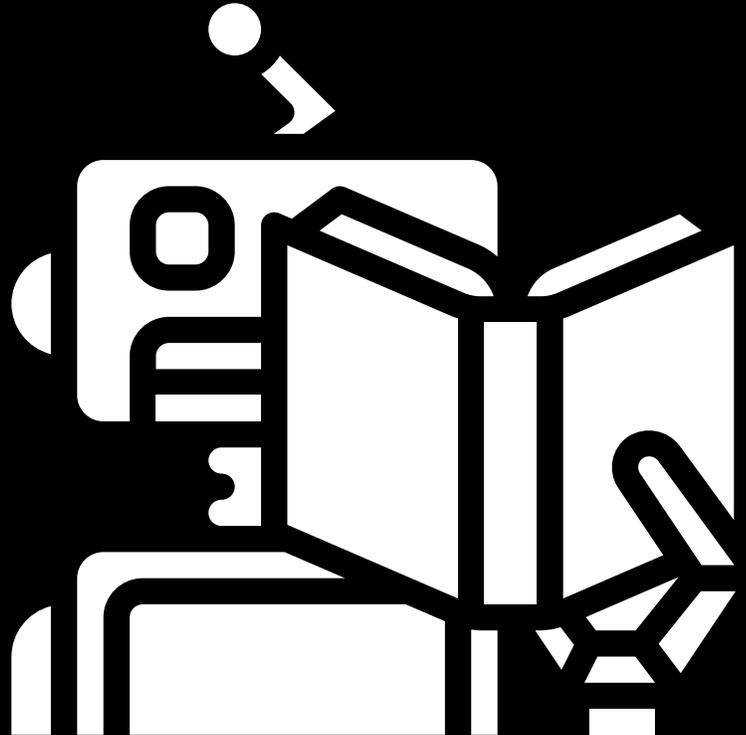


MORE THAN MEETS AI

ASSESSING THE IMPACT OF ARTIFICIAL INTELLIGENCE
ON THE WORK OF GOVERNMENT



FEBRUARY 2019



PARTNERSHIP FOR PUBLIC SERVICE



IBM Center for
The Business of Government

The Partnership for Public Service is a nonpartisan, nonprofit organization that works to revitalize the federal government by inspiring a new generation to serve and by transforming the way government works. The Partnership teams up with federal agencies and other stakeholders to make our government more effective and efficient. We pursue this goal by:

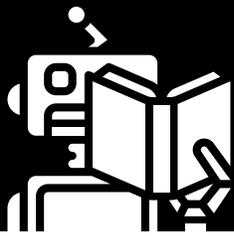
- Providing assistance to federal agencies to improve their management and operations, and to strengthen their leadership capacity.
- Conducting outreach to college campuses and job seekers to promote public service.
- Identifying and celebrating government's successes so they can be replicated across government.
- Advocating for needed legislative and regulatory reforms to strengthen the civil service.
- Generating research on, and effective responses to, the workforce challenges facing our federal government.
- Enhancing public understanding of the valuable work civil servants perform.

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Through research stipends and events, the IBM Center for The Business of Government stimulates research and facilitates discussion of new approaches to improving the effectiveness of government at the federal, state, local and international levels. Since its creation in 1998, the Center has awarded research stipends to public management researchers in the academic and nonprofit communities that have resulted in nearly 350 reports—all of which are available on the Center's website at businessofgovernment.org.

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Foreword

Human beings have been interested in intelligent automation as far back as ancient times, when Greeks believed an automated man made of bronze circled Crete several times a day to protect Europa, the mother of the island's King Minos, from pirates and invaders.

This myth from more than 2,000 years ago perhaps prophesized the vision people have today of relinquishing routine tasks to machines, so people can take on assignments that require creative thinking and high-level reasoning. Now, it is not a bronze man performing a daily job, but artificial intelligence that is automating everyday tasks at an increasing rate. The world is grasping the possibility that technology could simplify numerous repetitive jobs.

Government has taken notice. In May 2017, Congress established the bipartisan Congressional Artificial Intelligence Caucus, and members have since introduced numerous pieces of legislation on AI. On the other end of Pennsylvania Avenue, the administration launched the American AI Initiative through a February 2019 executive order. It calls on agencies to prioritize research and development investments in AI, improve access to data and the computing power AI systems rely on, create guidelines for dependable AI technology and take steps to prepare the American workforce for the coming disruption. The Defense Department also recently released its own strategy on how to incorporate AI into national security.

The federal government will not be immune to technological changes. Agencies and their leaders will have to manage challenges that arise from the extensive disruption AI brings while taking advantage of the opportunities it presents. Federal employees will need new technical and social skills to succeed in AI-augmented workplaces.

The Partnership for Public Service and the IBM Center for The Business of Government believe the opportunities AI affords far outweigh the challenges. AI could enable agencies to fulfill their numerous roles more efficiently and effectively by reducing or eliminating repetitive tasks, revealing new insights from data, improving customer service and enhancing agencies' ability to achieve their missions.

Drawing from multiple discussions with current and former federal executives and leading academics in the AI field, this paper highlights steps government needs to take for successful implementation. We focus on three areas of impact these experts agreed agencies will need to consider and manage: a transformed workday, the potential for personalized customer service and the increased importance of technical and data skills.

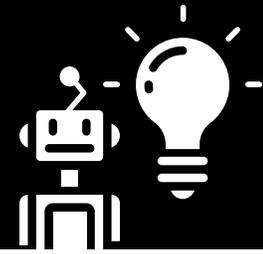
We aim to spark a conversation on the use of AI, help prepare federal leaders to assess the inevitable changes coming and provide government leaders with insights to navigate this transformative time.

The federal government can lead or follow on AI. We believe agencies can lead, and we are optimistic that they will meet the challenge.

Max Stier
President and CEO
Partnership for Public Service

Daniel Chenok
Executive Director
IBM Center for The Business of Government

Introduction: Artificial Intelligence Will Revolutionize How Government Employees Work



The federal government must be ready for a boom in the use of artificial intelligence. How agencies incorporate AI into their work and manage the potential impact on the workforce has implications beyond the professional lives of federal employees. It affects all Americans and millions more outside our borders. Federal agencies must become knowledgeable about AI if they hope to develop effective policies for technologies such as self-driving cars or applications that protect our national security.

AI is expected to revolutionize how government works. For one, AI could enable federal employees to focus on core responsibilities related to their agencies' missions and spend fewer hours on administrative duties. They are likely to have more time to deliver services, interact with customers and perform other mission-related tasks.

Should AI become pervasive in federal agencies, employees will need to enhance their digital and data literacy and learn how best to use the technology to work with citizens effectively.

AI is sure to change the composition of the federal workforce, creating new jobs related to managing

AI systems or requiring critical thinking. Jobs based mainly on tasks that can be automated would likely be phased out, and employees would have to learn new or different skills for other jobs. We aim to quantify some of AI's impact on the page that follows.

The changes brought on by AI would not be the first substantial disruption of the federal workforce. In 1985, 19 percent of full-time federal employees held clerical positions.¹ In 2017, they constituted just 4.3 percent in the workforce, according to Office of Personnel Management data. During those years, desktop computers and other technologies automated many clerical tasks, and new employees were hired to deliver programs in newly created agencies such as the Department of Homeland Security.

Whatever changes AI brings will not be immediate but an evolution that will play out over years and decades. It will not be "like a light switch," said Timothy Persons, chief scientist at the Government Accountability Office.

¹ Congressional Budget Office, "Changes in Federal Civilian Employment," July 1996, 14. Retrieved from <https://bit.ly/2Dw7TlJ>

Methodology

The Partnership for Public Service and the IBM Center for The Business of Government set out to examine the opportunities and challenges artificial intelligence presents to federal government operations. During our research, we learned about many ways AI is likely to impact agencies and their employees. However, given the scope of our study, this white paper focuses on only three of those areas.

The pages that follow are part of a multiyear series. This paper comes on the heels of the January 2018 release of "The Future Has Begun: Using Artificial Intelligence to Transform Government," the Partnership and the IBM Center's first study on AI in government. We will present additional AI-related issues for government to consider in a subsequent research paper slated for publication later in 2019.

The ideas presented in this white paper are based on two roundtable discussions the Partnership and the IBM Center hosted in July and October of 2018 as well as interviews we conducted in October and November of 2018. The 43 people who participated have AI expertise in a variety of sectors and fields.

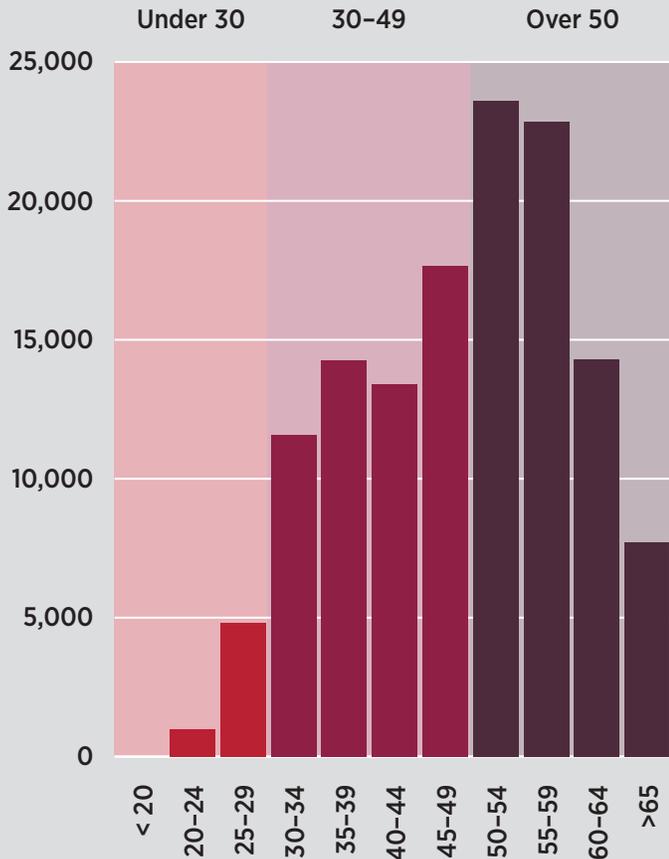
On Artificial Intelligence

The term artificial intelligence refers to machines and software able to perform tasks we typically associate with humans, such as recognizing speech or images, predicting events based on past information or making decisions. Machine learning, another commonly used term, is a subset of AI that uses large amounts of data and information to continually improve how the system performs a task.

The computing power behind AI enables machines to complete tasks faster than humans, and machines do not tire after hours or days of repetitive tasks. AI is continuing to improve at tasks such as transferring information from paper to computers, answering questions by quickly finding relevant information in large databases or long documents, detecting patterns in troves of data, making decisions about simple queries, and predicting someone's behavior based on past conduct.

The Potential of AI to Transform Federal Work

AGE BREAKDOWN OF EMPLOYEES IN OCCUPATIONS LIKELY TO SEE NEAR-TERM IMPACT FROM AI



AGENCIES WITH THE LARGEST SHARE OF OCCUPATIONS LIKELY TO SEE NEAR-TERM IMPACT FROM AI

| AGENCY | PERCENTAGE OF WORKFORCE AFFECTED | TOTAL EMPLOYEES AFFECTED |
|---|----------------------------------|--------------------------|
| Department of the Treasury | 36% | 28,664 |
| Government Publishing Office | 28% | 490 |
| Securities and Exchange Commission | 22% | 975 |
| Pension Benefit Guaranty Corporation | 19% | 178 |
| Merit Systems Protection Board | 18% | 38 |
| Department of Defense | 17% | 16,183 |
| Federal Election Commission | 14% | 45 |
| Department of Transportation | 9% | 5,273 |
| Federal Retirement Thrift Investment Board | 9% | 25 |
| Department of Housing and Urban Development | 8% | 670 |

130,000

the number of employees who work in occupations likely to be affected by AI

The Partnership and the IBM Center set out to explore the occupations where AI has the opportunity to transform work in the near term.

Our analysis found more than 80 different federal occupations for which data shows there is substantial opportunity for federal leaders to transform the work of their agencies. More than 130,000 federal employees worked in these occupations in fiscal 2017, holding a wide-range of responsibilities from examining taxes and inspecting food to scheduling cargo and operating cranes.

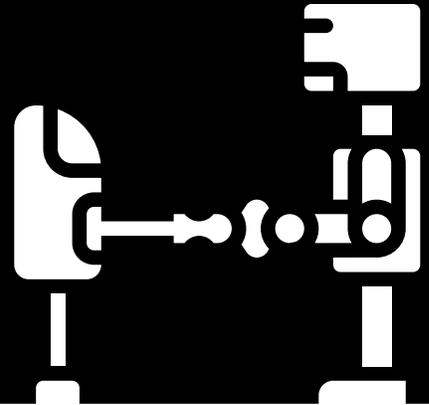
Some agencies are more likely than others to have significant opportunities to use AI. Data shows that more than a third of the Treasury Department's staff are in occupations where employees could strategically use the technology. Additionally, both the Government Publishing Office and the Securities and Exchange Commission have considerable opportunity to use AI in select occupations.

We recognize that the full extent of AI's impact is uncertain. We simply cannot predict with certainty how far-reaching the effect will be or what share of the occupations we identified will indeed be affected. The broader AI expert community also expresses a wide range of views about when AI's impact will become pronounced. Some experts say we will have to wait decades while others say we will see the impact in mere years. Either way, federal leaders have the opportunity now to embrace AI's potential and lead the way in transforming the nature of federal work.

See appendix A on page 13 for a detailed methodology and data sources.

I. Artificial Intelligence Will Transform the Federal Workday

Experts predict that automating administrative tasks will be one of AI's initial benefits. Over time, federal employees will spend less time on repetitive administrative work and more of their workday on tasks that are core to their agencies' missions, from mitigating hazards in workplaces to following up on complicated applications for grants or other government services.



Ten or 20 years from now, a federal workday is likely to unfold differently than a workday today. An AI transformation is expected to start with the automation of repetitive tasks, freeing up employees' time to focus on mission-critical work. In the long term, however, AI will change the nature of jobs and how humans work alongside machines.

A food safety inspector could spend more time advising on sanitation standards in restaurants or stores than on processing food sample data, with AI pointing out where and how facilities are falling short. A tax examiner could take more time to follow up with taxpayers whose returns AI identifies as potentially incorrect rather than spend hours compiling and recording routine tax returns. And an occupational safety technician might use more of the day developing recommendations for safer workplaces than on categorizing information on job injuries, based on AI's determination of which occupations are most hazardous.

Documenting information is among the most common tasks federal employees do now, spending about 10 percent of their time on it annually, according to one study of Department of Labor data.² Combined with other administrative duties, these responsibilities take up to 30 percent of employees' time—a day and a half in an average workweek.³

The burden of clerical work is more pronounced in some occupations than others. Physicians at the Department of Veterans Affairs, for example, “spend two hours on administrative work for every hour they spend with patients,” according to department estimates. Similarly, child welfare caseworkers in 2014 spent 38 percent of their time on documentation and administration,

² Peter Viechnicki and William Eggers, “How much time and money can AI save government?” Deloitte Center for Government Insights, 2017, 7. Retrieved from <https://bit.ly/2B8FzuA>

³ Ibid.

according to a Colorado state study.⁴

“These are the so-called mundane tasks that almost no public employee wants to do,” said Kevin Desouza, a professor of business, technology and strategy at Queensland University of Technology in Australia.

The impact of AI will be most visible for employees through the “transformation of the tasks within a job,” said Chuck Howell, chief scientist for dependable artificial intelligence at the MITRE Corporation. “There is a lot of simple clerical work which will no longer be required or at least will be a much smaller part of an individual's day.”

Instead, it is expected that as an early benefit of AI, agencies will complete routine tasks more rapidly and efficiently. AI will “enable us to do things in new ways: reach more people, do things faster and do things that are on a larger scale,” said Craig Jolley, senior data scientist at

⁴ ICF International, “Colorado Child Welfare County Workload Study,” August 2014, 27. Retrieved from <https://bit.ly/2qTDjS5>

the U.S. Agency for International Development.

For example, the U.S. Coast Guard now uses AI to analyze satellite images to identify vessels at sea that might be smuggling humans, wildlife, drugs or arms. This saves the Coast Guard from patrolling randomly, hoping to stumble upon criminals in action. National Aeronautics and Space Administration scientists use AI to search for planets in data and images that space telescopes collect. In 2017, AI helped NASA discover a new planet—Kepler-90i—by analyzing more than 35,000 pieces of telescope data. And AI pilot programs underway in several Department of Health and Human Services divisions aim to speed up blood sample inspection, health-record reviews, and food-sample collection and management, among other goals.⁵

These are just a few examples of

AI's progression in government. "No agency is immune," Desouza said. Jenn Gustetic, digital research fellow at the Harvard Kennedy School, agreed. "Automating the routine is something that can apply anywhere, regardless of where you are."

In the long term, the transformation of federal work will likely go beyond automating the routine and will impact the nature of jobs. For some employees, the change might mean safer jobs. For example, AI could protect the lives of law enforcement agents, who can now police high-crime areas using a video-recording drone with help from AI to analyze the footage. With the benefit of videos showing criminal activity, agents can do a better job preparing for a threat before putting themselves in harm's way. Without that information, there is a higher

likelihood of agents getting ambushed with no warning while on patrol.

For other federal employees, AI could lead to more engaging jobs. AI is helping the Labor Department's Bureau of Labor Statistics read and sort through hundreds of thousands of responses to an annual survey on occupational injuries and illnesses. Bureau staff can now focus on more complex tasks, such as asking clarifying questions from those who were injured, or work with other parts of the department to shape policy proposals that can prevent similar injuries from happening in the future.

⁵ Department of Health and Human Services, "Secretary's Ventures Fund Projects," 2018. Retrieved from <https://bit.ly/2pRdwrD>

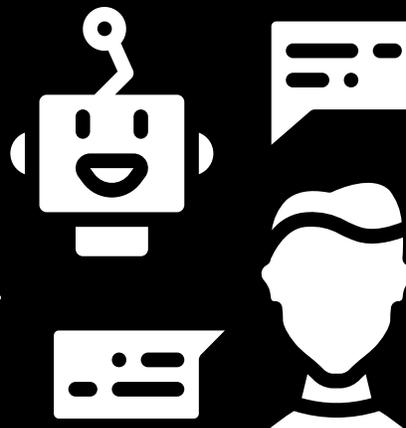
Recommendations

Agency political leaders and senior executives will have to manage change if artificial intelligence transforms the federal workday as foreseen.

- Leaders should communicate with employees early and often about the potential of AI to disrupt and alter their work. Leaders and managers should learn from early adopters of AI, such as the U.S. Coast Guard, NASA and the Department of Health and Human Services. They should find out the extent to which the workday changed for employees, what types of agency work AI helped these organizations accomplish, which tasks were automated successfully, and what kind of work employees might start doing in place of current, repetitious tasks that AI could perform.
- The Office of Management and Budget should focus on AI in the context of cross-agency priority goals, showing the federal workforce the "art of the possible." Through these CAP goals, OMB and agencies should focus on government-wide areas of concern where AI could improve mission delivery, such as helping connect health care data across agencies or identifying critical talent gaps and searching through resumes for qualified candidates. Government also should monitor progress made toward the CAP goal to demonstrate AI's value to agency missions and reveal potential challenges agencies will need to address.

II. The Use of Artificial Intelligence Could Enable More Personalized Services to Agency Customers

If AI, as predicted, decreases time spent on clerical work and increases the amount of information that can be collected and analyzed, employees could focus more of their attention on customer service and tailor services to the needs of individuals.



Many observers who envision greater use of AI in government picture more face-to-face interactions between agency employees and customers, and additional opportunities for more personalized customer services. The shift toward employees engaging more with agency customers is expected to be one of several possible effects of automating administrative tasks.

Relieved of burdensome paperwork, immigration officers could spend more time interacting with visa applicants or following up on individual immigration cases. Scientists could allot more of their day to working with research study participants. And grants managers could take more time to learn about and support individual grantees.

On average, federal employees now spend only 2 percent of their time communicating with customers and other people outside their agencies, or less than one hour in a

workweek, according to one study.⁶

At the same time, citizens want government to do better. The experiences customers have with companies is driving demand for personalized government services. In a survey of more than 6,000 people from six countries, including the United States, 44 percent of respondents identified personalized government services as a priority.⁷

To fulfill that demand, employees may have to be trained or retrained in customer service.

Personalized customer experience is the norm in the private sector, and people's expectations for good

service have risen. Government lags behind in this area for the most part, according to MITRE's Howell. "There is a big gap between my expectations and my user experience with the private sector and with government agencies," he said. "Most interactions I have with government are like Groundhog Day. We start as strangers and we slowly but surely build up a shared understanding of my case or my background. Then that information evaporates."

Some agencies are already responding. The U.S. Agency for International Development, for example, is partnering with organizations such as Colombia's International Center for Tropical Agriculture to help farmers predict rain, drought and other weather conditions, according to USAID's Jolley. It can be complex for rural Colombian farmers to figure out when and what to plant, and when to harvest, according to a USAID case study. More accurate weather

6 Peter Viechnicki and William Eggers, "How much time and money can AI save government?" Deloitte Center for Government Insights, 2017, 7. Retrieved from <https://bit.ly/2B8FzuA>

7 Joanne Veto, "Citizen Enthusiasm for Personalized Government Services and Digital Innovation Are on the Rise, Accenture Survey Finds," Accenture, Sept. 20, 2018. Retrieved from <https://accentu.re/2DpztaD>

forecasts help with those decisions.⁸

The availability of more data and AI's ability to analyze that information helps provide weather forecasts tailored to specific farms. These forecasts—and recommendations based on them—take into account particular farms' characteristics, such as altitude, land slope, plant varieties or soil type, rather than calculating weather data averages and applying them to entire regions.

AI enables USAID and other agencies to “reach a larger number of people in an individual way,” and offer services geared toward individual farmers or families, Jolley said.

Similarly, with AI collecting, storing, connecting and analyzing vast quantities of data relatively rapidly, more agencies could analyze data faster to derive new insights

on how to serve individuals rather than extrapolating from higher-level data on communities.

⁸ U.S. Agency for International Development, “Reflecting the Past, Shaping the Future: Making AI Work for International Development,” 2018, 26. Retrieved from <https://bit.ly/2DsTBbZ>

Recommendations

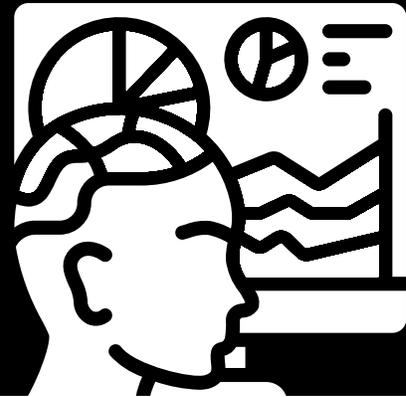
As artificial intelligence enables employees to focus more on the customer, federal agencies should help their employees improve their customer service skills.

- Federal employees should receive training that emphasizes skills for handling interactions with agency customers with the help of AI. “Social literacy” entails skills such as active listening, communication, critical thinking, negotiation, persuasion, reading comprehension and writing. These skills will become more important as employees are able to spend more time with customers.
- Agency recruiters and hiring managers should assess job applicants for the skills listed above. Some digital tools already enable hiring managers to assess job candidates for these capabilities. For one, USA Hire, an online skills and qualifications assessment offered to agencies by the Office of Personnel Management, measures social literacy through decision-making, interpersonal skills and reading comprehension, among other skills.

III.

Artificial Intelligence Will Put Technical and Data Skills Front and Center

Federal employees in the future will need new skills to succeed in a world with AI. Creating, understanding, managing and working with AI requires technical, digital and data literacy that much of the workforce currently lacks.



Artificial intelligence will change the set of skills federal employees need to use in the future compared to the required skills today.

A government more widely powered by AI would likely lead to agencies training employees or hiring more people with analytical, statistical and investigative skills. With less need for human beings to do clerical work, library technicians could use more of their day writing information-cataloguing software. Environmental scientists might spend more time evaluating sample data that machines compile for them instead of on the initial steps of transferring and compiling the data. Claims specialists could use their statistical skills to discern why an AI system recommends approving or denying customers' applications for government services, rather than on transcribing paperwork.

As the government relies more on AI, federal employees will need a shared understanding about the technical, societal, economic and governmental aspects of AI and

the data it relies on, said MITRE's Howell. Agency staff should have a "baseline" of technical skills and familiarity, he added.

Other interviewees agreed. "If you're a [Department of Veterans Affairs] nurse, you don't necessarily need to know how to code" AI systems, said GAO's Persons. "Your focus is going to be on effective delivery of care to the patient. But it does mean you should understand, 'How does the robot know how to get the right drug from the dispensary?'" he said. Knowledge of how AI works "will have to be inculcated into the workforce," he added.

Understanding AI means comprehending probability theory, the branch of mathematics that measures the likelihood of events occurring, Persons said. AI arrives at its conclusions based on the probability of a picture showing a cat rather than dog, for example, or a person saying, "real eyes" rather than "realize."

Additionally, employees will need to understand the data AI uses, how AI algorithms work with the data and

how to interpret the results of AI's data analysis. Their work will entail evaluating the quality of data going into the system to determine if bias exists and whether AI's predictions or recommendations can be trusted.

Consider an AI system that assesses job applications. If most applicants for an open position are men, the system could conclude that being male is a position requirement and discount applications from women, leading to biased or incorrect recommendations. If bias like this is not caught and corrected, AI will operate with incorrect assumptions. Employees would need analytical skills to recognize the potential bias in job application data, deduce the cause and fix the problem.

Federal employees also must be able to assess whether AI presented the right conclusion, and explain how AI arrived at its conclusion, whether it's to a grant applicant whose request was denied or to a congressional committee with questions about the process. "Everybody will be a bit of a data scientist in the future. It doesn't matter

if you are an HR person, an IT person or a business person,” said Dorothy Aronson, chief information officer at the National Science Foundation. Natesh Manikoth, chief data officer at the Federal Aviation Administration, agreed. “There’s a general data literacy that we will have to have.”

How employees use AI-related skills eventually could mirror how employees today use spreadsheet software such as Excel. That is, most employees will know some basics while employees who rely on it heavily would know the software well. “If you ask the question, ‘Who’s good at using Excel?’ that’s a very broad span of people. And who gets to be best at it? The people who need it the most,” Aronson said.

Government would also need AI specialists—people with advanced technical and data skills. “Humans are going to be needed to design, plan, install, manage and maintain any robotics, technology, or AI systems,”

according to Bernard Marr.⁹ A World Economic Forum analysis found increasing demand for specialists who understand and can use the latest technologies, including AI and machine-learning experts, robotics engineers, and “human-machine interaction designers.”¹⁰

As these specialists come on board, project managers will have to know how to manage teams that involve humans and intelligent machines. For example, employees might get assistance from bots—simple computer programs that do repetitive tasks such as identifying keywords in online queries. “Whether you work in a warehouse or the White House, you’ll need to know how to team with these bots and robots. You’ll need to know when to trust them and how

9 Bernard Marr, “7 Job Skills Of The Future (That AIs And Robots Can’t Do Better Than Humans),” *Forbes*, Aug. 6, 2018. Retrieved from <https://bit.ly/2QVN6Cx>

10 World Economic Forum, “The Future of Jobs Report,” 2018, 8. Retrieved from <https://bit.ly/2xeWN7e>

to test them,” according to the Institute for the Future.¹¹

Yet training for new job skills has not been available to the degree many federal employees would like. Government-wide, only 53.3 percent of respondents are satisfied with the training they receive for their current job, 12.7 percentage points lower than in the private sector, according to the Partnership’s 2018 Best Places to Work in the Federal Government® rankings.

Additionally, a large percentage of federal managers responded that their agency did not train them on technology it bought, said Jeff Neal, senior vice president at ICF, referencing a 2018 study by the National Academy of Public Administration. “Training is not sexy. New toys are,” he said.

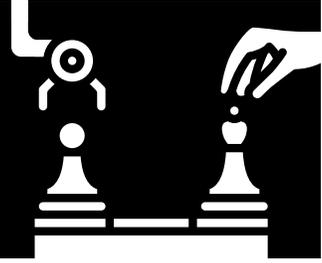
11 Institute for the Future, “Future Skills: Get Fit for What’s Next,” 2018, Retrieved from <https://bit.ly/2Fuxowr>

Recommendations

As artificial intelligence becomes more ubiquitous in federal workplaces, the federal government should emphasize expertise in technical, digital and data skills.

- The Office of Management and Budget and Congress should provide sufficient funding for AI and related technical training. Federal employees will need extensive and ongoing training in technology, digital skills and data analysis to succeed in an AI workplace.
- The Office of Personnel Management should consider establishing an AI occupational series in line with the proposed AI in Government Act of 2018, which directs OPM to create a new occupational series or change an existing one to focus on AI-related tasks. Employees in this AI job series would have the primary responsibility for managing AI in government.
- OMB should work with the General Services Administration to establish a team for AI talent similar to the U.S. Digital Service, an information technology talent and consulting group in government. This AI team should be governed by rules that make it easy to hire top AI talent from the private sector for time-limited stints in government, helping federal agencies that need expertise for AI projects.

Conclusion



Widely publicized advancements in artificial intelligence in the past few years have put AI front and center for governments, companies and individuals, whether it was AI winning the quiz show “Jeopardy!” or AI systems helping to simplify government procurement. AI has become ubiquitous in our homes and private lives through smartphone applications, smart appliances and virtual assistants. Now AI is starting to transform our offices and the way we work.

The federal government, one of the world’s largest employers, is bound to face disruption from AI. As leaders incorporate the technology into their agencies, they will have to oversee employees who will face myriad changes in their work lives.

At the same time, federal employees will play a crucial role for other sectors adopting AI, whether by writing regulations on self-driving cars or ensuring malicious actors are not exploiting AI-powered algorithms. This essential role underscores the need for government to become a responsible user and customer of the technology, address ethics and transparency in AI implementation, and translate its experience with AI into guidance for other sectors.

The changes AI drives are expected to unfold over years and decades. Some observers say AI’s full impact will not be felt for another century. But the evolution has begun, and federal agencies should be ready to manage their workforces in this new world.

Every part of our government, from federal agencies to the White House to Congress, plays a role in ensuring this transition to an AI-augmented federal workplace is as smooth as possible and that federal employees have the skills to thrive. The Partnership and the IBM Center hope that our continuing research and recommendations will help guide leaders through the transformation.

Appendix A

Artificial Intelligence's Workforce Impact by the Numbers – Methodology

To identify the federal jobs AI-driven automation will substantially impact, the Partnership and the IBM Center cross-referenced federal occupations with private sector occupations marked as susceptible to automation in “The Future of Employment: How Susceptible Are Jobs to Computerisation?” a September 2013 Oxford University study by Carl B. Frey and Michael A. Osborne.

“The Future of Employment” is among the most referenced studies on the future of work. The study ranks 702 different occupations from not computerizable, marked as “0” probability of computerization in the study, to computerizable, marked with a probability of “1.” For example, according to the study’s methodology, an occupation with 0.003 probability of computerization is “First-Line Supervisors of Mechanics, Installers, and Repairers.” An occupation with 0.99 probability of computerization is “Mathematical Technicians.”

The study classifies occupations using six-digit Standard Occupational Classification System codes. The SOC system, managed by the Bureau of Labor Statistics, is a “federal statistical standard used by federal agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data,” according to the bureau.

To match the study’s occupations with federal jobs, we used the Equal Employment Opportunity Commission’s “EEOC Federal Sector Occupation Cross-Classification Table.” The EEOC’s table links the Oxford study’s six-digit SOC-coded occupations with four-digit Office of Personnel Management occupational series codes. For example, the table matches the SOC system’s “43-2021—Telephone Operators” occupation with the “0382—Telephone Operating” OPM federal occupational series.

Given the time and scope limitations of our research, we only considered occupations in the Oxford study that:

- Had a direct match to a four-digit OPM occupational series; that is, we excluded matching occupational groups and families that contain multiple occupations.
- Were identified as having a 0.9 or higher probability of computerization.

We then asked two experts to examine and vet this methodology before data collection. We chose individuals from the private sector and academia with expertise in:

- Government management.
- Artificial intelligence.
- Research methodologies.

Once we identified OPM occupational series most likely to be impacted by automation and computerization based on the above methodology, we used OPM’s FedScope, the federal employment statistics website, to quantify how many federal employees are in such occupations. We also analyzed these occupational series by agency, location, age, race and educational level.

As a final step, two Partnership staff examined and checked the data collected from FedScope based on the above described and vetted methodology. We chose Partnership staff with expertise in:

- FedScope.
- Research methodologies.

Appendix B Acknowledgements

The individuals listed below generously offered their input on artificial intelligence’s impact on the federal workforce. We greatly appreciate their time and counsel. However, the contents of this report do not necessarily reflect the views of those with whom we spoke. Additionally, the views of participating federal officials do not necessarily reflect positions or policies of the federal government or its agencies.

Roundtable Participants

| | | |
|---|--|--|
| Calvin Andrus Data Scientist Central Intelligence Agency | Joseph Greenblott Associate Director, Analysis Division Environmental Protection Agency | Alexander Measure Economist Bureau of Labor Statistics, Department of Labor |
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