

**United States Senate
Committee on Commerce, Science and Transportation**

***The Future of Unmanned Aviation in the U.S. Economy:
Safety and Privacy Considerations***

January 15, 2014

**Statement of
Henio Arcangeli
Vice President of Corporate Planning
Yamaha Motor Corporation, U.S.A.**

Chairman Rockefeller, Ranking Member Thune, and members of the Committee, good afternoon. My name is Henio Arcangeli. I am Vice President of Corporate Planning for Yamaha Motor Corporation, U.S.A. I appreciate this opportunity to discuss the important agricultural services performed by our remotely-piloted helicopter, the Yamaha RMAX, and our desire to offer these same essential services to farmers, growers, and land managers in the United States.¹

Yamaha is based in Cypress, CA and has extensive manufacturing and business facilities throughout the United States, where we design, engineer, manufacture and distribute a wide range of consumer products, including motorcycles, ATVs, snowmobiles, boats, outboard engines, and golf carts, just to name a few. Yamaha has over 2,800 full-time employees, and our products are sold by thousands of authorized dealers and small businesses nationwide.

The Yamaha RMAX helicopter is controlled by trained, on-site operators using a handheld radio transmitter with a communications range of about 500 feet. The RMAX weighs 140 pounds, is 9 feet long, and uses a specially designed 2-cylinder engine that sounds like a small motorcycle when operating.²

For over 20 years, remotely piloted RMAX have been safely used for precision crop dusting, “spot spraying,” weed and pest control, and fertilization in Japan and, more recently, Australia and South Korea.³ The RMAX is only operated within a pilot’s line of sight, during

¹ Exhibit 1.

² Exhibit 2.

³ The RMAX can dispense both liquid and granular spray using different tanks that attach to the unit. The capacity for liquids is about 4.25 gallons and about 7 gallons for granular applications.

daylight hours, at slow speeds of 12 mph or less, at altitudes of about 16 feet. This is lower than where most kites fly, and far below the airspace in which manned aircraft operate (generally 500 feet or higher) – and where “sense and avoid” and other safety-related technologies may be necessary.

Over 2,600 remotely-piloted RMAX are in operation today, treating more than 2.4 million acres of farmland each year in Japan alone.⁴ This roughly equivalent to treating the entire states of Delaware and Rhode Island, combined. For many applications, the RMAX has proven to be far more economical and effective than other spraying methods, helping farmers increase productivity at lower costs using less chemicals.

There is mounting commercial interest and need for the RMAX from farmers and growers in this country. For example, recent testing at the world’s largest almond and pistachio farm just outside of Bakersfield, CA showed the RMAX would be ideal for treating against the navel-orange worms that threaten this \$4 billion-a-year industry. The worms infest the top of tree canopies, making treatment by conventional ground spraying methods difficult and inefficient.

Similar testing in Napa Valley showed that the RMAX can treat up to 11 acres of vineyards in the same time a conventional tractor can cover about 1.5 acres -- without exposing a

⁴ In Japan, many farms are very small – 5 acres or less – and by necessity are situated closer to areas where people work and live. The RMAX was designed to serve these small farms more safely, and with greater precision, than a manned aircraft could provide – thereby reducing the risks to populated areas while also reducing the costs for farmers. The RMAX offers these same benefits here in the United States, where most farm and land areas are not as proximate to inhabited areas as they are in Japan.

human operator to the risks of making sharp turns on steep slopes.⁵ The RMAX uses a fraction of the fuel, causes no soil compaction or crop damage, and provides more precise spray deposition, significantly reducing chemical drift and operator exposure to the chemicals.

Research developed by our industry trade association, AUVSI, indicates that use of the RMAX and similar unmanned aerial systems (UAS) in the U.S. could improve crop yields by 15%, increase net returns by \$17 to \$54 per acre, and reduce fertilizer use by as much as 40%.⁶ A study by Ben-Gurion University similarly found that precision UAS spraying could reduce pesticide use by up to 60%. These potential benefits can and should be available to U.S. farmers and growers.

Commercial use of UAS would also result in thousands of new jobs and millions of dollars in related economic growth for our country. Recent projections indicate that the economic impact of these products could exceed \$13.6 billion and result in 70,000 new jobs in the first three years of integration alone.⁷

Ensuring public safety and privacy are certainly top priorities of this Committee and the FAA in considering commercial UAS use here. Yamaha understands and shares these priorities. During its more than two decades of use, the RMAX has safely logged over 1.8 million total flight hours without, to our knowledge, a single privacy complaint.⁸ This stellar record reflects a

⁵ Exhibit 3.

⁶ Exhibit 4.

⁷ Exhibit 5.

⁸ Exhibit 6.

systematic approach to safety and privacy that includes: (1) a quality engineered and manufactured product; (2) intensive pilot training and certification programs; and (3) comprehensive operating restrictions and policies.

Specifically, the RMAX is manufactured to exacting standards and has a host of built-in safety features, including excellent flight stability systems and GPS for speed and hovering control; a “loss link” feature that guides the unit to hover in place and then slowly land if there is any loss of radio communication; and a rotor brake that brings the propeller to a full stop within seconds of landing.⁹

In addition to these on-product safety systems, Yamaha has worked closely with aviation authorities in other countries to develop extensive pilot training and certification programs, which include both classroom and field components involving many hours of in-flight training. For example, the training and certification requirements we have established with the Civil Aviation Safety Authority (CASA) in Australia include:

- a pilot theory exam;
- a comprehensive UAV training course;
- 30 hours of supervised agricultural spraying;
- a Class 2 medical certificate;
- a certificate of radio proficiency;
- completion of Yamaha’s training program; and

⁹ In addition, the RMAX has a self-monitor function that makes sure the unit is functioning properly before takeoff. Once airborne, the RMAX has an Altitude Control System with GPS, developed by Yamaha. This gives the unit excellent flight stability and control. There are indicator lights on the unit for the altitude control system and vehicle speed, which provide constant visual feedback to the pilot. A warning light is also present in the event of any potential malfunction. Exhibit 7.

- continuing periodic training even after certification.

These comprehensive pilot training and certification programs provide an excellent model that could be adopted for use here in the United States.

We have also developed comprehensive flight restrictions, including low altitude, low speed operation over uninhabited areas. And Yamaha's use policies prohibit any RMAX operation where a third party's privacy rights would be infringed.¹⁰

Autonomous versions of the RMAX have also been safely deployed in Japan, using pre-set flight routes to conduct geographical surveys, to lower measuring and sensing equipment into volcanoes, and to monitor radiation from the Fukushima nuclear power plant. Together, these autonomous activities have involved over 3,000 additional safe flight hours.¹¹

The RMAX's proven systems, used for over 20 years and nearly 2 million hours of flight, can and should provide an effective blueprint for the FAA to build on in approving similar agricultural uses of the remotely-piloted RMAX and other UAS here, under the same operating conditions and restrictions I have described -- which together minimize any personal safety or privacy concerns for the general public.

¹⁰ From a practical perspective, privacy is not an issue for the vast amount of RMAX use, since it involves chemical spraying over farmland and other rural, uninhabited spaces. We expect that our experiences in the United States will be no different, and we will of course comply with any applicable privacy rules or policies here.

¹¹ Autonomous versions of the RMAX could be used for similar important purposes in this country, but our initial efforts with the FAA are focused on obtaining approval for the kind of precision agricultural services that our remotely-piloted unit performs each year on millions of acres of land in other countries.

We have met with FAA staff, and they have been very helpful in explaining the current regulatory requirements for commercial aircraft and their efforts to develop new regulations more suitable for UAS. At present, however, the RMAX cannot be used for any commercial purpose. We can only conduct limited R&D testing. And we have no clear roadmap or timeline for when the RMAX or similar UAS might be approved for use in Bakersfield, Napa Valley, or anywhere else.¹²

We urge Congress to give the FAA the authority and flexibility to authorize products like the RMAX for precision agricultural and other appropriate commercial uses, such as spraying for mosquito and gypsy moth control, where there is a proven performance record and under appropriate operating restrictions that mitigate any public safety or privacy concerns.

For example, Congress could encourage the FAA to use its existing authority, under Section 333 of the FAA Modernization and Reform Act of 2012, to issue Certificates of Authorization – which are currently limited to public agency uses – to include specific commercial uses, like precision agricultural spraying, in circumstances where, as here, you have a UAS with a proven safety record and established operating procedures and restrictions; namely, line-of-sight, low altitude, low speed operation during daylight over uninhabited areas.

Similarly, Congress could consider authorizing a class and type of UAS that would be approved for these kind of uses under equivalent operating procedures and restrictions, similar to the Class 1 UAV category adopted by the International Civil Aviation Organization (ICAO).

¹² UAS are being developed and tested for precision agricultural uses by numerous research teams at Ohio State University, Kansas State University, Virginia Tech and other places. AUVSI, our industry trade association, has more complete information about these various products.

This is the same classification that CASA has applied to the RMAX for precision agricultural uses in Australia.

Alternatively, the FAA should be authorized to rely on and adopt the training, certification, operating, and other policies and procedures that Yamaha has established with aviation authorities in Japan or Australia, much like the FAA already does for commercial manned aircraft under bi-lateral treaties.

Encouraging the FAA to issue these kind of approvals, even while the agency develops more comprehensive UAS regulations, would help ensure that American farmers and growers have access to the same vital services their counterparts in other countries already enjoy,¹³ and that our economy begins reaping the substantial benefits these new products offer.¹⁴

Thank you again for this opportunity to appear before the Committee.

¹³ Yamaha's initial market plans would not involve sales of the RMAX to farmers or other private individuals. For the most part, in other countries, Yamaha retains custody of the units and leases them for agricultural services, which are only provided by trained and certified pilots and spotters. This enables Yamaha to maintain custody over each unit and to ensure safe and proper usage. We expect to follow that same operating model here, once we have the necessary approvals.

¹⁴ In addition to the immediate benefits in greater productivity and reduced costs for farmers and growers, use of the RMAX here would directly result in new jobs for pilots, spotters, and others who provide the services. Although the RMAX is currently manufactured in Japan, Yamaha is also open to considering production of units in the United States, which could create hundreds of new jobs in manufacturing and at dealers and other small businesses that help administer and provide the product's services.

EXHIBITS