believe that drones can be used to invade privacy. It has been made very difficult for customized drones to

enter the industry. Instead, most companies are designing small packages which fall under FAA legislation but are not solely capable of carrying out all the tasks they are required to on a farm. Only one drone weighing over 55 lbs. has been approved for sale in the US.

That machine, the Yamaha RMax, was granted permission to be freely sold in California. This was initially seen as a huge step for the industry because the massive mini-helicopter was delayed from entering the country for twenty years. Over that time period, over a dozen countries worldwide redesigned their own agricultural sectors to rely on the RMax. In Japan, nearly 90% of aerial crop dusting is now done with the RMax, covering 1 million hectares of farmland. What's especially notable is that government data indicates the average size of a farm in Japan is just 2 hectares while the average farm size in the United States is 180 hectares. If the RMax is worth the cost for the average Japanese farmer, its value increases massively if it retails for the same price in the US.

The Yamaha RMax: The mini-helicopter UAV that revolutionized the precision agriculture world.

Unfortunately, it is not all good news. While widely seen as a gesture of the FAA loosening its policies, it would be much more accurate to see it as a position where the government realized it was severely behind the rest of the world and then granted permission to the safest device possible. The RMax does not pass most FAA regulations but has collected 2 million flight hours over twenty years, with very few recorded malfunctions. It was also authorized for sale only in California so far, with the expectation that the FAA will continue rolling it out to each state individually. This is a poor precedent: must every drone first operate for two decades around the world before they can even reach the US? Furthermore, it would be nearly impossible to design an all-in-one UAV which actually follows FAA policies. The RMax maximum payload is 200 lbs., nearly 4 times over that of the mandated limit. No one can just find an extraneous 145 lbs. to shave off.

It is also not optimal for companies to continue releasing small drones which do not appeal to the market, because farmers then feel forced to buy multiple drones with different hardware and software interfaces. This makes it very difficult and expensive to organize data.

Instead, there exists a much more efficient solution which serves the dual purpose of being able to pass FAA legislation and appeal to the agricultural sector as a product which they can rely on.

The Solution: Horizontal Integration

The method which companies around the world should begin implementing is one of horizontal integration. It is not smart to spend years of time developing a machine which the FAA will just have to see once to slap on a rejection. This slows down the implementation of UAVs in agriculture and reduces the benefit for the farmers. Instead, all the capabilities should be spread out to a line of drones which each serve one purpose. One drone will specialize only in handling camera systems. One drone will specialize only in crop spraying. One drone will specialize only in moisture and disease analysis. Then, the user should be able to gather the data sets of all these drones and unify them onto a single plot to make decisions by.

This approach allows numerous advantages for farmers. Instead of compromising on the quality of the analysis tools to fit everything onto a single drone, these individual UAVs can each be the best of their category. Every company out there has been trying to fit as many things as possible onto a single unit, but they no longer need to do that. Farmers just want to be able to deploy drones to ease their own labor and to increase their crop yield. The drone they purchase to accomplish that goal is chosen by low price and high efficiency. Horizontal integration can achieve meet those standards.

For example, the DJI Agras MG-1 is the fastest crop-spraying drone in the world, 12 times faster than the Yamaha RMax. It is allowed to be sold in the US because the FAA saw very few problems with this model: it was light and had a flight time of only 10 minutes. The FAA approved of the low flight time while the farmers appreciated the high efficiency.

The DJI Agras MG-1 octocopter: The fastest crop-spraying drone in the world.

The best part about this strategy is it would take very little time for a company to adopt it. Drones like the Agras MG-1 are inexpensive and can easily be manufactured. Of course, companies would have to spend some time on the software packages integrating everything together, but it would still be much less time than it would take to build an all-in-one drone which the FAA will approve. This is not an opinion - it is a fact.

Considering the current record-holder for fastest all-in-one drone to reach the market is the RMax with a whopping twenty years, it is unlikely that bigger changes will be occurring any time soon.

UAV companies should step up to the task the country are confronted with and deliver those products which represent the only possible solution at this time. Horizontal integration represents the only approach which can solve the problem right at this moment. If you're reading this at Boeing, Lockheed, or Northrop, start taking notes. It's time to make the difference.