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AI Enables Efficient and Effective Digital Government

by Vipin Jain and Seema Jain

Artificial intelligence (AI) is quickly becoming more science fact than science fiction. And despite concerns about thinking machines taking human jobs – or one day outsmarting their makers – the US federal government's investment in AI technology is growing and could be applied to a wide range of functions, from healthcare to public safety and defense/intelligence applications to employee performance.

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AI Enables Efficient and Effective Digital Government

by Vipin Jain and Seema Jain

A computer would deserve to be called intelligent if it could deceive a human into believing that it was human.

— Alan Turing

Artificial intelligence (AI) is quickly becoming more science fact than science fiction. And despite concerns about thinking machines taking human jobs — or one day outsmarting their makers — the US federal government's investment in AI technology is growing and could be applied to a wide range of functions, from healthcare to public safety and defense/intelligence applications to employee performance. Can cognitive technologies do government employees' thinking for them? Not yet. But they can augment employees' capabilities and free up billions of labor hours for more critical tasks — while delivering faster, better, and cheaper services.

The application of AI technologies can reduce backlogs, redesign work, cut costs, overcome resource constraints, enable more accurate predictions, and do myriad tasks not previously practical for humans to do on their own. Because of these potential benefits, the US government has invested in AI research for many years, and various committees and taskforces continue to investigate the technologies. Indeed, the opportunities that emerge from AI will help to transform the relationship between people, process, and technology (see Figure 1).

AI in the US Government: Strategic Directions

The US National Artificial Intelligence Research and Development Strategic Plan¹ establishes a set of objectives for federally funded AI research — research occurring within the government as well as federally funded research occurring outside of government, such as in academia. The goal of this research is to produce new AI knowledge and technologies that provide a range of positive benefits to society, while minimizing the negative impacts. To achieve this goal, the Strategic Plan identifies seven priorities and makes the following recommendations for federally funded AI research:

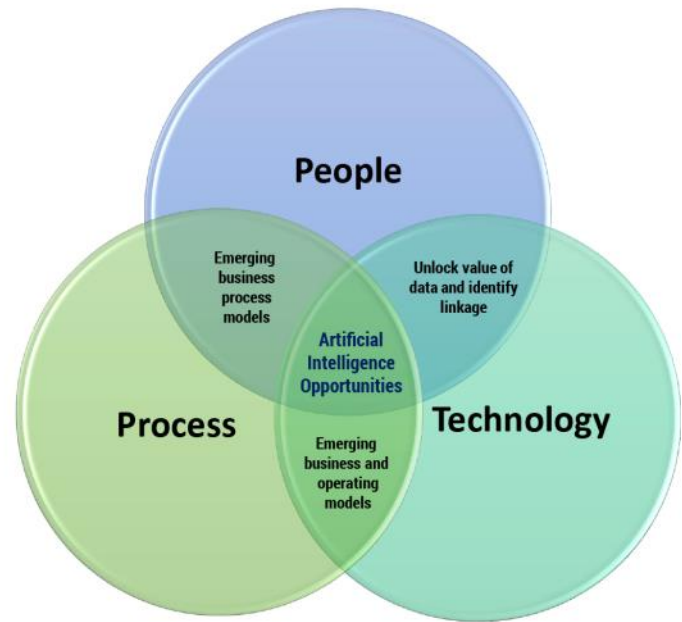


Figure 1 — AI opportunities.

1. **Make long-term investments in AI research.** Prioritize investments in the next generation of AI that will drive discovery and insight and enable the US to remain a world leader in AI.
2. **Develop effective methods for human-AI collaboration.** Rather than replace humans, most AI systems will collaborate with humans to achieve optimal performance. Research is needed to create effective interactions between humans and AI systems.
3. **Understand and address the ethical, legal, and societal implications of AI.** We expect AI technologies to behave according to the formal and informal norms to which we hold our fellow humans. Research is needed to understand the ethical, legal, and social implications of AI and to develop methods for designing AI systems that align with ethical, legal, and societal goals.
4. **Ensure the safety and security of AI systems.** Before AI systems are in widespread use, assurance is needed that the systems will operate safely and

securely, in a controlled, well-defined, and well-understood manner. Further progress is needed to address this challenge of creating AI systems that are reliable, dependable, and trustworthy.

5. **Develop shared public data sets and environments for AI training and testing.** The depth, quality, and accuracy of training data sets and resources significantly affect AI performance. Researchers need to develop high-quality data sets and environments and enable responsible access to high-quality data sets as well as to testing and training resources.
6. **Measure and evaluate AI technologies through standards and benchmarks.** Essential to advancements in AI are standards, benchmarks, testbeds, and community engagement that guide and evaluate progress in AI. Additional research is needed to develop a broad spectrum of evaluative techniques.
7. **Better understand the national AI R&D workforce needs.** Advances in AI will require a strong community of AI researchers. An improved understanding of current and future R&D workforce demands in AI is needed to help ensure that sufficient AI experts are available to address the strategic R&D areas outlined in this plan.

If used strategically, AI offers tremendous opportunity to help government agencies reduce their costs, complement the current workforce's capabilities, and deliver improved and timely services to citizens.

As a contribution toward preparing the US for a future in which AI plays a major role, the National Science and Technology Council's subcommittee on Machine Learning and Artificial Intelligence was chartered in May 2016. It is responsible for fostering interagency coordination, providing technical and policy advice on topics related to AI, and monitoring the development of AI technologies across industry and the research community. The US government's report, "Preparing for the Future of Artificial Intelligence,"² includes a comprehensive list of recommendations for further specific actions by federal agencies and other supporting organizations.

AI in the US Government: Focus Areas

Strategic, widespread use of artificial intelligence could save government up to 1.2 billion work hours and US \$41.1 billion annually.

— IBM Center for the Business of Government³

AI is ready to digitally transform the business of government to an extent that we have not seen since the last industrial revolution. The key to successful implementation of AI lies in its being done with a defined scope and skilled workers. AI is not a single technology but rather a collection of multiple advanced technologies allowing machines to sense, understand, perform, and learn from experience continuously. If used strategically, AI offers tremendous opportunity to help government agencies reduce their costs, complement the current workforce's capabilities to focus on critical tasks while AI does some of their routine work faster, and deliver improved and timely services to citizens. Many federal, state, and local agencies have been experimenting with the use of AI, and that use is expected to further accelerate as the agencies become more comfortable with AI and realize its benefits. Following are some areas in government where AI is either currently used or being considered.

Healthcare

As one of the fastest-growing areas and with much of that growth fueled by analytics, medical imaging, and diagnostic capabilities, healthcare AI could and should be leveraged and considered for the following:

- Identifying possible spread of diseases early on and narrowing down the people and locations at risk
- Supporting and expediting FDA processes for drug testing and approval for consumption by citizens
- Identifying people at risk of post-traumatic stress disorder and other diseases, and providing them with timely treatments
- Analyzing healthcare data to identify possible violations of health codes at all levels

As an example of AI's use in healthcare, the US Department of Veteran Affairs is using AI to better predict medical complications and improve treatment of severe combat wounds at the Walter Reed National

Military Medical Center, leading to better patient outcomes, faster healing, and lower costs.⁴

Social Media and Sentiments

From Facebook posts to sensor readings, we generate far too much data for humans to make sense of it in a timely manner. Cognitive technologies can help sift through data much faster and understand sentiments concerning national security, crime prevention, or national disaster, allowing authorities to make faster decisions.

Fraud Detection

There will likely always be a small group of people who will cheat the system for their personal gain. AI can be leveraged to identify those people and protect the rest of society from fraud. For example, AI could:

- Identify fraudulent Medicaid and Medicare claims, help catch culprits, and support reduced operating costs
- Identify and stop insider trading to avoid any loss of confidence in our financial system

Electronic Document Discovery

In our current system, we generate enormous amounts of paper, especially within legal and healthcare segments. Without AI, it is very difficult, time-consuming, and resource-intensive to find relevant documents when needed. The proper use of AI and other relevant technology-based solutions will facilitate the following:

- Identifying relevant documents in the discovery phase of legal cases, reducing cost and time
- Expediting the FDA approval process for medicines

Performance Measurement

AI can help in monitoring and measuring whether new or upgraded policies or systems are producing the expected results. For example:

- Did a new childcare policy help reduce the potential harm done to children in foster care?
- Did a new capability reduce the time required to process a citizen request?

Citizen Experience and Engagement

AI has great potential for improving customer experience and engagement by:

- Understanding and sensing citizens' needs from data collected from social media, blogs, or feedback, and using it to help develop or update policies, regulations, and business solutions and addressing citizens' needs in a timely manner
- Developing AI-enabled service desks, including suggesting additional relevant services and resources to citizens who are applying for something such as Medicaid benefits, driving licenses, or business permits
- Having chatbots handle common service requests like password resetting, freeing workers to handle more complex requests and giving citizens quick answers to important questions — improving service while reducing costs and backlog

Cognitive technologies can help sift through data much faster and understand sentiments concerning national security, crime prevention, or national disaster, allowing authorities to make faster decisions.

Public Safety

The public infrastructure is dated and requires ongoing maintenance. AI can help with the following:

- Understanding weather conditions and traffic patterns; predicting traffic congestion and accidents and identifying alternate routes
- Anticipating road, bridge, port, or other infrastructure maintenance and replacement needs
- Monitoring social media for quick notification of emergency situations (e.g., flood, crime, agitation)

Analytics and Prediction

Machine learning (ML) and natural language processing can reveal patterns, enabling better predictive capabilities. When your email program flags a message

as spam, or your credit card company warns you of a potentially fraudulent use of your card, ML is probably involved. Some examples where technology is already being used in these areas include:

- The US Army is developing wearable monitors that use an ML algorithm to determine wound seriousness, helping medics prioritize treatment.⁵
- The US Department of Energy's self-learning weather and renewable forecasting technology uses ML, sensor information, and cloud motion physics derived from sky cameras and satellite observations to improve solar forecasting accuracy by 30%.⁶

As cognitive technologies advance in power, government agencies will need to bring more creativity to workforce planning and work design.

Training

The US Defense Advanced Research Projects Agency (or DARPA), intending to reduce from years to months the time required for new US Navy recruits to become experts in technical skills, now sponsors the development of a digital tutor that uses AI to model the interaction between an expert and a novice.⁷

Robotic Process Automation

Robotic process automation will allow agencies to significantly reduce administrative tasks and have their employees maximize their time for mission-focused work. Some examples include:

- A Colorado survey found child-welfare caseworkers spending 37.5% of their time on documentation and administration, versus just 9% on actual contact with children and their families.⁸
- At the federal level, research indicates that simply documenting and recording information consumes a *half-billion* staff hours each year. "Bots" can automate such activities, ranging from invoice processing to filling in forms, from data entry to writing budget-reporting documents.⁹

By freeing up time, we can create a more effective government, empowering employees to do the work that really matters: serving citizens in need.

As these examples illustrate, cognitive technologies eventually will fundamentally change how government works, and the changes will likely come much sooner than many think. As cognitive technologies advance in power, government agencies will need to bring more creativity to workforce planning and work design. The most forward-leaning jurisdictions will see cognitive technologies as an opportunity to reimagine the nature of government work itself — making the most of complementary human and machine skills.

An AI Adoption Framework

AI presents government agencies with new opportunities to innovate that previously may have been impossible. Cognitive computing leverages several AI components, such as ML, to understand, reason, and learn much like the human brain does. Cognitive complements AI, enabling computers both to think like humans and to understand how humans think. Current AI systems and subsystems are able to learn, make decisions, and solve complex problems. Examples include speech recognition, self-driving cars, online assistants, and image recognition.

As government agencies are realizing the need to start using AI to develop and deliver new business capabilities to meet their mandates, our recommendation is that they take an incremental approach to adopting AI. Irrespective of the maturity and experience of the AI team, the members should have a good understanding of the agency's overall digital strategy and, more specifically, its AI strategy if already in place. AI could be extremely helpful in improving the speed and efficiency of many tasks, but it is not suited for every task. The AI team should have a good understanding of the role of AI and the outcomes to be expected from its use in the workplace.

AI is not plug and play, and agencies cannot simply "buy intelligence" and apply it to address their requirements. Many AI services are available in the market, but the hard work of managing the interplay of planning, data, processes, and technologies happens and gets managed in-house. The conceptual framework for putting AI to work is quite simple. This framework can and should be customized based on an agency's environment and requirements.

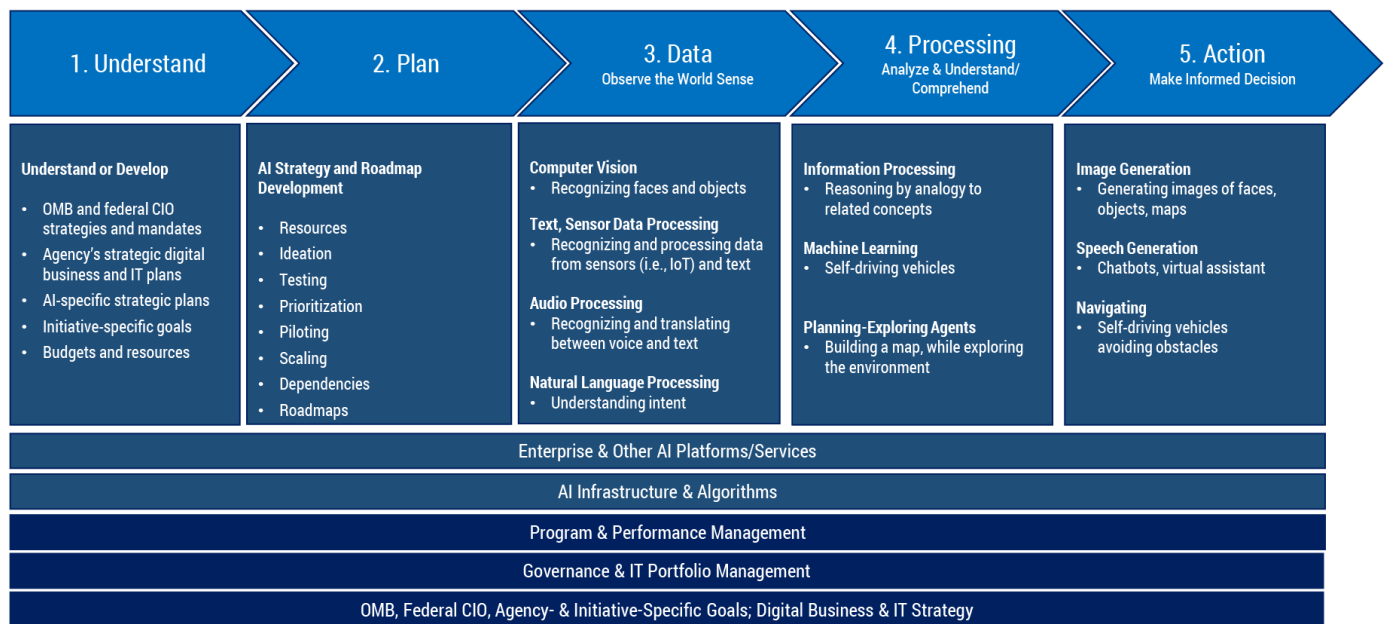


Figure 2 – A conceptual AI adoption framework.

The framework, as shown in Figure 2, has five steps to be executed from left to right, but this linear progression is not a requirement. For an organization new to AI, it will be best to go through all the steps, but a mature organization may want to focus on specific areas based on its needs. AI algorithms consume data, process it, and then help with actions. Processing of the data depends on proper planning and integration of technologies.

AI Service Providers

Leading cloud service providers (CSPs), including Amazon Web Services, Azure, Google, and IBM, offer a wide array of AI and ML services that are quickly maturing. These services are expected to dominate enterprise AI in the near term and may also affect smaller startups. Most AI-branded services from the CSPs fall into one of four categories:

1. **Computer vision services.** These provide APIs that allow digital images or digital video to be passed to a pretrained ML algorithm for analysis. Each of these purpose-built services focuses on a different analysis use case.
2. **Language-processing services.** These provide the cloud services and APIs used for analyzing human language — either in text or in audio. In most cases, these services provide support for several languages.

As with computer vision services, language-processing services and their pretrained ML models are segmented into distinct domains, with each service solving one or more aspects of the language-processing problem. For example, some services analyze and extract speech from digital recordings; others enable development of conversational interfaces, translation to and from a wide array of languages, and robust text-to-speech processing.

3. **ML services.** This category comprises general-purpose ML services. Unlike the previous two categories, which include task-specific, pretrained algorithms, ML services allow developers, data practitioners, and architects to generate their own models. ML services also allow users to train and evaluate those models using their own data.

These services can perform the most common types of ML analysis, including classification, clustering, and regression. Among ML services, there will be a range of options, even from a single provider. Some of these ML services are built to be extremely simple to use. However, as is often the case, simplifying the solution might mean less flexibility or functional limitations.

4. **Miscellaneous services.** This category includes those services that do not necessarily fall into any of the other three categories.

AI Demand: Job Creator or Destroyer?

As government agencies and commercial organizations are starting to deploy AI within their environments, they are faced with a shortage of AI skills, resulting in delays, increased cost, and, at times, failed initiatives. Demand for AI talent is far outpacing the availability of skilled resources worldwide. Industry research suggests that there are about 300,000 skilled AI workers available today, and while more are retooling to acquire the needed skills, current demand for AI workers runs into the millions, leaving a large gap.¹⁰ Agencies requiring employees to have clearances could face an even wider gap.

The short-term impact of AI should be a positive one if we manage it well, even though jobs may require a better-educated and AI-aware workforce.

Large commercial firms like Amazon, Baidu, and Microsoft are paying higher premiums to attract AI talent. This competition to hire the limited AI talent available will have an impact on the budget to hire and retain AI experts and should be considered as part of the strategic plan by governmental agencies and the service providers supporting them.

An important concern associated with AI is its impact on current jobs. Will it create or destroy jobs? How will job profiles evolve? And what types of skills will be in demand? The answers to these questions are critical to business leaders and policy makers as they seek to take full advantage of the opportunities arising from AI by ensuring that an appropriately skilled workforce is in place to capture them.

Looking at some past industrial revolutions and their impacts on jobs may provide some insight into what we might expect in the near future. Past revolutions have transformed and dramatically improved industrial productivity: steam power in the 19th century, electricity in the early 20th century, automation in the 1970s, and the Internet in the late 1990s. These waves of technological advancement did not reduce overall employment, however. Although the number of manufacturing jobs decreased, new jobs emerged and the demand for new skills grew.

Today, AI — along with a few other emerging technologies, such as blockchain, sensors, robotics, 3D printing, and others collectively known as part of Industry 4.0 — represents ongoing workforce transformation. These technologies are disrupting almost all industries and all kinds of jobs, be they in government, manufacturing, service, or white-collar sectors. We believe that, overall, the short-term impact of AI should be a positive one if we manage it well, even though jobs may require a better-educated and AI-aware workforce. In the long term, as AI becomes much stronger, we should be aware of the possible threats AI poses and begin to plan for them now.

Recent progress in AI is being driven by multiple complementary developments, including greater availability of data, cheaper and faster cloud-based computing power enabled by faster and more powerful graphics processing units, and the development of new algorithms. Venture capitalists are also making many investments in AI startups, and tech giants are opening up resources to enable others to develop better AI.

AI is accelerating the automation of white-collar jobs, and a growing wave of expert automation and augmentation software platforms are expected to usher in a new era of AI-enhanced productivity. Startups are targeting multiple industries, such as the legal field, journalism, wealth management, and healthcare, among others, which until now have been relatively safe from the threats of automation. AI-supported capabilities will allow for faster and better diagnosis or advice with fewer resources.

Conclusion

Artificial intelligence is the future, not only for Russia, but for all humankind. It comes with colossal opportunities, but also threats that are difficult to predict. Whoever becomes the leader in this sphere will become the ruler of the world.

— Vladimir Putin

I am in the camp that is concerned about artificial intelligence. First the machines will do a lot of jobs for us and not be super intelligent. That should be positive if we manage it well. A few decades after that, though, the intelligence is strong enough to be a concern. I agree with Elon Musk and some others on this and don't understand why some people are not concerned. Humans should be worried about the threat posed by artificial intelligence.

— Bill Gates

The AI genie has already been released from the lamp, and any efforts to try to put it back or ignore it will be futile and possibly harmful. AI is a disruptive technology with implications for humankind at all levels, be it as an individual citizen or independent business, or at the level of an industry, an individual country, or the whole world. The importance of AI-based startups, the pace of progress achieved in the past decade, and the adoption of AI by various organizations are ensuring that the capabilities and capacity of AI-based solutions will continue to accelerate.

AI has tremendous potential to transform our government and help us address many of our concerns and enhance our safety, education, health, and how various services are delivered. AI could and should be used to change the way public servants do their jobs. The AI field is advancing rapidly at a time when agencies are looking for new ways to achieve their missions. It can improve agencies' effectiveness, make data more understandable and easier to use, and help citizens navigate government services. And it could save government up to 1.2 billion work hours and \$41.1 billion annually.¹¹

According to Machine Intelligence Research Institute's Katja Grace and colleagues, researchers predict AI will outperform humans in many activities in the next 10 years, such as translating languages (by 2024), writing high school essays (by 2026), driving a truck (by 2027), working in retail (by 2031), writing a bestselling book (by 2049), and working as a surgeon (by 2053).¹² According to the same study, researchers also believe there is a 50% chance of AI outperforming humans in *all* tasks in 45 years and all human jobs will be automated in 120 years.

Even though we will not be here to witness the reality of all these predictions, developments such as Sophia, the first robot citizen of Saudi Arabia; Tesla's self-driving vehicles; robotic surgeries; or realistic conversational chatbots lead us to believe that AI will continue to be part of our daily lives and will make life easier. Like many other disruptive technologies, in addition to all its promises, AI will have some downsides as well, including the risk of job elimination for those jobs that can be better performed by an AI solution. We are optimistic that even though some jobs may be lost due to AI, moving forward, AI will result in the creation of more, better-paying jobs and new job categories.

AI is here to stay, and so are the disruptions it will cause worldwide. Government agencies and businesses are just getting started in leveraging emerging technologies such as AI, blockchain, robotics, computer vision, automation, and so on, to provide enhanced citizen services, create new business models, and optimize business operations. Savvy leaders are not taking any chances and are facing the challenges head on. They are anticipating upcoming AI disruptions and working to convert them into strategic opportunities.

AI has the potential to help citizens navigate government services, allow agencies to respond to threats more thoroughly, and improve agencies' overall effectiveness.

Although there will be challenges and detractors, AI has the potential to help citizens navigate government services, allow agencies to respond to threats and crises more thoroughly, and improve agencies' overall effectiveness. For some, AI promises to solve significant and long-standing problems, while for others AI presents a sense of peril. But all agree that AI will have a lasting impact on our lives.

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