



May 2021

# FAA WORKFORCE

## Better Assessing Employees' Skill Gaps Could Help FAA Prepare for Changes in Technology

Accessible Version



A Century of Non-Partisan Fact-Based Work

## FAA WORKFORCE

### Better Assessing Employees' Skill Gaps Could Help FAA Prepare for Changes in Technology

#### Why GAO Did This Study

FAA relies on a skilled and specialized workforce of nearly 45,000 employees to operate and oversee the national airspace system. However, changes in the aviation industry—including emerging technologies and non-traditional users, such as unmanned aircraft systems (i.e., drones)—will require FAA to increase oversight activities and seek additional critical skills for its workforce.

The FAA Reauthorization Act of 2018 included a provision for GAO to assess FAA's workforce-planning efforts, among other things. This report examines the extent to which FAA has: (1) identified the critical skills its current and future workforce will need as a result of changes in aviation technology and (2) determined whether its current workforce has those skills.

GAO analyzed FAA workforce-planning documentation, including documents describing its Strategic Workforce Planning Initiative. GAO interviewed officials from five selected FAA offices whose work will likely be affected by changing technologies. To obtain a range of perspectives, GAO interviewed representatives from industry associations and FAA labor groups, such as the National Air Traffic Controllers Association.

#### What GAO Recommends

GAO is recommending that FAA should ensure that planned skill gap assessments, conducted in coordination with FAA offices, are quantitative and include all mission-critical occupations. FAA concurred with our recommendation.

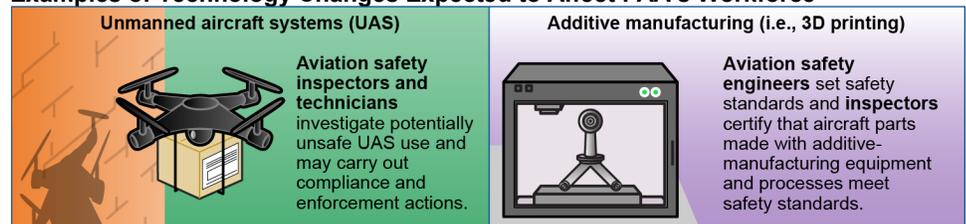
View [GAO-21-310](#). For more information, contact Heather Krause at (202) 512-2834 or [Krauseh@gao.gov](mailto:Krauseh@gao.gov).

#### What GAO Found

Through its workforce-planning initiative, the Federal Aviation Administration (FAA) identified critical skills needed for its workforce to respond to technology changes, such as those described in the figure below. The FAA's efforts are consistent with leading principles of effective workforce planning. These principles call for agencies to determine the critical skills needed to achieve current and future programmatic results. For example:

- In 2018, FAA's Office of Human Resource Management began an agency-wide Strategic Workforce Planning Initiative to assess the skills FAA's workforce needs today and will increasingly need in the future. These skills include data analytics, project management, and cybersecurity skills.
- Individual FAA offices also conduct workforce-planning activities. Selected offices have taken steps to identify critical future skills, such as specific technical skills for the engineers in the Office of Commercial Space Transportation.

#### Examples of Technology Changes Expected to Affect FAA's Workforce



Source: GAO analysis. | GAO-21-310

#### Text of Examples of Technology Changes Expected to Affect FAA's Workforce

- **Unmanned aircraft systems.** Aviation safety inspectors and technicians investigate potentially unsafe UAS use and may carry out compliance and enforcement actions.
- **Additive manufacturing** (i.e. 3D printing). Aviation safety engineers set safety standards and inspectors certify that aircraft parts made with additive- manufacturing equipment and processes meet safety standards.

FAA also has taken steps to determine whether its workforce has the skills needed to respond to technology changes, but these efforts have not been quantitative nor have they included all mission-critical occupations. In 2019, FAA conducted interviews with managers and staff to collect officials' perspectives on what skill gaps exist. While the qualitative interviews yielded useful information on the skills needed, they did not provide measurable data showing how many employees have the skills needed and where gaps exist. FAA also obtained some information on skill gaps in its workforce from a 2020 Department of Transportation workforce assessment, but FAA's response rate to that

assessment was low, ranging from 12 to 25 percent. As a result, the information FAA has collected may not provide a complete assessment of whether its workforce has the critical skills needed to respond to technology changes. Recognizing these limitations, FAA officials said they intend to conduct additional skill gap assessments. However, officials said that because FAA is a large and dynamic agency, the process of completing agency-wide skill gap assessments will require better coordination with individual FAA offices. Thus, FAA has shifted its focus to developing a strategic workforce- planning policy and community of practice to facilitate agency-wide coordination on workforce-planning activities. These efforts represent positive steps and could help FAA conduct more comprehensive skill gap assessments in the future.

---

# Contents

---

GAO Highlights	2
Why GAO Did This Study	2
What GAO Recommends	2
What GAO Found	2
Letter	1
Background	5
Consistent with Stakeholder Perspectives, FAA Identified Critical Skills Needed to Respond to Technology Changes through Its Workforce-Planning Initiative	10
FAA Has Conducted a Limited Assessment of Current Employee Skill Gaps and Plans to Improve Internal Coordination before Taking Additional Steps	18
Conclusions	23
Recommendation for Executive Action	24
Agency Comments	24
Appendix I: Technology Changes That Will Affect the Federal Aviation Administration’s (FAA) Workforce Needs	25
Appendix II: Comments from the Department of Transportation	30
Text of Appendix II: Comments from the Department of Transportation	31
Appendix III: GAO Contact and Staff Acknowledgments	32
GAO Contact	32
Staff Acknowledgments	32
Tables	
Text of Examples of Technology Changes Expected to Affect FAA’s Workforce	2
Table 1: Distribution of the Federal Aviation Administration’s (FAA) Employees across FAA’s Mission-Critical Occupations	7
Text of Figure 2: Examples of Technology Changes Affecting the Federal Aviation Administration’s (FAA) Work	8
Table 2: Skills That the Federal Aviation Administration’s (FAA) Officials Identified as Needed to Support Increasing Unmanned Aircraft System Activity	14

---

---

Figures

Examples of Technology Changes Expected to Affect FAA's Workforce	2
Figure 1: The Federal Aviation Administration's (FAA) Lines of Business and Staff Offices	5
Figure 2: Examples of Technology Changes Affecting the Federal Aviation Administration's (FAA) Work	8
Figure 3: Strategic Workforce Planning Incorporating Select Leading Principles	10

---

---

**Abbreviations**

DOT	Department of Transportation
FAA	Federal Aviation Administration
UAS	unmanned aircraft systems

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.

May 13, 2021

The Honorable Maria Cantwell  
Chair  
The Honorable Roger Wicker  
Ranking Member  
Committee on Commerce, Science, and Transportation  
United States Senate

The Honorable Peter DeFazio  
Chairman  
The Honorable Sam Graves  
Ranking Member  
Committee on Transportation and Infrastructure  
House of Representatives

The Federal Aviation Administration (FAA) relies on a skilled and specialized workforce to operate and conduct oversight of the national airspace system in the United States, including regulating the safety of civil aviation. FAA's workforce, consisting of nearly 45,000 employees, is responsible for a wide range of important activities. For example, FAA's workforce sets standards for certifying aircraft; ensures that manufacturers and suppliers meet those standards; maintains and operates air navigation facilities, systems, and equipment; and integrates aircraft in the national airspace system safely. However, the aviation industry is rapidly evolving, and new technologies are being introduced at a faster pace, changing how the agency conducts its work. For example, unmanned aircraft systems (UAS)—commonly known as drones—and commercial space transportation activities are increasing in U.S. airspace and newer technologies with automation, artificial intelligence, and digitalization capabilities are also on the rise. To ensure the safety of new users and technologies, FAA's oversight responsibilities and activities have increased, and its workforce will need certain skills to meet them. At the same time, FAA's workforce will increasingly need technical and other related skills.

Our prior work has highlighted challenges that FAA faces with adapting its workforce in response to its increasing oversight activities and the emergence of new technologies. For example, we reported that FAA faced challenges in providing inspectors with sufficient training and collecting information that its officials need to investigate and ensure UAS

users comply with regulations.<sup>1</sup> We have also reported that FAA needs to take further steps to ensure that the size, composition, and skills of its workforce align with projected commercial space workload and goals.<sup>2</sup> Moreover, with about 35 percent of the FAA's non-controller workforce eligible to retire within the next 5 years, FAA faces the challenge of developing an adequately trained workforce that is prepared to fill future vacancies.

The FAA Reauthorization Act of 2018 included a provision for GAO to, among other things, assess FAA's workforce-planning efforts in light of technology changes, such as increases in automation, digitalization, and artificial intelligence.<sup>3</sup> This report examines the extent to which FAA has:

- identified the critical skills its current and future workforce will need as a result of changes in aviation technology, and
- determined whether its current workforce has those skills.

To address both objectives, we reviewed government and industry studies and academic journal articles that discuss:

---

<sup>1</sup>In 2019, we recommended that FAA: (1) identify UAS-specific education and training needs for inspectors, and develop appropriate training to address any needs identified; (2) develop an approach to more effectively communicate key information to local law enforcement agencies regarding their expected role with regard to small UAS safety oversight; and (3) identify and obtain data needed to evaluate FAA's small UAS compliance and enforcement activities. Small UAS means an unmanned aircraft and its associated elements weighing less than 55 lbs. FAA subsequently implemented these recommendations. GAO, *Unmanned Aircraft Systems: FAA's Compliance and Enforcement Approach for Drones Could Benefit from Improved Communication and Data*, [GAO-20-29](#) (Washington D.C.: Oct. 17, 2019).

<sup>2</sup>GAO, *Commercial Space Transportation: Improvements to FAA's Workforce Planning Needed to Prepare for the Industry's Anticipated Growth*, [GAO-19-437](#) (Washington D.C.: May 23, 2019). We made four recommendations including that FAA: (1) develop workload metrics to determine appropriate workforce size and composition; (2) establish a timeline for finalizing workload projections that extend beyond the 2-year budget cycle; (3) ensure that FAA's skills assessment survey collects information from staff on skills and competencies both currently needed and needed in the future; and (4) develop and document a plan for periodically assessing whether staff possess the necessary skills and competencies to achieve programmatic goals. As of March 2021, FAA had implemented the third recommendation but had not implemented the remaining ones.

<sup>3</sup>FAA Reauthorization Act of 2018, Pub. L. No. 115-254, § 567, 132 Stat. 3186, 3386.

- new entrants and emerging technologies in the aviation industry that have increased automation, digitalization, and artificial intelligence, and
- how these technologies will affect FAA’s workforce.

To identify studies and articles, we searched selected websites—such as the FAA, Congressional Research Service, National Academies of Science, and Eno Center for Transportation—for government and academic studies, industry trade articles, and other publications that discussed technology changes in the aviation industry. In addition, we reviewed relevant studies and articles collected by other GAO teams working on similar studies. We also reviewed our prior work on leading principles for effective strategic workforce planning, and we evaluated FAA’s workforce-planning efforts against these criteria.<sup>4</sup> We focused our analysis on the principles related to:

- involving top management, employees, and other stakeholders in developing, communicating, and implementing the strategic workforce plan; and
- determining the critical skills that will be needed to achieve current and future programmatic results.

To assess the extent to which FAA has identified the critical skills its current and future workforce will need as a result of aviation technology changes, we reviewed FAA’s planning documents, including its strategic plan, human capital plan, and documents describing its Strategic Workforce Planning Initiative. We also interviewed officials from the Office of Human Resource Management about agency-wide workforce planning activities, including the following:

- steps the officials have taken to identify the effects of technology changes on FAA’s workforce,
- skills its workforce needs currently and for the future, and
- actions officials are taking to address any gaps in skills employees need to oversee changes in aviation technology.

We determined whether FAA’s efforts to identify skill needs specifically address technology changes occurring in the aviation industry, such as

---

<sup>4</sup>GAO, *Human Capital: Key Principles for Effective Strategic Workforce Planning*, GAO-04-39 (Washington, D.C.: Dec. 11, 2003).

increases in automation, digitalization, and artificial intelligence. In addition, we compared FAA's workforce-planning efforts to selected key principles for effective strategic workforce planning described above. To determine the extent to which FAA is meeting these criteria, we also reviewed documents and interviewed officials from five selected FAA offices whose work will likely be affected by changing technologies in the industry—Air Traffic Organization, Office of Aviation Safety, the Office of Commercial Space Transportation, the Office of Security and Hazardous Materials Safety, and the Office of NextGen Office.<sup>5</sup>

We also interviewed selected industry associations and labor groups to obtain their perspectives on the skills FAA's workforce needs, technological advancements, effects of aviation technology changes on the workforce, and the methods used by FAA to coordinate with industry. We selected the following industry and labor groups that work directly with our selected FAA offices or represent these workforces: the General Aviation Manufacturers Association, Aeronautical Repair Station Association, Aerospace Industry Association, National Air Traffic Controllers Association, and Professional Aviation Safety Specialist. We also interviewed a representative from FAA's Research, Engineering, & Development Advisory Committee.

To assess the extent to which FAA has determined whether its workforce has the critical skills it needs to oversee technology changes in the aviation industry, we reviewed documents and interviewed officials about actions FAA has taken to assess and address skill gaps in its workforce. We compared these actions against the selected key principles for effective strategic workforce planning described above. Additionally, we reviewed our prior work describing leading practices for developing effective training and development programs, identifying skill needs, and conducting an effective skills assessment and compared these practices to FAA's efforts.<sup>6</sup>

We conducted this performance audit from January 2020 to May 2021 in accordance with generally accepted government auditing standards.

---

<sup>5</sup>To identify which offices to include in our selection, we reviewed each FAA office's fiscal year 2019 business plan and available workforce plans and searched for examples of how technological changes are affecting the work conducted by these offices.

<sup>6</sup>GAO, *Human Capital: A Guide for Assessing Strategic Training and Development Efforts in the Federal Government*, [GAO-04-546G](#) (Washington, D.C.: Mar. 1, 2004) and GAO, *Federal Workforce: OPM and Agencies Need to Strengthen Efforts to Identify and Close Mission-Critical Skills Gaps*, [GAO-15-223](#) (Washington, D.C.: Jan. 30, 2015).

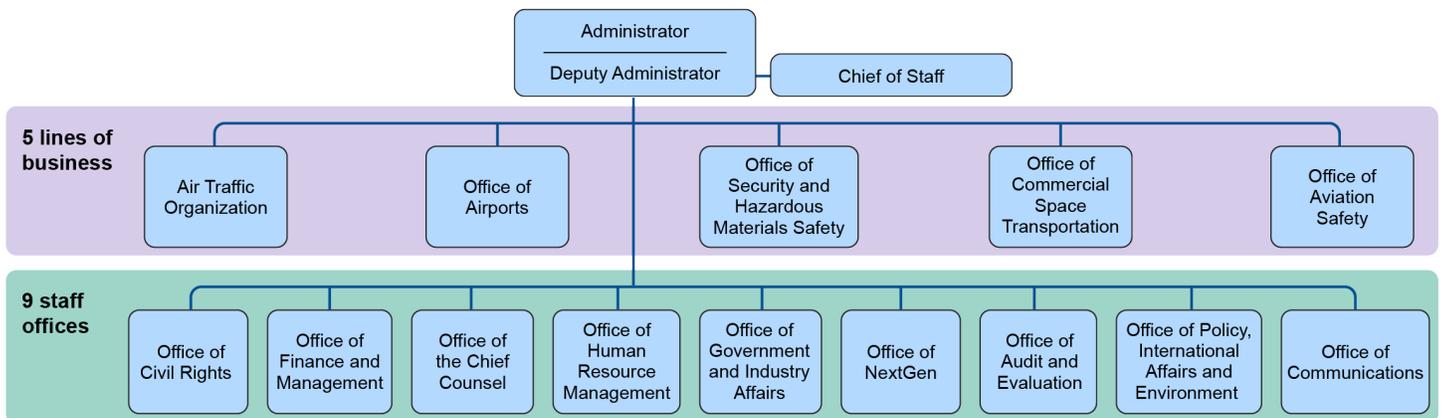
Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

## Background

FAA has five lines of business that carry out the agency’s primary responsibility of providing safe and efficient air travel, and nine staff offices that help administer key programs (see fig 1). Collectively, we refer to these 14 offices as “FAA offices” in this report. FAA’s Office of Human Resource Management plays a coordinating role in workforce planning across the agency. This office is responsible for developing agency-wide workforce-planning strategies, policies, and guidance, and for providing human resource services across all of these FAA offices at the headquarters and regional level. Specifically, this office is to:

- provide human resource support to the agency, which includes recruiting, hiring, and providing support on other personnel activities;
- assist with the development of competencies for FAA’s workforce;
- provide leadership training and development; and
- maintain FAA’s learning management system.

Figure 1: The Federal Aviation Administration’s (FAA) Lines of Business and Staff Offices



Source: GAO presentation of FAA information. | GAO-21-310

While FAA's Office of Human Resource Management provides support, the offices are to manage their own workforce-planning activities in accordance with agency-wide policies. A few individual offices also develop their own workforce plans or strategies, conduct their own workforce skill assessments, and produce their own staffing and attrition models to identify staffing needs. For example, the Office of Aviation Safety and the Air Traffic Organization develop and issue annual workforce plans, as required by statute.<sup>7</sup> In addition, while the Office of Human Resource Management provides agency-wide training and development on leadership and management, offices are responsible for developing and providing specialized technical training to their workforces.

As part of its workforce planning, FAA has identified employees in mission-critical occupations across the agency—occupations that it relies on to accomplish its safety mission. FAA has designated 13 categories of occupations across the agency as mission-critical. Eighty one percent of its 45,000 employees are in mission-critical occupations as shown in table 1 below.<sup>8</sup>

---

<sup>7</sup>For the statute relating to the Office of Aviation Safety, see the FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 606, 126 Stat. 11, 114. For the statutes relating to the Air Traffic Organization, see the Consolidated Appropriations Act, 2019, Pub. L. No. 116-6, 133 Stat. 13, 401 (codified at 49 U.S.C. § 44506 note), and Vision 100—Century of Aviation Reauthorization Act, Pub. L. No. 108-176, § 221, 117 Stat. 2490, 2526-27 (2003) (codified at 49 U.S.C. § 44502 note).

<sup>8</sup>Based on data from FAA and Federal Personnel Payroll System data as of October 27, 2020.

**Table 1: Distribution of the Federal Aviation Administration’s (FAA) Employees across FAA’s Mission-Critical Occupations**

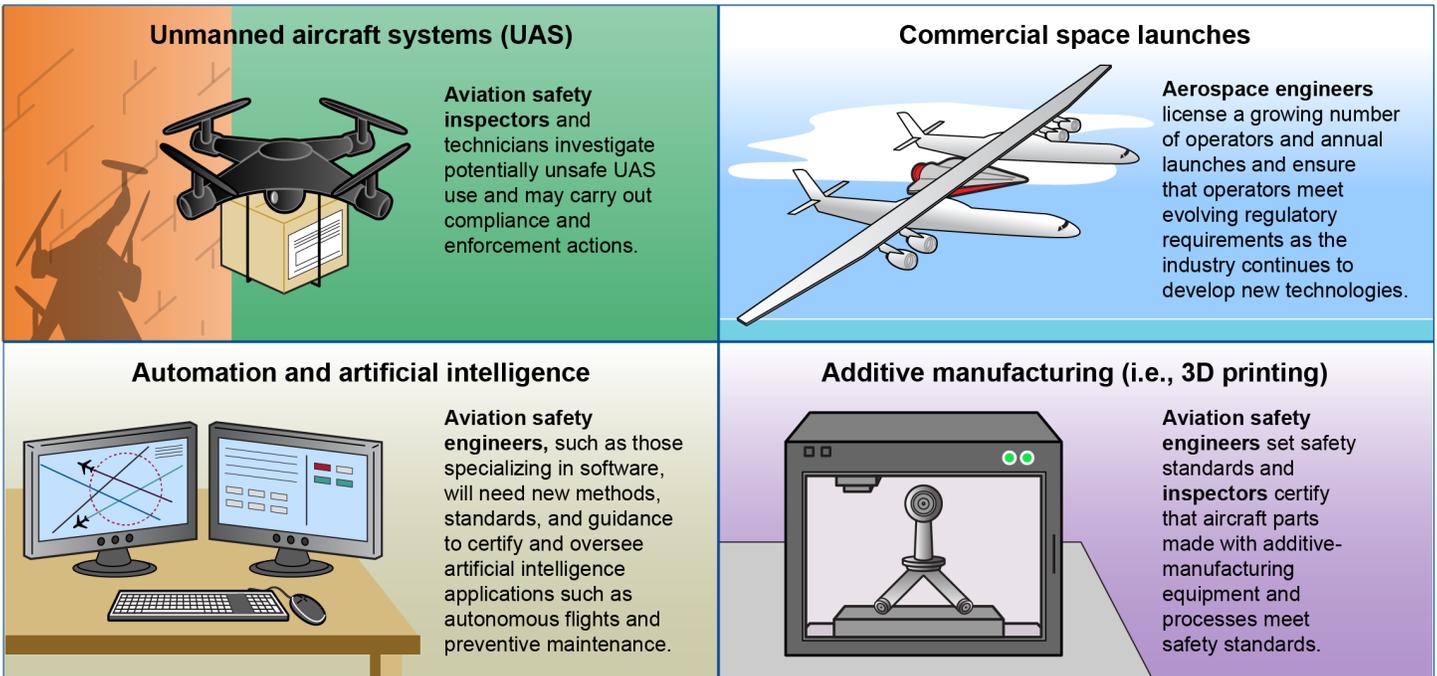
<b>Mission-Critical Occupation</b>	<b>Count and Percentage of FAA’s Total Employees</b>
Air Traffic Control Specialist	18,458 (41%)
Airway Transportation System Specialist	5,947 (13%)
Aviation Safety Inspector	4,198 (9%)
Professional Engineer	3,432 (8%)
Information Technology Specialist	1,912 (4%)
Engineering Technician	521 (1%)
Financial Specialist	507 (1%)
System Inspector	499 (1%)
Electronic Technician	365 (1%)
Human Resource Specialist	324 (1%)
Contract Specialist	301 (1%)
Operations Research Analyst	171 (0.38%)
Flight Surgeon	53 (0.12%)
<b>Total employees in mission-critical occupations</b>	<b>36,688 (81%)</b>
<b>Total employees in non-mission-critical occupations</b>	<b>8,386 (19%)</b>

Source: GAO analysis of data from the Federal Personnel and Payroll System as of October 27, 2020 and FAA. | GAO-21-310.

Note: The term, mission-critical occupations, refers to occupations determined by the Office of Personnel Management and the FAA as critical to mission operations.

FAA’s agency-wide workforce-planning efforts are critically important because the aviation industry today is undergoing significant changes that will affect its operating environment and workforce needs in the future. Changes, such as new types of users in the national airspace system and emerging technologies, will affect FAA’s work, as it is responsible for overseeing or regulating them in some capacity. In particular, as shown in figure 2, UAS and commercial space launches; additive manufacturing (i.e., 3D printing); and automation and artificial intelligence technologies are changing how FAA executes its mission and influencing how its workforce must evolve to meet expected and future work requirements. See appendix I for additional information about how these technology changes will affect FAA’s work.

Figure 2: Examples of Technology Changes Affecting the Federal Aviation Administration’s (FAA) Work



Source: GAO analysis. | GAO-21-310

Text of Figure 2: Examples of Technology Changes Affecting the Federal Aviation Administration’s (FAA) Work

- **Commercial space launches.** Aerospace engineers license a growing number of operators and annual launches and ensure that operators meet evolving regulatory requirements as the industry continues to develop new technologies.
- **Unmanned aircraft systems.** Aviation safety inspectors and technicians investigate potentially unsafe UAS use and may carry out compliance and enforcement actions.
- **Additive manufacturing (i.e. 3D printing).** Aviation safety engineers set safety standards and inspectors certify that aircraft parts made with additive- manufacturing equipment and processes meet safety standards.
- **Automation and artificial intelligence.** Aviation safety engineers, such as those specializing in software, will need new methods, standards, and guidance to certify and oversee artificial intelligence applications such as autonomous flights and preventive maintenance.

As technology changes in the aviation industry continue to evolve, it will become increasingly important that FAA's workforce-planning efforts are robust and adhere to leading practices. We have previously reported that strategic workforce planning is an essential component of an agency's human capital program, and in our prior work, we have identified several key principles and practices for effective strategic planning.<sup>9</sup> We relied on two key principles and practices in this report to assess FAA's workforce-planning efforts, because these principles are particularly relevant to FAA's efforts of ensuring its workforce is equipped to address technology changes:

- **Involvement of management and employees.** Obtaining input from managers, employees, and other stakeholders to inform workforce-planning efforts.
- **Determine critical skills needed.**<sup>10</sup> Determining the critical skills that will be needed to achieve current and future programmatic results and assessing any gaps between these skills and the skills of the existing workforce.

As shown in figure 3, workforce planning is an ongoing and continuous process whereby agencies re-evaluate and assess their workforce needs on an ongoing basis.

---

<sup>9</sup>In [GAO-04-39](#), we identify five key principles for workforce planning. We focused our analysis on principles that relate to identifying skill needs and gaps as well as using stakeholder input to inform workforce planning. The other workforce-planning principles include building the capability needed to support workforce strategies, and monitoring and evaluating the agency's progress toward its human capital goals. We also reviewed [GAO-04-546G](#), which describes four components for effective training and development. One of the components—planning/front-end analysis of training—describes practices for identifying skill needs and skill gaps.

<sup>10</sup>In this report, we use the word "skills" to refer to both skills and competencies. In our prior work, we have defined competencies to be observable, measurable sets of critical skills, knowledge, abilities, behaviors, and other characteristics an individual needs to successfully perform work roles or occupational functions. [GAO-15-223](#) and GAO, *DHS Strategic Workforce Planning: Oversight of Departmentwide Efforts Should be Strengthened*. [GAO-13-65](#) (Washington, D.C.: Dec. 3, 2012).

Figure 3: Strategic Workforce Planning Incorporating Select Leading Principles



Source: GAO. | GAO-21-310

## Consistent with Stakeholder Perspectives, FAA Identified Critical Skills Needed to Respond to Technology Changes through Its Workforce-Planning Initiative

### FAA Interviewed Managers and Employees to Identify Critical Skills Needed to Address Emerging Technologies

In 2018, FAA’s Office of Human Resource Management began an agency-wide Strategic Workforce Planning Initiative to guide its workforce-planning activities going forward. The Initiative was intended to assess current workforce skills, model the agency’s future workforce needs, and implement a strategy to close identified workforce gaps. The Office launched this Initiative to address a recommendation in a 2017 National Academy of Public Administration report, which found that FAA

lacked an agency-wide workforce planning strategy.<sup>11</sup> While understanding how technology changes are affecting FAA's workforce is one component of this effort, the Initiative has a broader focus and is examining how a wide range of external and internal drivers will affect FAA's operating environment in the future. For example, as part of this initiative, the Office examined how technology innovations—such as UAS, urban air mobility, additive manufacturing, and the potential use of supersonic aircraft—will affect FAA's operating environment in the future. According to agency documents, the Strategic Workforce Planning initiative is a continual ongoing effort that will, among other things, enable FAA to anticipate, plan for, and respond to changes, including emerging technologies. More specifically, this initiative is designed to:

- respond to evolving mission requirements, workforce needs, talent supply, and critical skills, and
- make decisions related to the workforce's size and composition, and future skill requirements across the agency.

As part of its Strategic Workforce Planning Initiative, Office of Human Resource Management officials have completed several activities to identify critical occupations and skill needs, including the skills and occupations to address changing technology. Several of these activities are consistent with leading principles for effective strategic workforce planning. These principles call for agencies to determine the skills that are critical to successfully achieve mission and goals using qualitative or quantitative information and to determine how different future environments may affect an agency's workforce needs.<sup>12</sup> For example, officials undertook the following activities:

---

<sup>11</sup>National Academy of Public Administration, *Federal Aviation Administration: Personnel Reform Effectiveness Assessment*, Academy Project Number: 2208 (Washington, D.C.: January 2017).

<sup>12</sup>We have reported that agencies can use various approaches for making a fact-based determination of the critical human capital skills needed for the future. For example, agencies can use qualitative approaches such as interviews with managers and executives or quantitative approaches such as employee surveys and training data, attrition rates, projected retirement rates, fluctuations in workload, geographic, and demographic trends. We have also found that scenario planning—an approach that agencies have used to manage risks of planning for future human capital needs in a changing environment—is an important element of workforce planning to determine how different future environments may affect an agency's workforce needs. [GAO-04-39](#).

- collected and analyzed agency-wide data to determine the percentage of FAA's workforce in each FAA office and in mission-critical occupations;
- reviewed how these percentages changed from fiscal year 2014 to fiscal year 2018; and
- examined actual and projected employee attrition rates.

This analysis examined the number of employees across FAA's current workforce and how those numbers are projected to change over time due to attrition rates.

To support this staffing analysis, the Office of Human Resource Management also undertook a substantive effort to interview a wide range of FAA officials to obtain their views on FAA's future workforce needs. This step was consistent with leading principles of effective workforce planning; these principles call for agencies to obtain input from managers, employees, and other stakeholders to inform workforce-planning efforts. Specifically, the Office:

- conducted interviews with 60 senior officials from 10 of the 14 offices to obtain their perspectives on current and future internal and external drivers affecting their work, workforce supply and demand, workforce occupations and skills, and top workforce-related challenges facing FAA in the next 3 to 5 years;<sup>13</sup> and
- facilitated a workshop that included focus group discussions with agency officials to obtain their perspectives on mission-critical occupations and skills FAA's workforce would need to support a future state with increased small UAS activity.

The Office of Human Resource Management coordinated with the UAS Integration Office—an office within the Office of Aviation Safety—on this workshop. In total 38 attendees—a mix of managers, supervisors and employees from 11 out of the 14 FAA offices—participated in the focus group discussions.

The culmination of these interviews and workshop discussions was a July 2019 *Baseline Workforce Assessment Report* and a December 2019 *Strategic Workforce Planning Gap Analysis Report*. Collectively these reports summarized the results of the Office of Human Resource

---

<sup>13</sup>According to FAA, in total they completed 11 individual interviews and 15 group interviews.

Management's staffing data analysis and also identified: (1) mission-critical occupations needed today and in the future, (2) critical skills that FAA employees will need over the next 3-to-5 years, and (3) critical skills needed to support the increased use of small UAS, as described below.

- Mission-critical occupations that FAA officials said are particularly important today and may be even more so in the future are aviation safety inspectors, air-traffic-controller specialists, airway transportation-system specialists, professional engineers, system inspectors, and engineering and electronic technicians. According to FAA's *Baseline Workforce Assessment Report*, senior officials cited several factors that are contributing to continued or increased demand for these occupations, including the following: (1) implementation of NextGen technologies, (2) the modernization of the national airspace system, and (3) the corresponding increase in the amount and complexity of aviation data. These factors will directly affect the work conducted by air traffic controllers, inspectors, technicians, engineers, and other occupations. For example, these officials stated that FAA would need more engineering technicians with the skills needed to both maintain the equipment and systems in the legacy national airspace system, and also help transition to newer technologies and systems in the national airspace system.
- Critical skills that FAA officials said employees across occupations need to learn are project management, data analytics, information management, strategic communication, air-traffic separation services to maintain safe aircraft distance, and safety inspection skills. For example, senior officials cited an overarching need for project management skills as the national airspace system continues to experience rapid changes from technologies (e.g., current data-reporting systems with cloud-based architecture), which can facilitate faster and larger data exchanges. These officials also stated that data analysis skills will be critical in the future because, as the aviation industry shifts toward a focus on automated technologies that generate substantial amounts of data, employees will need to be able to collect, analyze, and use data to support decision-making. They added that, to meet this need, FAA will need not only to cross-train existing employees in data analytics but also create new occupations to specifically perform data analysis on safety systems performance and employee performance metrics. Office of Human Resource Management officials stated that their office is advocating for additional data scientists and data analysis skills across all offices to strengthen competency in this area.

- In workshop discussions, FAA officials also provided their perspectives on critical skills that its workforce will need to support the increased use of small UAS. From these workshop discussions the Office of Human Resource Management compiled a list of skills needed and categorized these skills into three areas: core, technical, and leadership and management (see table 2). FAA summarized this information in its *Strategic Workforce Planning Gap Analysis Report*. While these skill needs were identified during workshop discussions about small UAS, Office of Human Resource Management officials stated these same skills would be needed more broadly in the future. Specifically, these officials stated that as other technology changes are introduced in the aviation industry—such as automated technologies, additive- manufacturing technologies, and new communications technologies—these same skills will be needed. According to agency documentation, Office of Human Resource Management officials selected small UAS as the focus for the first workshop from a list of nine possible workshop scenarios because of the overwhelming anticipated effect of UAS technology on air traffic management, regulations, aircraft certification, and other aspects of the national airspace system. Officials stated that they plan to conduct additional workshops similar to the UAS workshop covering different emerging technologies. In future workshops, they anticipate exploring scenarios on cybersecurity, artificial intelligence, and other technologies as they relate to specific workforces and individual offices.

**Table 2: Skills That the Federal Aviation Administration’s (FAA) Officials Identified as Needed to Support Increasing Unmanned Aircraft System Activity**

	Skills
<i>Core and Enterprise-Wide Skills:</i> Skills that all FAA employees should possess	Collaboration, partnering, and stakeholder management
	Communication
	Organizational awareness, “big picture” thinking, and systems thinking
	Problem solving, critical thinking, and analytical reasoning
	Creativity and innovation
<i>Technical Specific:</i> Skills that are required for certain occupations	Data analytics and data analysis
	Data management and data handling
	Human capital and human resource management
	Engineering
	Information technology
	Cybersecurity
	Policy and planning

---

---

	Skills
<i>Leadership and Management Skills: Skills needed in leadership roles</i>	Urban planning
	Leadership
	Change management
	Decision making
	Developing others
	Strategic thinking

---

Source: FAA. | GAO-21-310.

---

## Individual FAA Offices Have Also Identified Critical Skills Needed

In addition to FAA’s Office of Human Resource Management’s efforts, three of the FAA offices we spoke to have additional ongoing efforts to identify critical skills that their office’s workforce needs to address technology changes. These offices have conducted interviews and surveyed their workforce to collect data on skill needs, among other things. Some of the skills that these offices said they expect to see an increased need for in the future, as described below, were similar to those identified as part of the Office of Human Resource Management’s Strategic Workforce Planning initiative.

- **Office of Commercial Space Transportation.** In December 2019, this office assessed skill needs for the aerospace engineer occupation—which is a mission-critical position and the most common occupation in Office of Commercial Space Transportation. The office conducted this assessment in response to two recommendations we made in 2019—that it (1) collect information from staff on skills needed currently and that may be needed in the future and (2) assess whether staff possess the necessary skills to achieve programmatic goals.<sup>14</sup> As part of the assessment, officials surveyed staff and supervisors to identify technical and general skills required of engineers as well as gaps and training areas needing focus. The office identified computer-engineering and software-engineering skills for programming and conducting flight safety and system safety analysis as key technical skills aerospace engineers will need in the future.
- **Office of Aviation Safety.** Officials from this office stated that, in November 2019, their office began developing critical competencies

---

<sup>14</sup>[GAO-19-437](#).

for its engineer workforce. The competencies for engineers include technical areas, such as data analytics, systems thinking, project management, and risk-based decision-making as well as non-technical areas such as communication and stakeholder focus. These officials also stated that they plan to develop critical competencies for inspectors and other safety critical occupations.<sup>15</sup> In addition, the Air Traffic Safety Oversight Service office, an office within Aviation Safety responsible for providing independent oversight of the Air Traffic Organization, is currently conducting its first formal competency modeling to identify critical skill needs for the air-traffic safety inspector's position.

- **Air Traffic Organization.** This office recently completed a job task analysis of current airway transportation systems specialists (also referred to as “technicians”) to identify the knowledge, skills, and abilities essential for that position. Through that analysis, according to documentation from this office, they identified several non-technical and technical knowledge, skills, and abilities, including knowledge of computer networking, electrical and electronic theory, and radio frequency theory, among other skills. Officials told us that they are also working to identify the minimum skills that technicians working in the maintenance program will need in the future. In addition, these officials stated that the national airspace system Security and Enterprise Organization within the Air Traffic Organization would need to ensure it is hiring staff with the necessary cybersecurity knowledge and skills.

Office of Human Resource Management officials said that they intend the Strategic Workforce Planning Initiative to augment and support FAA offices' efforts. In 2020, these officials reached out to offices to inform them of the Strategic Workforce Planning Initiative and to offer to provide workforce-planning support based on analysis completed for the Strategic Workforce Planning Initiative. Officials in several offices we spoke to stated that they have begun working with the Office of Human Resource Management to begin to identify critical skills that their individual workforces will need in the future. For example:

---

<sup>15</sup>In November 2020, we recommended that the Office of Aviation Safety assess, on a recurring basis, organization-wide competency gaps for its inspector and engineer workforces. FAA concurred with this recommendation. GAO, *Aviation Safety: FAA's Office of Aviation Safety Should Take Additional Actions to Ensure Its Workforce Has Needed Skills*, [GAO-21-94](#), (Washington, D.C.: Nov. 9, 2020).

- According to officials from the Office of NextGen, they are coordinating with the Office of Human Resource Management to develop the Office of NextGen's strategic workforce plan. A key component of that effort will involve identifying critical skills needed in that office and how to maintain those skills. The Office of Human Resource Management began monthly meetings with the Office of NextGen in January 2021 to coordinate on these efforts. According to officials, the initial round of meetings were focused on sharing information about the Office of NextGen's workforce-planning needs and operating environment to develop the Office of NextGen's strategic workforce plan.
- Similarly, Office of Security and Hazardous Materials Safety officials stated that with the support of the Office of Human Resource Management, they are developing a strategic workforce plan that includes a four-phased approach to identify the key skills necessary to meet future demands, assess skill gaps, and identify strategies to close identified skill gaps.

Officials in the Office of Human Resource Management say they intend to continue reaching out to offices over time to incorporate information gathered from workforce planning activities in individual offices into agency-wide workforce planning efforts.

---

## Labor and Industry Representatives Identified Similar Skill Needs as FAA Officials

Skills that FAA officials identified as needed for the future are consistent with what we heard from some of the labor group, aviation industry, and advisory committee representatives we interviewed. These representatives discussed a number of technology developments that could affect how FAA does its work and the skills it needs. For example:

- Representatives from four of the six groups we interviewed said FAA will need more engineers with in-depth knowledge of software engineering or systems engineering, and related fields as new automated technologies are developed.
- Representatives from two of the six groups we interviewed said with increased automation in the aviation industry and with aviation technologies now collecting more data, data analysis has become a key component of aviation safety inspectors' responsibilities.
- Representatives from two of the six groups we interviewed said analyzing data to identify and eliminate potential risks will continue to

---

be a key component of the safety inspector role, especially as FAA has changed how it conducts its safety oversight work, transitioning to a risk-based approach that uses data proactively to identify emerging safety problems.

- Representatives from three of the six groups we interviewed said cybersecurity skills are critically important and FAA will need employees with cybersecurity expertise who can recognize potential risks, such as potential aircraft cybersecurity risks.<sup>16</sup>

---

## FAA Has Conducted a Limited Assessment of Current Employee Skill Gaps and Plans to Improve Internal Coordination before Taking Additional Steps

---

### FAA Used Interviews with FAA Managers and Staff and a Department of Transportation's (DOT) Assessment to Identify Skill Gaps, but this Information Was Not Comprehensive

While FAA has identified the critical skills needed, its effort to determine whether its current workforce has those skills has been limited. To assess whether it has the critical skills that FAA officials said will be needed, FAA's Office of Human Resource Management collected some information about skill gaps from (1) interviews conducted as part of FAA's Strategic Workforce Planning Initiative and (2) DOT's agency-wide skill gap assessment completed in 2020. We have previously reported that accurately assessing skill gaps is an important first step in identifying the most appropriate gap remediation strategies.

---

<sup>16</sup>We have previously recommended that FAA identify staffing and training needs for agency inspectors specific to avionics cybersecurity, and develop and implement appropriate training to address identified needs. FAA concurred with our recommendation. GAO, *Aviation Cybersecurity: FAA Should Fully Implement Key Practices to Strengthen its Oversight of Avionics Risks*, [GAO-21-86](#) (Washington D.C.: Oct. 9, 2020).

---

Interviews Conducted as Part of Strategic Workforce-Planning Initiative

The Office of Human Resource Management analyzed interview responses from interviews it conducted in 2019 with officials to identify critical skills FAA's workforce would need to support a future state with increased small UAS. The Office subsequently analyzed the interview responses from the workshop discussions as a means to identify some skills gaps across the agency related to emerging technology.<sup>17</sup> While this analysis was sufficient to identify the critical skills needed, it is not sufficiently comprehensive to fully measure skill gaps across FAA's workforce and develop actions to address skill gaps.

- First, the Office of Human Resource Management used qualitative interviews to collect FAA officials' perspectives on what skill gaps exist. This methodological approach did not yield measurable data on the distribution of its employees' current skills in a way that could be used to measure and identify gaps in skills. Leading practices specify that qualitative information, such as the information collected from FAA's interviews with officials, is sufficient to allow an agency to identify what skills will be critical to its workforce in the future; however, leading practices call for agencies to use comprehensive data-analytic methods to identify skill gaps.<sup>18</sup> This approach can include conducting a survey of employees and supervisors to develop an inventory of existing skills and identify skill gaps.
- Second, according to documentation, not all offices were able to participate in the workshop interviews due to scheduling constraints. Office of Human Resource Management interviewed a total of 38 officials from 11 out of the 14 offices to identify skill gaps across FAA's workforce. As a result, the information collected from these interviews may not reflect critical skill gaps that may exist across the workforce.

---

<sup>17</sup>This analysis was summarized in an internal FAA report titled *Strategic Workforce Planning Gap Analysis Report*.

<sup>18</sup>GAO, *A Model of Strategic Human Capital Management*, [GAO-02-373SP](#), (Washington D.C: March 15, 2002), [GAO-04-39](#), and [GAO-04-546G](#).

---

## DOT's Skill Gap Assessments

FAA's Office of Human Resource Management has also begun analyzing data from a 2020 DOT department-wide gap assessment to analyze skill gaps in selected FAA occupations. As required by the Office of Personnel Management, DOT conducts a department-wide gap assessment to identify any gaps between the skills employees currently possess and the skills employees should have.<sup>19</sup> DOT conducts the assessment every 3-to-4 years. DOT's 2020 gap assessment updated a similar gap assessment that was conducted in 2016. The focus of the assessment is to assess skill gaps of employees in government-wide mission-critical and DOT mission-critical occupations across the agency.<sup>20</sup>

DOT's methodology for completing this gap assessment was consistent with leading principles and practices for identifying skill gaps. Specifically, DOT consulted with subject matter experts from across the agency to identify the skills needed to perform successfully in these mission-critical occupations. DOT then surveyed employees in these occupations, asking them to rate their proficiency in each skill, and compared the responses to their supervisors' rating of their proficiency. This information was then used to identify skill gaps across DOT. Office of Human Resource Management officials stated that they had completed their review of the DOT's skills gap assessment results. Officials said that they are working with internal stakeholders to discuss the results and to generate ideas for addressing identified skill gaps.

However, DOT's skill gap assessment had shortcomings in three areas.

- First, in reviewing the gap assessment results, we found that the assessment did not comprehensively represent all occupations. Specifically, the response rate for employees in FAA mission-critical occupations ranged from 12 to 25 percent, which triggers significant questions about the reliability of the results. In particular, Aviation Safety Inspectors, Airway Transportation System Specialists, and Professional Engineers—three occupations that FAA officials cited as

---

<sup>19</sup>Personnel Management in Agencies, 81 Fed. Reg. 89,357, 89,365-6 (Dec. 12, 2016) (codified at 5 C.F.R. §§ 250.202, 250.204)

<sup>20</sup>The DOT survey assessed eight DOT-designated mission-critical occupations and six government-wide occupations. DOT's designated mission-critical occupations differ from FAA's mission-critical occupations, and as a result, some of FAA's mission-critical occupations were not included in the survey.

critical occupations—had a response rate of 16, 17, and 18 percent respectively.

- Second, while most of FAA’s mission-critical occupations—9 of 13—were surveyed as part of DOT’s gap assessment, four were not. Two of the occupations not surveyed—operations research analysts and system inspectors—play a key role in several FAA offices and were also identified by FAA officials as increasingly needed in the future.
- Third, DOT’s gap assessment was missing some of the skills that FAA officials identified as critical to FAA’s workforce. As previously discussed, some of the critical skills that FAA officials said they will need more of in the future include cybersecurity skills to manage and mitigate potential security threats, and systems thinking to understand the interdependencies of FAA’s operating environment and systems. However, these skills were not included in the DOT gap assessment.<sup>21</sup>

While the interviews and DOT skills gap assessment provide some information, these efforts provide FAA with a limited understanding of skill gaps. Specifically, the Office of Human Resource Management did not collect sufficient information through these efforts to identify how many employees have the critical skills needed and where skill gaps exist. For example, more than 80 percent of employees in mission-critical occupations did not respond to the DOT skill gap assessment. Without this information, FAA is unable to reliably quantify skill gaps. In addition, while these efforts may provide some information about skill gaps, they will only do so for part of the workforce. As a result, FAA does not have a complete understanding of whether its workforce has the critical skills needed to respond to technology changes. This lack of understanding can undermine efforts to identify and implement the most appropriate strategies to acquire critical skills. Without a more reliable and complete understanding of agency-wide skill gaps, FAA is not positioned to ensure that employees in critical occupations have the skills needed to carry out the agency’s mission.

---

<sup>21</sup>Some skills that FAA officials said will be critical in the future, such as change management, strategic thinking and leadership were assessed as part of the DOT gap assessment but only for the Information Technology mission-critical occupation and not the other FAA mission-critical occupations included in the assessment.

---

## FAA Expects to Conduct Future Skill Gap Assessments to Address Skill Gaps but Wants to Improve Coordination First

Recognizing that additional skill gap information is needed, Office of Human Resource Management officials said that they will complete additional skill gap assessments, but not until they improve coordination on workforce planning. According to officials, a critical first step is to build up its agency-wide capacity for conducting workforce planning and to establish a mechanism to coordinate with offices on agency-wide workforce-planning activities, including future skill-gap assessments and actions for acquiring critical skills. As such, the Office of Human Resource Management is in the process of developing an agency-wide workforce-planning policy that articulates roles and responsibilities for this office and other FAA offices. Office of Human Resource Management officials stated that the policy will serve as the cornerstone for enabling the Strategic Workforce Planning initiative across the agency and will help their office coordinate with individual offices on workforce-planning activities. Office of Human Resource Management officials also said that they have started drafting the agency-wide policy and plan to finalize the policy and obtain approval from agency deputies by the end of fiscal year 2021.

The Office of Human Resource Management is also establishing a strategic workforce-planning community of practice that is intended to provide a forum for FAA offices to collaborate regularly on workforce-planning activities and share information and best practices. Office of Human Resource Management officials said that their office and FAA offices share responsibility for assessing whether staff have needed skills. They stated that their goal is not to duplicate efforts that offices already have in place but to support those efforts, an approach that the community of practice should help facilitate. For example, the Office of Human Resource Management is currently coordinating with the Office of Aviation Safety on a plan to assess aviation safety inspectors' skills in that office. Officials said that they expect that as the agency's workforce-planning capability continues to grow, they will conduct additional skill gap assessments of additional mission-critical occupations, but that they will need to coordinate these efforts with individual offices. Officials said that the process of completing agency-wide skill gap assessments will require coordination with individual FAA offices and that the community of practice will provide the agency with a forum to coordinate on these additional skill gap assessments.

These two efforts represent positive steps toward establishing a better foundation for the Office of Human Resource Management to develop a more comprehensive and sound skill gap assessment. Office of Human Resource Management officials acknowledged that, because FAA is a diverse and dynamic agency, it will take agency-wide coordination and time to complete future skill gap assessments. Officials also said they will need to take a phased approach to complete future assessments and prioritize mission-critical occupations. Establishing an agency-wide workforce planning policy and community of practice could serve as effective tools to coordinate on future skill-gap assessments. Moreover, as the Office of Human Resource Management takes steps to ensure a more comprehensive understanding of skill gaps, it will be in a better position to determine which skill mitigation strategies to prioritize and invest in first and to target its resources towards implementing strategies that will address its most pressing skill gaps.<sup>22</sup>

---

## Conclusions

FAA's Office of Human Resource Management has taken several positive steps to enhance its agency-wide strategic workforce-planning efforts and to ensure its workforce is equipped with the skills it will need to effectively adapt and respond to the rapid pace of technology changes occurring in the aviation industry. In particular, FAA took a systematic approach to identifying the skills its mission-critical workforce will need to oversee aviation technology changes. However, FAA's efforts to assess gaps across the agency thus far have not been comprehensive and have resulted in limited information about which skills the agency has and which it still needs to develop or acquire. Identifying and understanding where skill gaps exist are key components of workforce planning and critical first steps to develop and implement appropriate recruitment, retention, and training strategies. As FAA moves forward with its efforts to improve coordination through better workforce-planning policies and a community of practice, it has an opportunity to address some of the limitations we identified with its skill gap assessment. Specifically, it can use these mechanisms to ensure that its efforts to assess its skill gaps

---

<sup>22</sup>Based on the workshop interviews, FAA's Office of Human Resource Management officials identified 78 actions—including strategies for recruiting, developing, and retaining employees—to acquire critical skills that FAA officials said FAA's workforce will need in the future. These officials said that they want to ensure that they have FAA offices' buy-in before implementing these actions and that they plan to use the community of practice to coordinate with FAA offices on prioritizing and implementing the 78 actions developed from FAA's skill analysis.

---

are based on more comprehensive quantitative information representing a high percentage of relevant employees and covering all mission-critical occupations.

---

## Recommendation for Executive Action

We are making the following recommendation to FAA's Office of Human Resource Management:

- The Assistant Administrator for Human Resource Management should ensure that planned skill gap assessments, conducted in coordination with FAA offices, are based on quantitative information about gaps in all critical skills for employees across all mission-critical occupations.

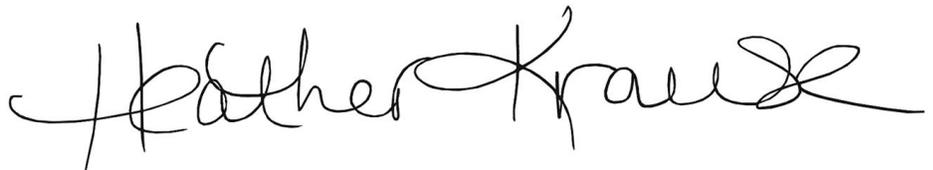
---

## Agency Comments

We provided a copy of this product to the Department of Transportation (DOT) for review and comment. In its written comments, reproduced in appendix II, DOT concurred with our recommendation. DOT also provided technical comments which we incorporated, as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, and other interested parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or [Krauseh@gao.gov](mailto:Krauseh@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



Heather Krause  
Director, Physical Infrastructure Issues

# Appendix I: Technology Changes That Will Affect the Federal Aviation Administration's (FAA) Workforce Needs

In documents that we reviewed and in our interviews with FAA and industry officials, several technology changes were identified as having an effect on the agency's workforce needs in the future. In particular, as described below, increases in unmanned aircraft systems (UAS) or drones, commercial space launches, automation and artificial intelligence technologies, and additive manufacturing were cited as affecting FAA's workforce.

---

## UAS

Small UAS—which weigh less than 55 pounds—are used for a variety of purposes, including aerial photography, crop monitoring, and infrastructure inspection.<sup>1</sup> These aircraft are typically flown via remote control by a pilot who is located on the ground. Although the aircraft are generally restricted from operating beyond the pilot's line of sight, a new FAA rule permits small UAS operating under certain conditions to operate over people not involved with the operation of the aircraft.<sup>2</sup> As part of its safety mandate, FAA regulates and oversees UAS operations' compliance, which includes prohibiting small UAS operators from operating in a careless or reckless manner that endangers the life or property of another, among other things.

According to agency documents, the most significant example of a technology change that is affecting the national airspace system today is the introduction, adoption, development, and increasing use of small UAS. FAA estimates there were about 1.5 million small UAS in the United

---

<sup>1</sup>Small UAS are being manufactured in large quantities by various companies and are popular among recreational users. Business and others are also interested in expanding small UAS operations for uses such as delivering packages and gathering video for news reporting.

<sup>2</sup>Operation of Small Unmanned Aircraft Systems Over People, 86 Fed. Reg. 4314 (Jan. 15, 2021) (to be codified at 14 C.F.R. part 107).

States in 2018, and the agency forecasts that there could be up to 3 million in the United States by 2023. According to FAA's December 2019 *Strategic Workforce Planning Gap Analysis Report*, increasing UAS will have an effect on FAA's air traffic management, regulations, aircraft certification, and direct and indirect functions to keep the national airspace safe. For example, the agency will be responsible for determining which of the existing certification standards will be applied to small UAS and how existing certification standards can be met or should be amended. According to FAA's *Strategic Workforce Planning Gap Analysis Report*, as the number of different types of UAS and the overall volume in operation increase, workload demands on inspectors, engineers, and analysts to evaluate, issue, and manage airworthiness certificates will also increase. Occupations that will be affected by increases in UAS include aviation safety inspectors and technicians who are responsible for investigating potentially unsafe UAS use and may carry out compliance and enforcement actions.

---

## Commercial space launches

The commercial space transportation industry provides launch services that enable national-security and commercial satellites, among other things, to be sent into orbit for government and private customers. The FAA plays a critical role in commercial space transportation by ensuring the protection of public safety during launch and re-entry operations. FAA's regulatory oversight responsibilities for commercial space transportation include licensing and permitting commercial launch and reentry vehicle operations (with a launch or reentry license) and non-federal launch sites (through a site operator's license), as well as conducting safety inspections of licensed launch providers and site operators. In 2020, the FAA licensed 41 commercial space operations (launches and reentries), the most in the agency's history. Those operations included 39 FAA-licensed launches, including the first ever NASA-crewed mission to be licensed. For 2021, the FAA is forecasting the number of licensed operations could reach 50 or more. In its *Strategic Workforce Planning Gap Analysis Report* FAA identified commercial space expansion and certification as one of several future state scenarios that will affect its workforce needs in the coming 1-3 years. According to FAA, it will need to assess the readiness of its workforce to meet the rising need for certification and regulation-related activities within the next 1 to 3 years.

In addition, in September 2020, FAA issued a rule that amended its commercial space-launch and reentry regulations to streamline the launch and reentry licensing requirements. The rule incorporates performance-based requirements that provide applicants flexibility in how they achieve required safety outcomes.<sup>3</sup> The Office of Commercial Space Transportation will need to ensure that it has the right number of staff with the appropriate expertise to conduct the analyses that will be required under the amended regulations. We previously reported that the Office of Commercial Space Transportation recognized that the composition of staff may no longer be appropriate, given planned regulatory changes.<sup>4</sup> For example, along with the regulations, FAA issued guidance that gives launch operators the option to use several specific methods to protect against multiple casualties during a launch, but also allows them to propose an alternate method that demonstrates an equivalent level of safety. In this case, FAA must compare the results of the alternate method to the expected casualty threshold in the newly issued regulation to determine whether the alternate method is acceptable.

---

## Automation and Artificial Intelligence

Emerging technological developments related to automation and artificial intelligence will increasingly be incorporated into new aviation products and will affect FAA's aviation workforce. For example, a study from the National Academies of Science noted that, while automation has been used in aviation almost from the beginning, automation and artificial intelligence will be increasingly incorporated in onboard aircraft technologies, unmanned aircraft and technologies used by air traffic controllers, traffic flow managers, and other air traffic management personnel.<sup>5</sup> Research and development, as well as the timely exposure of agency staff to industry developments related to automation and artificial intelligence, will be important in understanding these developments' effect on certification activities by aviation safety inspectors. Four out of the five industry and labor representatives we spoke to stated that FAA's

---

<sup>3</sup>Streamlined Launch and Reentry License Requirements, 85 Fed. Reg. 79,566, 79,567 (Dec. 10, 2020) (to be codified at 14 C.F.R. part 450).

<sup>4</sup>GAO, *Commercial Space Transportation: Improvements to FAA's Workforce Planning Needed to Prepare for the Industry's Anticipated Growth*, [GAO-19-437](#), (Washington D.C.: May 23, 2019).

<sup>5</sup>National Research Council, *Autonomy Research for Civil Aviation: Toward a New Era of Flight* (Washington, DC: The National Academies Press, 2014).

workforce will need additional skills as a result of increased use of automation and artificial intelligence technologies. For example:

- industry representatives stated that as aircraft become equipped with automated self-diagnostic capabilities, maintenance technicians will need to adjust to skills needed to evaluate the faults and take corrective action.
- labor representatives we spoke to also stated that technological developments related to automation will increase the agency's need for more engineers with in-depth knowledge of software engineering, systems engineering, cybersecurity, and related fields.
- Representatives from another industry association stated that FAA's workforce will need knowledge, skills, and abilities to establish safety requirements for the design and certification of complex automation and artificial intelligence systems.

In addition, a representative we interviewed from an FAA research, engineering, and development advisory committee stated that in order to assess and certify the safety of systems using automation and artificial intelligence, employees will need an understanding of non-deterministic systems and software (i.e., software that produces different outputs using the same inputs).

---

## Additive Manufacturing

Additive manufacturing (i.e., 3D printing) of aircraft parts is increasing as it is a cheaper alternative to traditional titanium manufacturing and allows for the production of more complex aircraft parts compared to more traditional manufacturing processes.<sup>6</sup> The production and processing of this type of manufacturing requires FAA approval, and according to FAA, to ensure the safety of aircraft, the agency will need to conduct research on the suitability of new materials. FAA aviation safety engineers are responsible for creating and administering safety standards and finding that the design shows compliance with those standards. FAA aviation safety inspectors approve and conduct safety oversight of manufacturer quality systems to ensure that each part produced conforms to the FAA-approved type design. This oversight includes airworthiness approval certification that aircraft parts made with additive manufacturing

---

<sup>6</sup>The term "additive manufacturing" refers to a layer-by-layer approach for producing 3D objects from a digital model using materials such as metal powders, plastic, and foundry sand.

---

**Appendix I: Technology Changes That Will  
Affect the Federal Aviation Administration's  
(FAA) Workforce Needs**

---

equipment, materials, and processes are manufactured in conformity to approved design data and meet safety standards. Industry officials we interviewed said that, in order to certify and inspect these new processes, inspectors need enough understanding of additive- manufacturing processes to approve quality systems and provide sufficient oversight. According to FAA's Aviation Safety Office officials, their office has been working to develop its expertise and capabilities in additive manufacturing through targeted hiring and training to ensure that their workforce has the ability to certify that products meet required safety standards. According to FAA, it is developing an additive-manufacturing road map, which will include training and education, development of regulation documents, and a research and development plan.

## Appendix II: Comments from the Department of Transportation



U.S. Department of  
Transportation  
Office of the Secretary  
of Transportation

Assistant Secretary  
for Administration

1200 New Jersey Avenue, SE  
Washington, DC 20590

April 22, 2021

Heather Krause  
Director, Physical Infrastructure Issues  
U.S. Government Accountability Office (GAO)  
441 G Street, NW  
Washington, DC 20548

Dear Ms. Krause:

The Federal Aviation Administration (FAA) is committed to ensuring that the FAA workforce has the skills necessary for an ever-evolving aviation industry. FAA's Office of Human Resource Management is developing an agency-wide competency model and leveraging data collected from Competency Assessments by the Department of Transportation (DOT). FAA is evaluating processes to improve skill gap analyses for all FAA occupations, such as updating the existing core and technical DOT competencies for Mission Critical Occupations (MCO), updating the FAA's leadership and managerial competencies, and building new competency models for non-MCO occupations.

Upon review of GAO's draft report, the Department concurs with the recommendation that FAA's Assistant Administrator for Human Resources Management ensure that "planned skill gap assessments, conducted in coordination with FAA offices, are based on quantitative information about gaps in all critical skills for employees across all mission-critical occupations." We will provide a detailed response to the recommendation within 180 days of the final report's issuance.

We appreciate the opportunity to respond to the GAO's draft report. Please contact Madeline Chulumovich, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if GAO would like to obtain additional details about these comments.

Sincerely,

A handwritten signature in black ink, appearing to read "Philip A. McNamara".

Philip A. McNamara  
Assistant Secretary for Administration

---

## Text of Appendix II: Comments from the Department of Transportation

April 22, 2021

Heather Krause, Director, Physical Infrastructure Issues

U.S. Government Accountability Office (GAO) 441 G Street, NW

Washington, DC 20548

Dear Ms. Krause:

The Federal Aviation Administration (FAA) is committed to ensuring that the FAA workforce has the skills necessary for an ever-evolving aviation industry. FAA's Office of Human Resource Management is developing an agency-wide competency model and leveraging data collected from Competency Assessments by the Department of Transportation (DOT). FAA is evaluating processes to improve skill gap analyses for all FAA occupations, such as updating the existing core and technical DOT competencies for Mission Critical Occupations (MCO), updating the FAA's leadership and managerial competencies, and building new competency models for non- MCO occupations.

Upon review of GAO's draft report, the Department concurs with the recommendation that FAA's Assistant Administrator for Human Resources Management ensure that "planned skill gap assessments, conducted in coordination with FAA offices, are based on quantitative information about gaps in all critical skills for employees across all mission-critical occupations." We will provide a detailed response to the recommendation within 180 days of the final report's issuance.

We appreciate the opportunity to respond to the GAO's draft report. Please contact Madeline Chulumovich, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if GAO would like to obtain additional details about these comments.

Sincerely,

Philip A. McNamara

Assistant Secretary for Administration

---

## Appendix III: GAO Contact and Staff Acknowledgments

---

### GAO Contact

Heather Krause, (202) 512-2834 or [Krauseh@gao.gov](mailto:Krauseh@gao.gov)

---

### Staff Acknowledgments

In addition to the contact named above, Heather Halliwell and Susan Zimmerman (Assistant Directors); Maria Mercado (Analyst-in-Charge); Richard Hung; Terence Lam; Elizabeth Leibinger; Steven Lozano; Oluwaseun Ajayi; Josh Ormond; Amy Rosewarne; and Elizabeth Wood made key contributions to this report.

---

---

## GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

---

## Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through our website. Each weekday afternoon, GAO posts on its [website](#) newly released reports, testimony, and correspondence. You can also [subscribe](#) to GAO's email updates to receive notification of newly posted products.

---

## Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, <https://www.gao.gov/ordering.htm>.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

---

## Connect with GAO

Connect with GAO on [Facebook](#), [Flickr](#), [Twitter](#), and [YouTube](#).  
Subscribe to our [RSS Feeds](#) or [Email Updates](#). Listen to our [Podcasts](#).  
Visit GAO on the web at <https://www.gao.gov>.

---

## To Report Fraud, Waste, and Abuse in Federal Programs

Contact FraudNet:

Website: <https://www.gao.gov/fraudnet/fraudnet.htm>

Automated answering system: (800) 424-5454 or (202) 512-7700

---

---

## Congressional Relations

Orice Williams Brown, Managing Director, [WilliamsO@gao.gov](mailto:WilliamsO@gao.gov), (202) 512-4400,  
U.S. Government Accountability Office, 441 G Street NW, Room 7125,  
Washington, DC 20548

---

## Public Affairs

Chuck Young, Managing Director, [youngc1@gao.gov](mailto:youngc1@gao.gov), (202) 512-4800  
U.S. Government Accountability Office, 441 G Street NW, Room 7149  
Washington, DC 20548

---

## Strategic Planning and External Liaison

Stephen J. Sanford, Acting Managing Director, [spel@gao.gov](mailto:spel@gao.gov), (202) 512-4707  
U.S. Government Accountability Office, 441 G Street NW, Room 7814,  
Washington, DC 20548



**Please Print on Recycled Paper.**