

EYE IN THE SKY

Assuring the Safe Operation of Unmanned Aircraft Systems

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Photo by James Sizemore

The General Atomics Altair was the first civil UAS to receive an experimental airworthiness certificate.

On a crisp, cool New Mexico morning, brilliant shades of orange and indigo sky paint an endless backdrop for the lone operator at Las Cruces International Airport (KLRU). After taxiing to Runway 4, the aircraft carefully positions itself on the centerline before its engine roars to life. The pilot slowly increases back pressure on the control stick until the small, but remarkably nimble aircraft accelerates into the morning sky.

Another routine takeoff at KLRU, right? Perhaps. What might not be routine, however, is the pilot in this scenario never left the ground. The takeoff is part of a growing number of test flights to gain a better understanding of Unmanned Aircraft Systems (UAS), the core component of a burgeoning industry ripe with opportunities and seemingly destined for success on a much larger scale.

Thanks partly to frequent appearances in movies, TV, and even video games, UAS awareness has “skyrocketed” over the last few years. Headlines boasting of UAS success in military operations are hard to miss. Additionally, the unique advantages of UAS continue to create a buzz among government

and private sector businesses as they ponder potential uses that seem to increase every day.

Yet, despite the numerous environmental, economic, and safety benefits of UAS, there remains an underlying, and understandable, apprehension of how these “flying robots” will perform alongside manned aircraft, especially during an unexpected event or emergency. Crucial to the success of this new aviation endeavor are well-planned policies and regulations, along with leveraging the technology of the very system—NextGen—that holds the key to safety and efficiency for future civil aviation operations.

In a November 2009 speech, FAA Administrator Randy Babbitt extolled the merits of UAS and said, “The technology has shown amazing potential and it’s provided an astonishing value in use for what they’re intended.”

However, likening the effect of UAS to the advent of the jet engine, Babbitt also recognized the level of technical maturity is not where it needs to be for full operation in the National Airspace System (NAS). “We’re talking about an exponential leap in capability,” said Babbitt, referring to the development of sense-and-avoid technology, considered by many

as the backbone for a successful UAS integration plan. “We have to make sure sense-and-avoid is more than a given—it must be a guarantee.”

Back to the Future

A fundamental aviation tenet—collision avoidance—is traditionally a pilot responsibility. Removing the human element from where it was originally based (in the cockpit) and putting it on the ground presents its own challenges and can change our understanding of aviation.

“What we’ve experienced with UAS is almost a retrograde action in terms of trying to understand aviation,” says FAA UAS Program Policy and Regulatory Lead Stephen Glowacki. “In many ways, we’re forced to re-evaluate the same things we thought we understood.” Glowacki offers this example: The need to rethink the concept of a cockpit, and, subsequently, the cockpit door. Will a UAS pilot, seated at a ground-operation station, be required to have the same door-security system as those installed on commercial aircraft? Will seatbelt requirements apply to UAS operators? The answers to these and many other questions, says Glowacki, will require the FAA to dig deep into its experience of being a regulator and service provider to come up with an understanding of aviation that remains consistent with UAS integration.

Among the more pressing questions is how to tackle the complexity of collision avoidance. NextGen technologies, such as ADS-B, as well as digital-data communication and performance-based navigation systems, will no doubt be key to integrating UAS into the NAS. However, the sheer variety of unmanned aircraft—which range in size from a Boeing 737 to the size of a cell phone—make an across-the-board installation difficult at best. There’s also the issue of differing performance characteristics among unmanned aircraft, not to mention the differences from their manned brethren. This makes speed and climb/turn rates difficult to predict and incorporate into standard

procedures, especially when considering critical evasive maneuvers.

RTCA Special Committee 203 is helping to close knowledge gaps caused by operational variations. FAA asked the committee to provide recommendations to establish minimum performance standards for UAS. The committee’s guidance will help serve as a foundation to assure safe, efficient, and compatible UAS operations with other vehicles operating in the NAS. As part of these standards, the committee plans to recommend standards and procedures for UAS sense-and-avoid systems that will provide a safety level equivalent to that of manned aircraft. The standards are scheduled to be completed in late 2013, according to the committee’s most recent plenary session, and once established, will allow the FAA to begin a more detailed approach towards certifying and regulating specific components and systems.

Although technological barriers abound for UAS, they do have an important out-of-the-box advantage over manned aircraft. Starting off with an inherent network-like infrastructure, UAS can

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Photo courtesy of UVS International

Many UAS models are equipped with high-quality camera equipment for surveillance, terrain mapping, and search and rescue.



Photo courtesy of Insitu, Inc.

Insitu's ScanEagle UAS can perform long-range operations—24 hours on a gallon and a half of gas—and with a variety of payloads.

easily upload critical operational performance and flight-control-systems data quickly, and wherever needed. “From a system-engineering perspective,” says Glowacki, “UAS have robust data-sharing capabilities as part of their design, unlike manned aircraft that function more as independent entities in comparison.” This same advantage is what may help UAS platforms be considered as proof-of-concept test beds for manned aircraft operations in the future NextGen environment.

Testing One, Two, Three

Recognizing there is still much knowledge and experience that must be acquired with UAS, FAA is working towards getting smarter on UAS.

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The New Mexico Flight Test Center is a prime example of the efforts to better

understand UAS impact on the environment, which until now, remains fairly speculative. This 12,000 square-mile facility, administered and co-located within the wide-open confines of New Mexico State University (NMSU), is the country's first FAA-approved UAS Flight Test Center.

Through a Cooperative Research and Development Agreement with the FAA, NMSU can conduct UAS research and development in a controlled testing environment and, in return, provide FAA with useful data for developing future standards and regulations. While the NMSU Test Center remains the only one of its kind in the United States, FAA recognizes the importance of enabling further testing and evaluating of new products to expand this developing technology and welcomes expanding these types of facilities, provided they meet guidelines and present no negative impact on other NAS users.

The FAA also conducts in-house UAS testing at the William J. Hughes Technical Center in New Jersey, including the use of a *Shadow* and a *Predator*

B simulator. FAA Aerospace Engineer Kerin Olson, who works with Technical Center test engineers to collect data, knows firsthand how these UAS flight demonstrations are changing the way we think about unmanned flight. “By observing simulated operations of UAS flights, we’re getting a better picture of the system’s overall performance, including the intricacies of aircraft commands and communications,” she says. From a human factors standpoint, these same tests also help the FAA gain better insight into UAS flight-crew dynamics, providing much needed data on flight-crew roles and responsibilities, minimum crewmember requirements, as well as which types of data-display systems work best. Studying these interactions will play an important role in determining future policy and regulation.

Soon to be added to the Technical Center’s UAS test arsenal will be a full-scale *Scan Eagle* platform provided by Insitu, Inc. With more than 300,000 flight hours, the *Scan Eagle* is a veteran UAS design that can perform long-range operations—24 hours on a gallon and a half of gas—and with a variety of payloads. The *Scan Eagle* is also completely runway-independent and uses a pneumatic catapult-launching system and a patented recovery system that catches the aircraft with a suspended rope.

Insitu Business Development Executive Paul McDuffee is optimistic this testing agreement will move the industry closer to a sense-and-avoid solution. “While we don’t have a pair of eyeballs on the aircraft,” says McDuffee, “there are several feasible alternatives that need to be tested and evaluated.” Existing test data show current ground-based radar and TCAS systems are able to pick up nearly any vehicle within 12 to 15 miles of a UAS. “By working with the FAA,” adds McDuffee, “we’re seeking to obtain the safety ‘street’ credit for these systems, along with rules that permit reasonable access.”

One Small Step for UAS...

Currently, UAS operations for civilian commercial purposes are largely prohibited, limited to mainly research and development, product demonstration, or crew training with an experimental certification. Public-use applicants for UAS must obtain a Certificate of Waiver or

Authorization (COA) which is processed by the FAA's Air Traffic Organization and reviewed by the FAA's Unmanned Aircraft Program Office, FAA's primary point of contact for unmanned operations. The application is reviewed to ensure the operation is safe and appropriate safety mitigations are imposed. If there are any questions about the safety of the operation, safety studies are required for those situations where a proponent wants to do something that is outside the bounds of the interim operational guidance material. FAA grants COAs on a case-by-case basis and only when it is clear that operations can be conducted safely.

Despite the multitude of restrictions, applications have increased nearly tenfold in the last six years. Realizing the rapid expansion of this billion-dollar industry, the FAA is taking steps toward allowing small unmanned aircraft (under 55 pounds) to operate commercially in the NAS—under low-risk conditions—in the near future. As part of the rulemaking process, the FAA formed an Aviation Rulemaking Committee to develop recommendations for consideration. The FAA expects to have a published Special Federal Aviation Regulation (SFAR) by mid-2011, with a final rule expected in late 2012.

The purpose of this SFAR is threefold:

- Educate
- Promote controlled safe development of UAS technology
- Gather data for future rulemaking efforts

Among the SFAR team members is Flight Standards Aviation Safety Analyst Silas Still, who is helping develop UAS pilot qualification and training requirements. "The Small UAS rulemaking will still only allow limited access to the NAS," says Still, "but it is an important step towards tackling some of the challenges of this industry, and will help us integrate future waves of UAS."

...One Giant Leap for Aviation

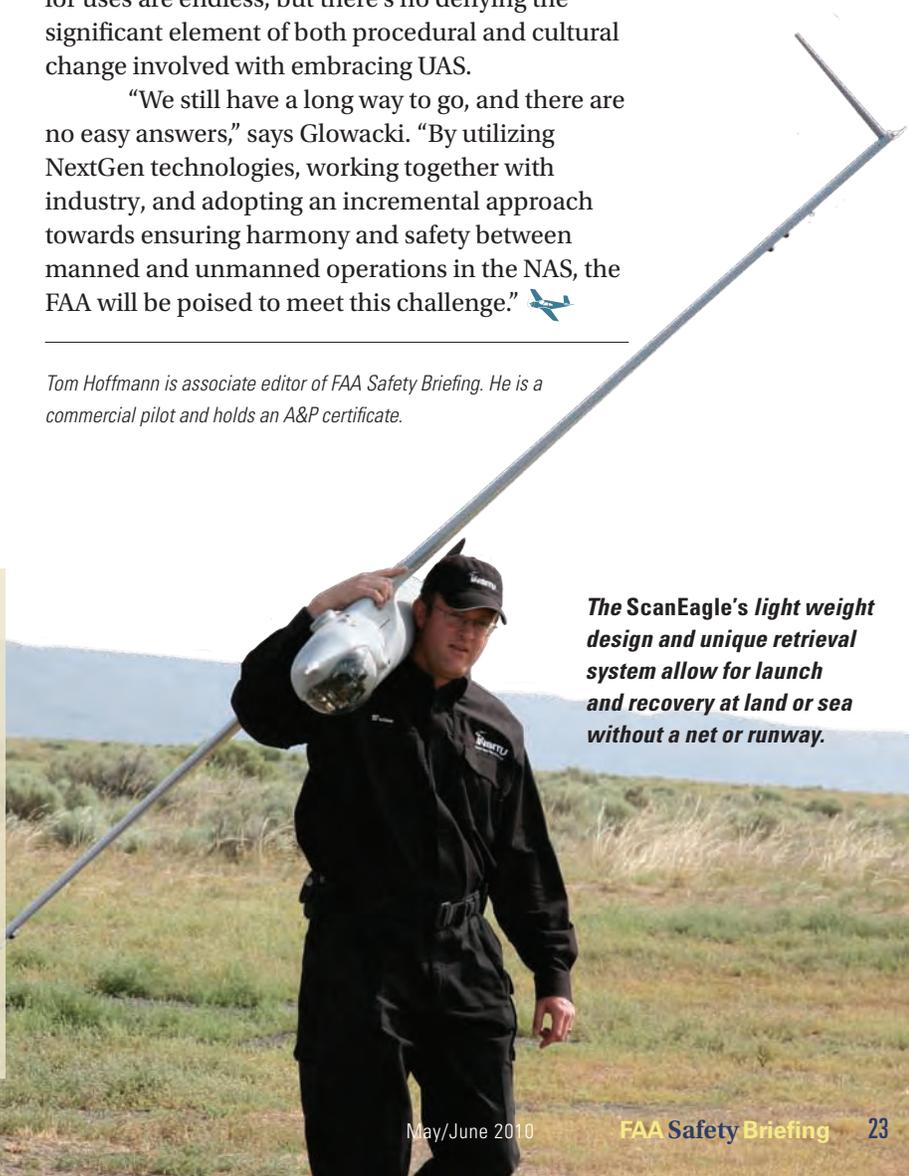
While there are still many obstacles and unknowns to overcome before full UAS integration, it's important to keep in mind the many benefits UAS missions can offer: search and rescue, weather mapping, security surveillance, and wildlife preservation, to name a few. The possibilities for uses are endless, but there's no denying the significant element of both procedural and cultural change involved with embracing UAS.

"We still have a long way to go, and there are no easy answers," says Glowacki. "By utilizing NextGen technologies, working together with industry, and adopting an incremental approach towards ensuring harmony and safety between manned and unmanned operations in the NAS, the FAA will be poised to meet this challenge." 

Tom Hoffmann is associate editor of FAA Safety Briefing. He is a commercial pilot and holds an A&P certificate.

For More Information

The Links provided in the printed edition were current at press time. They are in the process of being moved to a new site. An updated PDF will be provided when the new links are available.



The ScanEagle's light weight design and unique retrieval system allow for launch and recovery at land or sea without a net or runway.