



**Testimony on Unmanned Aircraft Systems
Committee on Small Business
U.S. House of Representatives**

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Thank you Chairman Chabot, Ranking Member Velazquez, and members of the committee for inviting me to speak today. I will provide the perspective of a professor who has been involved in unmanned aircraft systems (UAS) research for over 15 years and who has interacted with small businesses in a variety of ways.

I am a professor of mechanical engineering at Brigham Young University and currently direct a research consortium called the Center for Unmanned Aircraft Systems (C-UAS). This center brings together researchers from industry and academia to collaborate on research challenges facing the UAS industry. The center is sponsored by the National Science Foundation and receives much of its financial support from industry members that include many of the leading UAS companies and government labs. Our research universities include Brigham Young University, the University of Colorado-Boulder, and Virginia Tech.

During the years that I have been involved with UAS research, I have collaborated with many small businesses on a variety of projects. Currently, several small companies are members of our research center (C-UAS) and provide guidance and funding for our UAS research. With my colleagues and students, I have been a co-founder of two UAS startup companies: Procerus Technologies and Flying Sensors. My colleagues and I have also partnered with numerous small companies in the UAS industry on 15 SBIR and STTR awards, most of which have gone on to receive Phase II funding. Most of my research experience has been with small, unmanned aircraft of both fixed-wing and rotorcraft varieties.

From my perspective, small businesses have played a vital role in the creation and growth of the UAS industry in the United States. Without doubt, a significant portion of the innovation in the UAS industry has come from entrepreneurial start-up companies.

UAS technology, particularly for small, lower-cost aircraft, truly represents a disruptive innovation [1]. Advancements in batteries, miniature GPS receivers, microprocessors, electronics, materials, and sensors have made the small, unmanned aircraft of today possible. These small UAS have created new markets for aircraft among an entirely different set of consumers. Professional and consumer-grade small unmanned aircraft are displacing piloted aircraft from many markets, such as aerial photography and mapping. Furthermore, they provide a low-cost alternative to

military-grade small UAS and could potentially disrupt the defense-related markets as their reliability increases.

Just ten years ago, the small UAS market was not profitable enough for most large defense contractors to pursue. During the last decade, as UAS have had a transformational impact on military operations and as the promise of regulatory change has increased their viability for commercial applications, larger companies have taken greater interest in small UAS. Illustrating the importance of small business to the UAS industry, a common approach for large companies to enter or become more competitive in the UAS marketplace has been for them to acquire small, agile, innovative UAS companies. (See Table 1).

Table 1: Examples of small business acquisitions by large corporations.

Corporation	Acquisition
Raytheon	Sensintel, Blackbird Technologies
Lockheed Martin	Procerus Technologies, Chandler/May, CDL Systems
Boeing	Insitu, 2D3 Sensing
Textron Systems	Aerosonde
UTC Aerospace	Cloud Cap Technology
Rockwell Collins	Athena Technologies
Facebook	Ascenta
Google	Titan Aerospace
Qualcomm	Kmel Robotics

In the early years of the development of the UAS industry, government funding, administered primarily through the Department of Defense, was critically important for the development of unmanned aircraft. Military applications defined the desired missions and capabilities for UAS technology. DoD funding, including that provided by SBIR and STTR programs, drove the innovation in UAS technology. Many of the major players in the UAS industry have grown up by providing products and services to meet military needs.

As regulations are put in place to allow commercial flights of UAS, there will be a shift away from defense applications and an acceleration of market opportunities. This is particularly true for small UAS, due to their accessibility and relatively low cost. Applications that have been envisioned for small UAS include: agricultural monitoring, law enforcement, infrastructure inspection, wildfire monitoring, package delivery, aerial mapping and surveying, communication networks, news videography, and many more. During the first ten years following integration of unmanned aircraft into the National Airspace System, their economic impact in the U.S. is projected to be \$82 billion with over 100,000 new high-tech jobs created [2].

Because many UAS application markets are undeveloped and high risk, it is likely that small, innovative businesses will be the first to enter these markets, to build them, and prove their viability and value. More than ever, small business is essential to the growth and maturation of the UAS industry. These businesses will include of innovators and developers of UAS technology and providers of UAS services, such as farm-crop health assessment and land surveying.

Current UAS market estimates are based on specific applications that have been identified. From my perspective, even more exciting than these known applications are the applications that have not yet been conceived. Much like the Internet of the 1990's, the potential of unmanned aircraft to

enhance our lives is in its infancy and we do not yet have a full sense of the impact of this technology.

To enable and accelerate growth in the UAS industry and facilitate the participation of small business, the regulatory barriers to entry must be kept low. This is true for research entities, such as universities, as well. If the costs of obtaining authorization to fly are too high, in terms of the time, effort, and cost to obtain licenses and certifications, then these UAS markets of opportunity will be closed to all but larger companies that are well capitalized. Smaller companies will not be able to participate and bring their creative products to market. Costs for UAS technologies and services will remain high. Innovation and progress will be hampered and the U.S. will lose its competitive leadership position in an industry that it pioneered.

The progress of UAS research and commercialization in the U.S. has been inhibited by the lack of a regulatory framework that allows unmanned aircraft flights to take place. The FAA's Small UAS Notice of Proposed Rulemaking, also known as the Small UAS Rule, is a good step forward that will help accelerate growth in many UAS application areas [3]. The basic provisions of the Small UAS Rule allow unmanned aircraft up to 55 pounds to fly at speeds up to 100 miles per hour, up to altitudes of 500 feet above ground level, during daylight hours, and within visual line of site of the operator. As a small UAS researcher, this rule will accommodate most of my needs and I will be greatly relieved when it is finally implemented. I believe this rule will enable many commercial applications and allow viable UAS businesses to be established. For many applications with great potential for impact, beyond-line-of-site capabilities are essential. Many farms, for example, are much larger than could be efficiently surveyed by a UAS kept within visual site of the operator. Likewise, to inspect an oil pipeline or deliver a package, beyond-line-of-sight capabilities are essential for the UAS to be a useful tool. In consideration of these needs, the FAA has initiated the Pathfinder Program to perform experimental UAS flights beyond the line of sight of the operator [4]. Further research and development are needed to increase the reliability of beyond-line-of-site flight in demanding airspace conditions. Regulations permitting safe beyond-line-of-site flight are necessary to allow the benefits of UAS technology to be fully realized and to maintain U.S. competitiveness in this growing field.

In summary, small businesses have played a vital role in the development of the U.S. unmanned aircraft industry by way of their vision, innovation, and willingness to take risks in emerging technology markets. As we move into the future of commercial UAS applications, small businesses will continue to make critical contributions to the success of this industry. They will lead the way with technology innovations and in the creative application of UAS technology to problems facing the world.

Thank you again for this opportunity to address the committee. I would be happy to answer any questions that you may have.

References

- [1] Christensen, Clayton M. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston, MA: Harvard Business School Press, 1997.
- [2] Jenkins, Darryl and Vasigh, Bijan. "The Economic Impact of Unmanned Aircraft Systems Integration in the United States," AUVSI, March 2013.
- [3] Federal Aviation Administration, "Small UAS Notice of Proposed Rulemaking (NPRM)," <http://www.faa.gov/uas/nprm>. February 2015.
- [4] "FAA and Industry to Collaborate on Expanded UAS Operations," *Unmanned Systems*, July 2015, p. 27.