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UNMANNED AERIAL SYSTEMS

Efforts Made toward Integration into the National Airspace Continue, but Many Actions Still Required

Statement of Gerald L. Dillingham, Ph.D.
Director, Physical Infrastructure Issues

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GAO Highlights

Highlights of GAO-15-254T, a testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives

Why GAO Did This Study

UASs are aircraft that do not carry a pilot aboard, but instead operate on pre-programmed routes or are manually controlled by following commands from pilot-operated ground control stations. The FAA Modernization and Reform Act of 2012 put greater emphasis on the need to integrate UASs into the national airspace by requiring that FAA establish requirements governing them. FAA has developed a three-phased approach in its 5-year *Roadmap* to facilitate incremental steps toward seamless integration. However, in the absence of regulations, unauthorized UAS operations have, in some instances, compromised safety.

This testimony discusses 1) progress toward meeting UAS requirements from the 2012 Act, 2) key efforts underway on research and development, and 3) how other countries have progressed in developing UAS use for commercial purposes.

This testimony is based on GAO's prior work and an ongoing study examining issues related to UAS integration into the national airspace system for civil and public UAS operations.

View GAO-15-254T. For more information, contact Gerald L. Dillingham at (202) 512-2834 or dillinghamg@gao.gov.

What GAO Found

The Federal Aviation Administration (FAA) has made progress toward implementing the requirements defined in the FAA Modernization and Reform Act of 2012 (the 2012 Act). As of December 2014, FAA had completed 9 of the 17 requirements in the 2012 Act. However, key requirements, such as the final rule for small unmanned aerial systems (UAS) operations, remain incomplete. FAA officials have indicated that they are hoping to issue a Notice of Proposed Rulemaking soon, with a timeline for issuing the final rule in late 2016 or early 2017. FAA has established the test sites as required in the Act, sites that will provide data on safety and operations to support UAS integration. However, some test site operators are uncertain about what research should be done at the site, and believe incentives are needed for industry to use the test sites. As of December 4, 2014, FAA granted seven commercial exemptions to the filmmaking industry allowing small UAS operations in the airspace. However, over 140 applications for exemptions were waiting to be reviewed for other commercial operations such as electric power line monitoring and precision agriculture.

Previously GAO reported that several federal agencies and private sector stakeholders have research and development efforts under way focusing on technologies to allow safe and routine UAS operations. During GAO's ongoing work, FAA has cited many accomplishments in research and development in the past fiscal year in areas such as detect and avoid, and command and control. Other federal agencies also have extensive research and development efforts supporting safe UAS integration, such as a National Aeronautics and Space Administration (NASA) project to provide research that will reduce technical barriers associated with UAS integration. Academic and private sector companies have researched multiple areas related to UAS integration.

GAO's ongoing work found that other countries have progressed with UAS integration and allow limited commercial use. A 2014 MITRE study found that Japan, Australia, the United Kingdom, and Canada have progressed further than the United States with regulations that support commercial UAS operations. For example, as of December 2014, Australia had issued 180 UAS operating certificates to businesses in industries including aerial surveying and photography. In addition, Canada recently issued new regulations exempting commercial operations of small UASs weighing 25 kilograms (55 lbs.) or less from receiving special approval.

UAS Conducting Power Line Inspections and Precision Agriculture

Source: FAA. | GAO-15-254T

Chairman LoBiondo, Ranking Member Larsen, and Members of the Subcommittee:

I appreciate the opportunity to testify on the Federal Aviation Administration's (FAA) efforts to integrate unmanned aerial systems (UAS) into the National Airspace System (NAS).[1] The United States has been on a path toward UAS integration for years. The agency's rulemaking efforts related to UAS began in 2008, when the FAA established a committee to develop rules for the operation of small UASs.

The FAA Modernization and Reform Act, enacted in February 2012 (the 2012 Act),[2] required the development of regulations for the safe integration of civil UAS into the national airspace by December 2015 and therefore put greater emphasis on the need to integrate UAS. In the absence of regulations governing UAS, some United States businesses are going overseas to test UAS technology, while other civilian users continue to wait to launch commercial operations.[3] However, some individuals are conducting domestic operations illegally or unsafely. For example, one UAS nearly collided with a New York Police Department helicopter over New York City, another came dangerously close to a US Airways regional jet over the Florida panhandle, and numerous UASs have been spotted flying over professional and college football stadiums full of people.

My statement today focuses on 1) FAA's progress toward meeting requirements from the 2012 Act, 2) key efforts under way on UAS

[1]These aircraft are also referred to as unmanned aircraft vehicles, remotely piloted aircraft, or drones. They do not carry a pilot aboard, but instead operate on pre-programmed routes or are manually controlled by commands from pilot-operated ground control stations. Generally, UAS size is considered small or large based on weight. Under the 2012 Act, small UASs are defined as weighing less than 55 pounds, thereby leaving those UASs 55 pounds or more being described as large. UASs are being used for law enforcement, national defense, academic research, commercial, and recreational purposes.

[2]FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, §§ 331 – 335, 126 Stat. 11 (2012).

[3]Examples of commercial use could include delivering packages, precision agriculture, and power line inspection. According to a UAS industry association, these industries represent examples of commercial potential that in the first decade following integration will contribute to more than 100,000 jobs and $82 billion in economic impact.

research and development, and 3) how other countries have progressed toward UAS integration into their airspace for commercial purposes.

My statement is based on our prior products on UAS issued since 2012,[4] selected updates on this work, as well as preliminary observations of our ongoing study of UAS integration into the NAS underway for this committee and others. Detailed information on our scope and methodology can be found in those products. For this testimony we updated our prior work on the status of FAA's efforts to meet UAS requirements in the 2012 Act, by reviewing FAA documents, applicable laws, regulations, and program guidance. For our ongoing work, we reviewed FAA's *Comprehensive Plan*[5] and *Roadmap* for UAS integration.[6] To identify the key efforts and opportunities associated with the FAA's obtaining research, development, and operations data to support UAS integration, we reviewed documents from each of the six test sites where FAA has recently allowed UAS operations and spoke with officials from three of the test sites. To identify how other countries have progressed toward UAS integration for civil and commercial purposes, we spoke with the International Civil Aviation Organization (ICAO) and other stakeholders familiar with the UAS activities currently occurring in other countries.[7] We also conducted semi-structured interviews with FAA officials and a wide range of stakeholders, including representatives of federal agencies such as Department of Defense (DOD), National Aeronautics and Space Administration (NASA), test site officials, research organizations, academics, and industry experts. We also reviewed relevant empirical literature and media reports to obtain information and perspectives on current developments and future

[4]GAO, *Unmanned Aircraft Systems: Continued Coordination, Operational Data, and Performance Standards Needed to Guide Research and Development*, GAO-13-346T (Washington, DC: Feb. 15, 2013); *Unmanned Aircraft Systems: Measuring Progress and Addressing Potential Privacy Concerns Would Facilitate Integration into the National Airspace System*, GAO-12-981 (Washington, DC: Sept. 14, 2012); and *FAA Reauthorization Act: Progress and Challenges Implementing Various Provisions of the 2012 Act*, GAO-14-285T (Washington, DC: Feb. 5, 2014).

[5]JDPO, *Unmanned Aircraft Systems Comprehensive Plan: A Report on the Nation's UAS Path Forward (Washington, D.C.: Sept., 2013).*

[6]FAA, *Integration of Civil Unmanned Aircraft Systems in the National Airspace System Roadmap: First Edition—2013* (Washington, D.C.: Nov. 2013).

[7]ICAO is the international body that, among other things, promulgates international standards and recommended practices in an effort to harmonize global aviation standards.

challenges, and spoke with representatives from Canada's aviation authority to understand their regulations related to UAS and associated activities.[8] We obtained agency views on preliminary work and made changes as appropriate. The work this statement was based on was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

In November 2013, FAA released the *Roadmap* that describes its three-phased approach—Accommodation, Integration, and Evolution— to facilitate incremental steps toward its goal of seamlessly integrating UAS flight in the national airspace. Under this approach, FAA's initial focus will be on safely allowing for the expanded operation of UASs by selectively accommodating some UAS use. In the integration phase, FAA plans to shift its emphasis toward integrating more UAS use once technology can support safe operations. Finally, in the evolution phase, FAA plans to focus on revising its regulations, policy, and standards based on the evolving needs of the airspace.

Currently, FAA authorizes all UAS operations in the NAS—military, public (academic institutions and, federal, state, and local governments including law enforcement organizations), and civil (private sector entities). Federal, state, and local government agencies must apply for Certificates of Waiver or Authorization (COA), [9] while civil (commercial) operators must apply for special airworthiness certificates in the experimental category. Civil operators may also apply for a section 333 exemption, under section 333 of the 2012 Act, Special Rules for Certain Unmanned Aircraft Systems, which requires the Secretary of Transportation to determine if certain UAS may operate safely in the NAS prior to the completion of UAS rulemakings and gives the Secretary of

[8]The aviation authority in Canada is Transport Canada.

[9]A COA is an authorization generally for up to two years issued by the FAA to a public operator for a specific UAS activity. As of December 4, 2014, FAA had approved 526 COAs of 723 applications received in for the year.

Transportation the authority to determine whether to allow certain UAS aircraft to operate in the NAS without an airworthiness certification.[10]

As we previously reported, research and development continue in areas related to a UAS's ability to detect and avoid other aircraft, as well as in command and control technologies and related performance and safety standards that would support greater UAS use in the national airspace. Some of this research is being conducted by DOD and NASA. Until this research matures most UAS operations will remain within visual line of sight of the UAS operator.[11]

Foreign countries are experiencing an increase in UAS use, and some have begun to allow commercial entities to fly UASs under limited circumstances. According to industry stakeholders, easier access to these countries airspace has drawn the attention of some U.S. companies that wish to test their UASs without needing to adhere to FAA's administrative requirements for flying UASs at one of the domestically located test sites, or obtaining an FAA COA.

FAA Has Made Progress Meeting Statutory UAS Requirements, but Commercial Operation Is Limited

As we most recently reported in February 2014, the 2012 Act contained provisions designed to accelerate the integration of UAS into the NAS. These provisions outlined 17 date specific requirements and set deadlines for FAA to achieve safe UAS integration by September 2015 (See app. 1). While FAA has completed several of these requirements, some key ones, including the publication of the final small unmanned aerial systems rule, remain incomplete. As of December 2014, FAA had completed nine of the requirements, was in the process of addressing four, and had not yet made progress on four others. Some stakeholders told us in interviews that FAA's accomplishments to date are significant and were needed, but these stakeholders noted that the most important provisions of the 2012 Act have been significantly delayed or are unlikely

[10]FAA has granted regulatory exemptions to a few companies under section 333 of the 2012 Act - Special Rules for Certain Unmanned Aircraft Systems FAA officials said that as of December 4, 2014, FAA had received 160 section 333 exemption requests.

[11]Visual line of sight UAS operations, according to FAA, are defined as unaided (corrective lenses and/or sunglasses exempted) visual contact between a pilot-in-command or a visual observer and a UAS sufficient to maintain safe operational control of the aircraft, know its location, and be able to scan the airspace in which it is operating to see and avoid other air traffic or objects aloft or on the ground.

to be achieved by the mandated dates. Both the FAA and UAS industry stakeholders have emphasized the importance of finalizing UAS regulations as unauthorized UAS operations in the national airspace continue to increase and present a safety risk to commercial and general aviation activities.

Development of the Small UAS Rule

Before publication of a final rule governing small UAS, FAA must first issue a Notice of Proposed Rulemaking (NPRM). As we previously reported, the small UAS rule is expected to establish operating and performance standards for a UAS weighing less than 55 pounds, operating under 400 feet, and within line of sight. FAA officials told us in November 2014 that FAA is hoping to issue the NPRM by the end of 2014 or early 2015.[12] According to FAA, its goal is to issue the final rule 16 months after the NPRM. If this goal is met, the final rule would be issued in late 2016 or early 2017, about two years beyond the requirement of the congressional mandate. However, during the course of our ongoing work, FAA told us that it is expecting to receive tens of thousands of comments on the NPRM. The time needed to respond to such a large number of comments could further extend the time to issue a final rule. FAA officials told us that it has taken a number of steps to develop a framework to efficiently process the comments it expects to receive. Specifically, they said that FAA has a team of employees assigned to lead the effort with contractor support to track and categorize the comments as soon as they are received. According to FAA officials, the challenge of addressing comments could be somewhat mitigated if industry groups consolidated comments, thus reducing the total number of comments that FAA must be addressed while preserving content.

During our ongoing work, one industry stakeholder has expressed concern that the small UAS rule may not resolve issues that are important for some commercial operations. This stakeholder expects the proposed rule to authorize operations of small UASs only within visual line of sight of the remote operator and to require the remote operator to have continuous command and control throughout the flight. According to this stakeholder, requiring UAS operators to fly only within their view would

[12]The *NPRM* was being reviewed by the Office of Management and Budget (OMB), and FAA officials told us they could not be more specific about when it would be released. They noted that once OMB's review was complete, and the *NPRM* was approved, then it would be released.

prohibit many commercial operations, including large-scale crop monitoring and delivery applications. Furthermore, they formally requested that FAA establish a new small UAS Aviation Rulemaking Committee (ARC) with the primary objective to propose safety regulations and standards for autonomous UAS operations and operations beyond visual line of sight. According to FAA, the existing UAS ARC recently formed a workgroup to study operations beyond visual line of sight in the national airspace and to specifically look at the near- and long-term issues for this technology.

Planning for Integration

In November 2013, FAA completed the required 5-year *Roadmap*, as well as, the *Comprehensive Plan* for the introduction of civil UAS into the NAS. The *Roadmap* was to be updated annually and the second edition of the *Roadmap* was scheduled to be published in November 2014. Although FAA has met the congressional mandate in the 2012 Act to issue a *Comprehensive Plan* and *Roadmap* to safely accelerate integration of civil UAS into the NAS, that plan does not contain details on how it is to be implemented, and it is therefore uncertain how UASs will be safely integrated and what resources this integration will require. The UAS ARC emphasized the need for FAA to develop an implementation plan that would identify the means, necessary resources, and schedule to safely and expeditiously integrate civil UAS into the NAS. According to the UAS ARC the activities needed to safely integrate UAS include:

- identifying gaps in current UAS technologies, regulations, standards, policies, or procedures;
- developing new technologies, regulations, standards, policies, and procedures; and
- identifying early enabling activities to advance routine UAS operations in the NAS integration, and developing guidance material, training, and certification of aircraft, enabling technologies, and airmen (pilots).

Establishment of Test Sites

FAA has met two requirements in the 2012 Act related to the test sites by setting them up and making a project operational at one location.[13] In our 2014 testimony, we reported that in December 2013, 16 months past the deadline, FAA selected six UAS test ranges.[14] Each of these test sites became operational, during our ongoing work, between April and August 2014, operating under an Other Transaction Agreement (OTA) with FAA.[15] These test sites are affiliated with public entities, such as a university, and were chosen, according to FAA during our ongoing work, based on a number of factors including geography, climate, airspace use, and a proposed research portfolio that was part of the application. Each test site operator manages the test site in a way that will give access to other parties interested in using the site. According to FAA, its role is to ensure each operator sets up a safe testing environment and to provide oversight that guarantees each site operates under strict safety standards.[16] FAA views the test sites as a location for industry to safely access the airspace. FAA told us, during our ongoing work that they expect data obtained from the users of the test ranges will contribute to the continued development of standards for the safe and routine integration of UAS.

Under the OTAs, test sites are required to apply for a COA to operate a UAS,[17] and the COA requires the test sites to provide safety and operations data collected for each flight. However, while the test sites are operational, there are still questions regarding how they can contribute to

[13]The test sites are located at the University of Alaska (includes test ranges in Hawaii and Oregon); State of Nevada; New York's Griffiss International Airport (includes test range locations in Massachusetts); North Dakota Department of Commerce; Texas A&M University–Corpus Christi; and Virginia Polytechnic Institute and State University (Virginia Tech) (includes test ranges in New Jersey, partnered with Rutgers University).

[14]GAO-14-285T.

[15]OTAs are administrative vehicles used by the agency that take many forms and are generally not required to comply with federal laws and regulations that apply to contracts, grants, or cooperative agreements. OTAs enable the federal government and others entering into these agreements to freely negotiate provisions that are mutually agreeable.

[16]As part of these ranges, FAA designated airspace for integrated manned and unmanned flight operations, developed certification standards, and is working with each of the test site operators to verify the safety of UAS and related navigation procedures before integrating them into the national airspace.

[17]In order to fly under a COA the commercial entity leases its UAS to the public entity for operation.

the research and development supporting integration. According to FAA, it cannot direct the test sites to address specific research and development issues, nor specify what data to provide FAA, other than data required by the COA. FAA officials told us that some laws may prevent the agency from directing specific test site activities without providing compensation.[18] As a result, according to some of the test site operators we spoke to as part of our ongoing work, there is uncertainty about what research and development should be conducted to support the integration process. However, FAA states it does provide support through weekly conference calls and direct access for test sites to FAA's UAS office. This level of support requires time and resources from the FAA, but the staff believes test sites are a benefit to the integration process and worth this investment. In order to maximize the value of the six test ranges, FAA is working with MITRE Corporation (MITRE), DOD, and the test sites to define what safety, reliability, and performance data are needed and develop a framework, including procedures, for obtaining and analyzing the data. However, FAA has not yet established a time frame for developing this framework.

During our ongoing work, test site operators have told us that there needs to be incentives to encourage greater UAS operations at the test sites. FAA is, however, working on providing additional flexibility to the test sites to encourage greater use by industry. Specifically, FAA is willing to train designated airworthiness representatives for each test site. These individuals could then approve UASs for a special airworthiness certificate in the experimental category for operation at the specific test site. Test site operators told us that industry has been reluctant to operate at the test sites because under the current COA process, a UAS operator has to lease its UAS to the test site, thus potentially exposing proprietary technology. With a special airworthiness certificate in the experimental category, the UAS operator would not have to lease their UAS to the test site, therefore protecting any proprietary technology. According to FAA and some test site operators, another flexibility they are working on is a broad area COA that would allow easier access to the test site's airspace for research and development. Such a COA would allow the test sites to

[18]As a general proposition, an agency may not augment its appropriations from outside sources without specific statutory authority. The Antideficiency Act prohibits federal officers and employees from, among other things, accepting voluntary services except for emergencies involving the safety of human life or the protection of property. 31 U.S.C. § 1342.

handle the airworthiness certification, typically handled by FAA, and then allow access to the test site's airspace.

Granting Exemptions for Limited Commercial UAS Operations

FAA has started to use the authority granted under section 333 of the 2012 Act to allow small UASs access to the national airspace for commercial purposes, after exempting them from obtaining an airworthiness certification. While FAA continues to develop a regulatory framework for integrating small UASs into the NAS these exemptions can help bridge the gap between the current state and full integration. According to FAA, this framework could provide UAS operators that wish to pursue safe and legal entry into the NAS a competitive advantage in the UAS marketplace, thus discouraging illegal operations and improving safety. During our ongoing work, FAA has granted seven section 333 exemptions for the filmmaking industry as of December 4, 2014. FAA officials told us that there were more than 140 applications waiting to be reviewed for other industries, for uses such as precision agriculture and electric power line monitoring, and more continue to arrive.

Figure 1: Examples of Potential Commercial UAS Operations

Precision agriculture

Powerline inspection

Flare stack inspection

Powerline inspection

Source: FAA. | GAO-15-254T

While these exemptions do allow access to the NAS, FAA must review and approve each application and this process takes time, which can affect how quickly the NAS is accessible to any given commercial applicant. According to FAA, the section 333 review process is labor intensive for its headquarters staff because most certifications typically occur in FAA field offices; however, since exemptions under section 333 are exceptions to existing regulations, this type of review typically occurs at headquarters. FAA officials stated that to help mitigate these issues, it is grouping and reviewing similar types of applications together and working to streamline the review process.

Additional Challenges for FAA Integration

While FAA is making efforts to improve and accelerate progress toward UAS integration, additional challenges remain, including in the areas of authority, resources, and potential leadership changes. As we reported in February 2014, the establishment of the UAS Integration office was a positive development because FAA assigned an Executive Manager and combined UAS-related personnel and activities from the agency's Aviation Safety Organization and Air Traffic Organization. However, some industry stakeholders we have interviewed for our ongoing work have expressed concerns about the adequacy of authority and resources that are available to the office.[19] A UAS rulemaking working group, comprised of both government and industry officials, recently recommended that the UAS Integration Office be placed at a higher level within FAA in order to have the necessary authority and access to other FAA lines of business and offices. In addition, according to FAA officials, the Executive Manager's position may soon be vacant. Our previous work has found that complex organizational transformations involving technology, systems, and retraining key personnel—such as another FAA major initiative—NextGen—require[20] substantial leadership commitment over a sustained period, and also found that leaders must be empowered to make critical decisions and held accountable for results.[21]

[19]As of December 2014, FAA told us that they cannot identify total resources, both funding and personnel, dedicated to UAS integration because many different appropriations that support UAS work are managed by numerous organizations within the FAA. We plan on attempting to identify and report on the resources and budget that has been appropriated and planned for the integration of UAS into the national airspace as part of our on ongoing study.

[20]NextGen is a new satellite-based air-traffic management system that will replace the current radar-based system.

[21]GAO, *Results Oriented Cultures: Implementation Steps to Assist Mergers and Organizational Transformations,* GAO-03-669 (Washington, D.C.: July 2013); and *NextGen Air Transportation System: FAA Has Made Some Progress in Midterm Implementation, but Ongoing Challenges Limit Expected Benefits*, GAO-13-264 (Washington, D.C.: April 2013).

FAA and Others Have Made Some Progress in Carrying Out Research and Development in Support of UAS Integration

Several federal agencies and private sector stakeholders have research and development efforts under way to develop technologies that are designed to allow safe and routine UAS operations. As we have previously reported, agency officials and industry experts told us that these research and development efforts cannot be completed and validated without safety, reliability, and performance standards, which have not yet been developed because of data limitations. On the federal side, the primary agencies involved with UAS integration are those also working on research and development, namely, FAA, NASA, and DOD.

FAA uses multiple mechanisms—such as cooperative research and development agreements (CRDA),[22] federally funded research and development centers (FFRDC),[23] and OTAs (discussed earlier in this statement)—to support its research and development efforts. In support of UAS integration, FAA has signed a number of CRDAs with academic and corporate partners. For example, FAA has CRDAs with CNN and BNSF Railway to test industry-specific applications for news coverage and railroad inspection and maintenance, respectively. Other CRDAs have been signed with groups to provide operational and technical assessments, modeling, demonstrations, and simulations. Another mechanism used by FAA to generate research and development for UAS integration are FFRDCs. For example, MITRE Corporation's Center for Advanced Aviation System Development is an FFRDC supporting FAA and the UAS integration process. Specifically, MITRE has ongoing research and development supporting air traffic management for UAS detection and avoidance systems, as well as other technologies.[24]

FAA has cited many accomplishments in research and development in the past fiscal year, as we were conducting our ongoing work. According to FAA, it has made progress in areas related to detect and avoid

[22]A CRDA is an agreement that commemorates the collaborative partnership between the federal laboratory/agency and academia, local and state governments, and private entities.

[23]FAA's FFRDC's are located at MITRE and MIT's Lincoln Lab. FFRDC's are designed to meet long-term research and development needs that cannot be met effectively by other means.

[24]In addition, MITRE also has ongoing research and development supporting the development of standards and technologies for command and control communications link, analysis of safety and operational data.

technologies supporting ongoing work by RTCA Special Committee 228.[25] Other areas of focus and progress by FAA include command and control, as well as operations and approval. According to FAA, progress for command and control was marked by identifying challenges for UAS operations using ground-to-ground communications. FAA also indicated, during our ongoing work, that it conducted simulations of the effects of UAS operations on air traffic management. Furthermore, in support of research and development efforts in the future, FAA solicited for bids for the development of a Center of Excellence. The Center of Excellence is expected to support academic UAS research and development for many areas including detect and avoid, and command and control technologies. FAA expects to announce the winner during fiscal year 2015.

We have previously reported that NASA and DOD have extensive research and development efforts supporting integration into the NAS.[26] NASA has a $150-million project focused on UAS integration into the NAS. NASA officials that the current goal of this program is to conduct research that reduces technical barriers associated with UAS integration into the NAS, including conducting simulations and flight testing to test communications requirements and aircraft separation, among other issues. DOD has research and development efforts primarily focused on airspace operations related to detect and avoid systems. However, DOD also contributes to research and development focused on certification, training, and operation of UAS.

We reported in 2012 that outside the federal government, several academic and private sector companies are conducting research in support of advancing UAS integration.[27] Research by both groups focuses on various areas such as detect and avoid technologies, sensors, and UAS materials. For example, several private sector companies have developed technologies for visual sensing and radar sensing. Academic institutions have conducted extensive research into the use of various technologies to help the maneuverability of UASs.

[25]Formerly the Radio Technical Commission for Aeronautics, RTCA, is a private, not-for-profit corporation that develops consensus-based recommendations regarding communications, navigation, surveillance, and air traffic management (system issues). It is utilized as a federal advisory committee.

[26]GAO-13-346T, GAO-12-981.

[27]GAO-12-981.

Other Countries Have Progressed in UAS Integration to Allow Some Level of Commercial Use

A number of countries allow commercial UAS operations under some restrictions. A 2014 study, conducted by MITRE for FAA, revealed that Japan, Australia, United Kingdom, and Canada have progressed further than the United States with regulations supporting integration.[28] In fact, Japan, the United Kingdom, and Canada have regulations in place allowing some small UAS operations for commercial purposes.[29] According to this study, these countries' progress in allowing commercial access in the airspace may be attributed to differences in the complexity of their aviation environment.

Our preliminary observations indicate that Japan, Australia, United Kingdom, and Canada also allow more commercial UAS operations than the United States. According to the MITRE study, the types of commercial operations allowed vary by country. For example, as of December 2014, Australia had issued over 180 UAS operating certificates to businesses engaged in aerial surveying, photography, and other lines of business. Furthermore, the agriculture industry in Japan has used UAS to apply fertilizer and pesticide for over 10 years. Several European countries have granted operating licenses to more than 1,000 operators to use UASs for safety inspections of infrastructure, such as rail tracks, or to support the agriculture industry. While UAS commercial operations can occur in other countries, there are restrictions controlling their use. For example, the MITRE study showed that several of the countries it examined require some type of certification and approval to occur before operations. Also, restrictions may require operations to remain within line of sight and below a certain altitude. In Australia, according to the MITRE study, commercial operations can occur only with UASs weighing less than 4.4 pounds. However, the rules governing UASs are not consistent worldwide, and while some countries, such as Canada, are easing restrictions on UAS operations, other countries, such as India, are increasing UAS restrictions.

For our ongoing work, we spoke with representatives of the aviation authority in Canada (Transport Canada) to better understand UAS use and recently issued exemptions. In Canada, regulations governing the

[28]MITRE Corporation, *UAS International Harmonization: A Comparative Policy Assessment of Selected Countries*, Outcome 6, Output 4, (fiscal year 2014).

[29]According to the MITRE study, Japan's regulations also allow UAS operations for agricultural purposes with UASs weighing less than 220 pounds.

use of UAS have been in place since 1996. These regulations require that UAS operations apply for and receive a Special Flight Operations Certificate (SFOC). The SFOC process allows Canadian officials to review and approve UAS operations on a case-by-case basis if the risks are managed to an acceptable level. This is similar to the COA process used in the United States. As of September 2014, over 1,000 SFOCs had been approved for UAS operations this year alone. Canada issued new rules for UAS operations on November 27, 2014. Specifically, the new rules create exemptions for commercial use of small UASs weighing 2 kilograms (4.4 pounds) or less and between 2.1 kilograms to 25 kilograms (4.6 pounds to 55 pounds). UASs in these categories can commercially operate without a SFOC but must still follow operational restrictions, such as a height restriction and a requirement to operate within line of sight. Transport Canada officials told us this arrangement allows them to use scarce resources to regulate situations of relatively high risk. For example, if a small UAS is being used for photography in a rural area, this use may fall under the new criteria of not needing an SFOC, thus, providing relatively easy access for commercial UAS operations.

Finally, our ongoing work has found that FAA interacts with a number of international bodies in an effort to harmonize UAS integration across countries. According to FAA officials, the agency's most significant contact in Europe has been with the Joint Authorities for Rulemaking for Unmanned Systems (JARUS). JARUS is a group of experts from the National Aviation Authorities (NAAs) and the European Aviation Safety Agency. A key aim of JARUS is to develop recommended certification specifications and operational provisions, which countries can use during the approval process of a UAS. In addition, FAA participated in ICAO's UAS Study Group, an effort to harmonize standards for UAS. ICAO is the international body that, among other things, promotes harmonization in international standards. ICAO plans to release its UAS manual in March 2015, which will contain guidance about UAS integration for the states. Additional international groups that FAA interacts with in support of UAS integration include the Civil Air Navigation Services Organization, European Organization for Civil Aviation Equipment, and North Atlantic Treaty Organization (NATO).

Chairman LoBiondo, Ranking Member Larsen, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

Appendix 1: Selected Requirements and Status for UAS Integration under the FAA Modernization and Reform Act of 2012, as of December 2014

Deadline	FAA Modernization and Reform Act of 2012 requirement	Status of action
05/14/2012	Enter into agreements with appropriate government agencies to simplify the process for issuing COA or waivers for public UAS.	In process – MOA with DOD signed Sept. 2013; MOA with DOJ signed Mar. 2013; MOA with NASA signed Mar. 2013; MOA with DOI signed Jan. 2014; MOA with DOD's Director of Test & Evaluation signed Mar. 2014; MOA with NOAA still in draft.
05/14/2012	Expedite the issuance of COA for public safety entities	Completed
08/12/2012	Establish a program to integrate UAS into the national airspace at six test ranges. This program is to terminate 5 years after date of enactment.	Completed
08/12/2012	Develop an Arctic UAS operation plan and initiate a process to work with relevant federal agencies and national and international communities to designate permanent areas in the Arctic where small unmanned aircraft may operate 24 hours per day for research and commercial purposes.	Completed
08/12/2012	Determine whether certain UAS can fly safely in the national airspace before the completion of the Act's requirements for a comprehensive plan and rulemaking to safely accelerate the integration of civil UASs into the national airspace or the Act's requirement for issuance of guidance regarding the operation of public UASs including operating a UAS with a COA or waiver.	Completed
11/10/2012	Develop a comprehensive plan to safely accelerate integration of civil UASs into national airspace.	Completed
11/10/2012	Issue guidance regarding operation of civil UAS to expedite COA process; provide a collaborative process with public agencies to allow an incremental expansion of access into the national airspace as technology matures and the necessary safety analysis and data become available and until standards are completed and technology issues are resolved; facilitate capability of public entities to develop and use test ranges; provide guidance on public entities' responsibility for operation.	Completed
02/12/2013	Make operational at least one project at a test range.	Completed
02/14/2013	Approve and make publically available a 5-year roadmap for the introduction of civil UAS into national airspace, to be updated annually.	Completed
02/14/2013	Submit to Congress a copy of the comprehensive plan.	Completed
08/14/2014	Publish in the *Federal Register* the Final Rule on small UAS.	In process
08/14/2014	Publish in the *Federal Register* a Notice of Proposed Rulemaking to implement recommendations of the comprehensive plan.	None to date
08/14/2014	Publish in the *Federal Register* an update to the Administration's policy statement on UAS in Docket No. FAA-2006-25714.	None to date
09/30/2015	Achieve safe integration of civil UAS into the national airspace.	In process

Appendix 1: Selected Requirements and Status for UAS Integration under the FAA Modernization and Reform Act of 2012, as of December 2014

Deadline	FAA Modernization and Reform Act of 2012 requirement	Status of action
12/14/2015	Publish in the Federal Register a Final Rule to implement the recommendations of the comprehensive plan.	None to date
12/31/2015	Develop and implement operational and certification requirements for public UAS in national airspace.	In process
05/14/2017	Report to Congress on the test ranges	None to date

GAO analysis of FAA information. | GAO-15-254T

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

For further information on this testimony, please contact Gerald L. Dillingham, Ph.D., at (202)512-2834 or dillinghamg@gao.gov. In addition, contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement.

Staff Acknowledgments

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