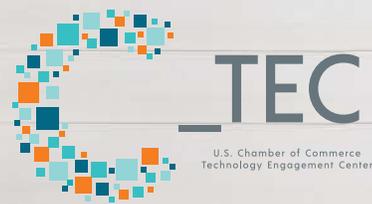
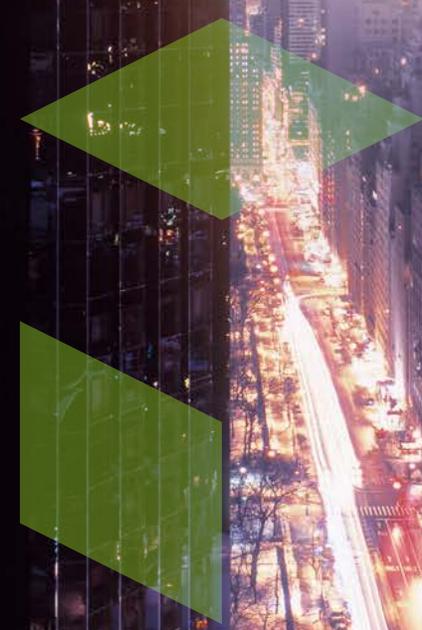


Deloitte.



Investing in trustworthy AI

A report by the Deloitte AI Institute
and Chamber Technology Engagement Center



Foreword

New technologies drive economic growth, create novel opportunities for society, and often raise new challenges and risks. The Deloitte AI Institute™ and the U.S. Chamber of Commerce Technology Engagement Center (C_TEC) find themselves at the forefront of addressing these challenges; helping their clients and members navigate these opportunities. Artificial Intelligence (AI) is no different, but the impact of AI will likely be more substantial and widespread than most technological innovations, affecting nearly every economic sector and occupation.

AI is already securing America's critical infrastructure, keeping fraudsters at bay, making access to finance more inclusive, and helping find the cures for diseases. These are merely a few examples of how this technology is changing the world. As it develops, it will continue to revolutionize how we tackle future societal challenges, live our day-to-day lives, and conduct business.

The private sector is the leading researcher, developer, and deployer of AI applications and is constantly discovering new ways that AI can be used for good. Consequently, businesses must be at the vanguard of our national discussions on AI to ensure that it is developed and deployed responsibly and consistent with our shared values and should collaborate with government on appropriate public policies to facilitate this goal. In this report the Deloitte AI Institute™ and the Chamber Technology Engagement Center, jointly seek to illustrate how businesses are thinking about the impact of AI on the economy and society, and how government can better enable trustworthy AI, now and in the future.



A handwritten signature in black ink that reads "Beena".

Beena Ammanath
Executive Director of the Deloitte AI Institute
Deloitte

A handwritten signature in black ink that reads "David".

David Hirschmann
President and CEO of Chamber
Technology Engagement Center (C_TEC)
U.S. Chamber of Commerce

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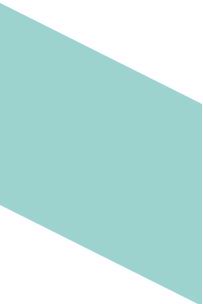
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Executive summary



Artificial intelligence (AI), broadly defined to include the wide range of statistical methods and computational technologies that enable systems to learn, respond, make decisions, and take actions with increasing autonomy, is rapidly becoming an enabler of growth, and a potential game changer of almost every global industry.¹ The United States Patent and Trademark Office reports that as of 2018, fully 25 percent of all US inventors were using AI technologies in their granted patents.² While the potential for the United States of harnessing its AI talent, computing capacity, and private-sector-driven innovation is enormous, AI also brings a unique set of challenges that should be addressed so that concerns over its risks do not dampen innovation, and to help ensure the United States can lead globally in trustworthy AI. The U.S. Chamber of Commerce's Technology Engagement Center (C_TEC) shares the perspective with many leading government and industry voices, including the National Security Commission on Artificial Intelligence (NSCAI), the National Institute of Standards and Technology (NIST), and the Deloitte AI Institute, that government policies to advance the ethical development of AI-based systems, sometimes called "responsible" or "trustworthy" AI, can enable future innovation and help the United States to be the global leader in AI.

Building trust and confidence on the part of businesses, their customers, their employees, and the public that AI adoption will lead to a positive impact on the economy and society can accelerate the social and economic benefits that can come from AI to maintain global competitiveness. A potential key to the execution of this approach is US government leadership through public investments and common-sense policies that balance a culture of growth and innovation and ensure that AI applications are developed and deployed in compliance with existing laws and in consideration of social, ethical, safety, security, and privacy concerns. Utilizing a survey of experienced leaders in AI innovation, this paper presents key findings and recommendations on risks and opportunities to trustworthy AI and some policy solutions to help promote the development of trustworthy AI. Part 1 of this paper examines opportunities and innovation that can create economic growth and provide social benefits to the United States while mitigating the risks posed by AI that might arise from the irresponsible development and implementation of AI applications. Part 2 of this report investigates a variety of public policy solutions to enable AI trustworthiness and facilitate positive impacts on the US economy and society.



Building trust and confidence on the part of businesses, their customers, their employees, and the public that AI adoption will lead to a positive impact on the economy and society can accelerate the social and economic benefits that can come from AI to maintain global competitiveness.

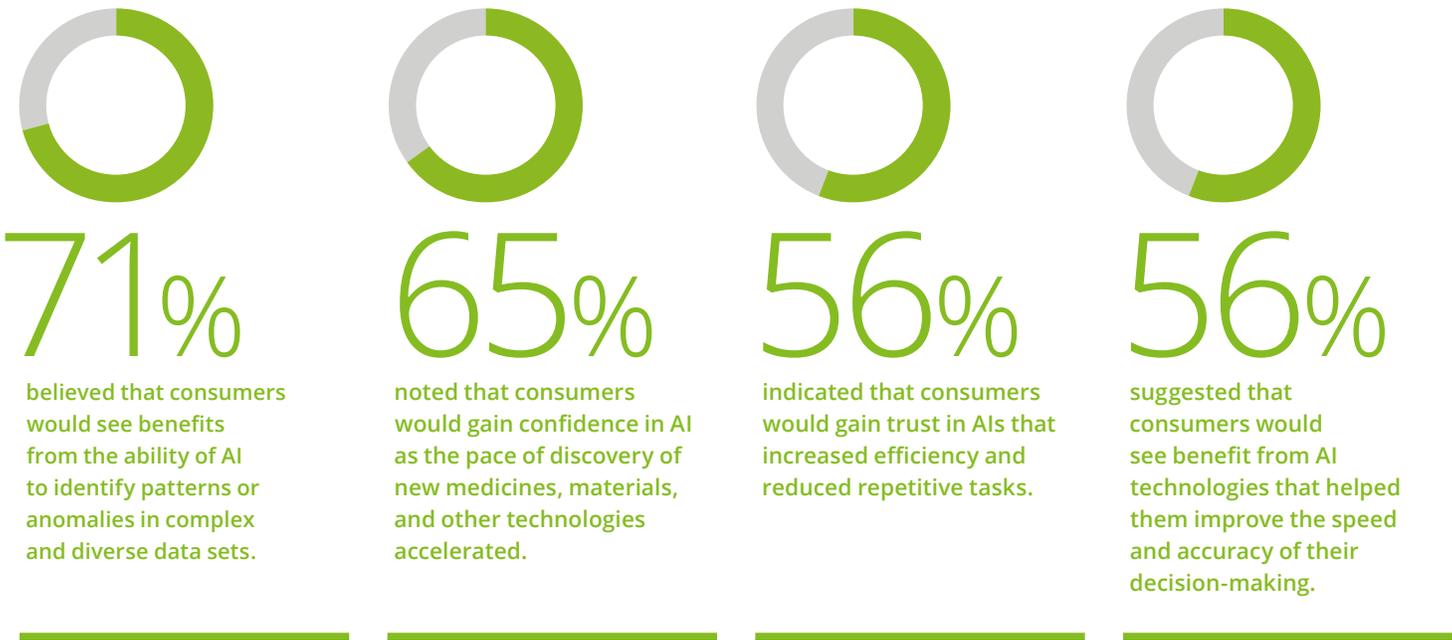


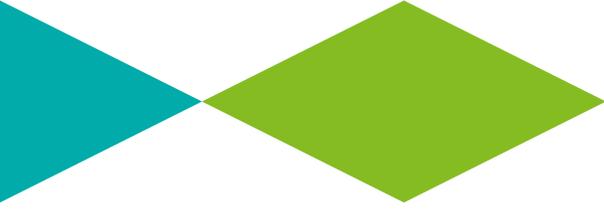
Key survey findings

Review of current research, consideration of the perspective of leading voices in government and industry, and the survey results support the position that public policies to support AI innovation can provide lasting economic and social benefits for United States citizens and companies. Building a thriving and sustainable AI-enabled economy will likely require sensible policy solutions to encourage innovators to embed concepts of trustworthy AI in the development and deployment of AI systems. A trustworthy AI approach can mitigate risks that might otherwise reduce confidence in AI systems and stifle innovation in this critical sector, while focusing investment on beneficial applications of AI that can lead to economic growth and improved health, safety, and well-being for Americans.

Emphasizing the benefits of AI applications to workers and consumers can increase trust in AI.

Respondents indicated that consumer trust in AI systems could increase as consumers saw personal benefit from adoption of AI technologies, whether as users of AI-enabled systems or as customers of new products and services generated or accelerated by AI:





Similarly, respondents indicated that workers could become more confident in using and working alongside AI systems as they saw it improve their day-to-day work experience, safety, and professional opportunities:



69%

saw the creation of new types of work, especially higher-value occupations focused on creating, managing, and maintaining AI systems.



62%

highlighted improved safety on job sites or in transit due to AI monitoring or control of equipment and vehicles.



55%

noted the increased efficiency and reduced repetitive tasks due to AI-enabled automation.



52%

suggested workers might see increased wages or improved working conditions associated with higher-value work made available by AI systems.

Development of AI technologies highlights several risks that may lead to less consumer and customer confidence in AI technologies.

When respondents to the survey were asked to indicate which concerns about AI technologies were likely to have a significant impact on reducing consumer and customer trust in AI:



68%

identified biases influencing decisions made by AIs.



66%

identified a lack of human accountability or liability for AI decisions.



60%

identified rogue or unanticipated behavior of partially or fully autonomous agents.



56%

identified a lack of explainability of AI algorithms.

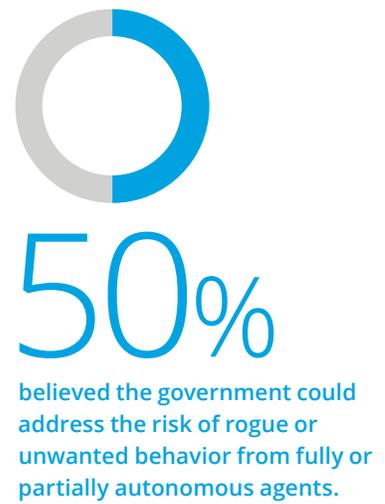
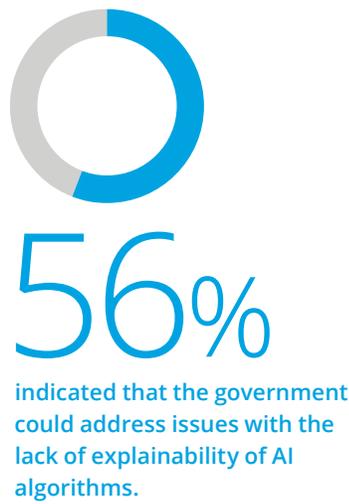
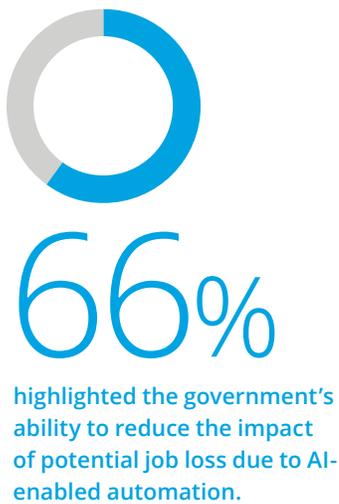
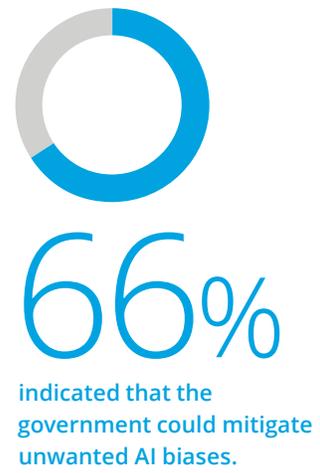
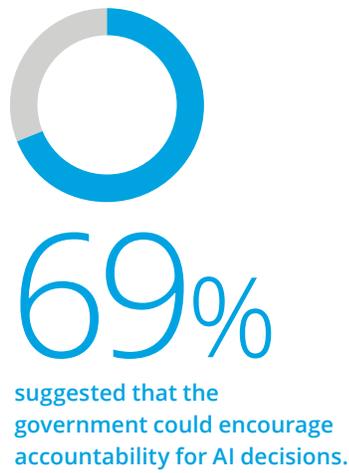
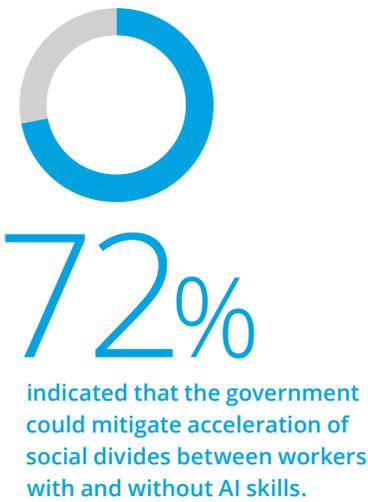
Public policies can play a significant role in the mitigation of these risks.



Respondents were confident about the ability of the government to influence the direction of AI innovation toward greater trustworthiness, and positive about the impact government policies could have in accelerating growth in the marketplace, mitigating AI risks, and enhancing AI's benefits.



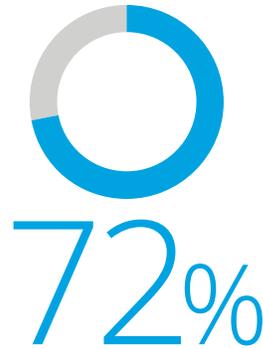
When respondents were asked about the ability of the government to mitigate risks associated with AI technologies:



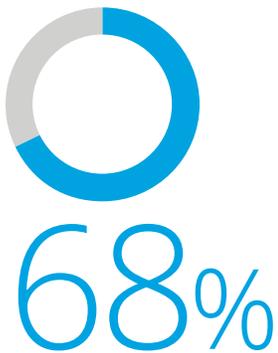
Respondents to the survey overwhelmingly agreed that the government could contribute to increased consumer trust in AI by enabling its benefits:



expressed confidence that government policies could increase the likelihood that new materials, medicines, and other products would result from AI innovation.



highlighted that the use of AI to helpfully identify patterns or anomalies could be accelerated or improved through government intervention.



of respondents believed government could support the removal of subjectivity and personal bias from business processes through expanded use of AI and adoption of more robust standards and models.

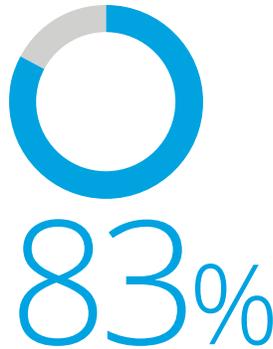


indicated that the government could support the ability of AI systems to make faster and more accurate decisions.

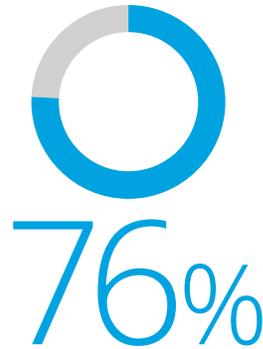


suggested that the government could encourage the use of AI to increase productivity.

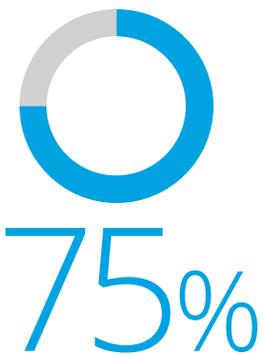
Respondents were also in agreement that government policies could help contribute to increased worker trust in AI technologies:



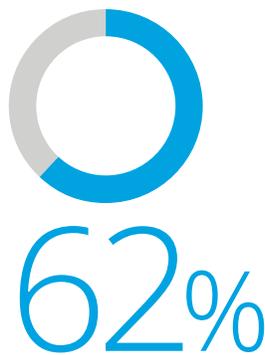
83% suggested that the government could encourage the use of AI to increase worker safety on job sites or in transit.



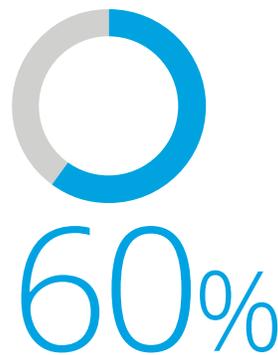
76% indicated that the government could encourage the use of AI to remove subjectivity and bias from scheduling, recognition, and promotion processes.



75% suggested that the government could enable the creation of new types of work focused on creating, managing, and maintaining AI systems.



62% indicated that the government could foster the use of AI-enabled automation to increase efficiency and reduce repetitive tasks.



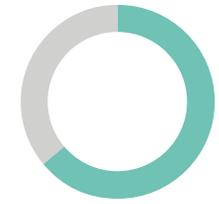
60% indicated that the government could increase the adoption of AI technologies that expanded worker access to higher-value work, potentially leading to higher wages or improved working conditions.

Appropriate government policies could encourage the development of trustworthy AI and accelerate its potential economic impacts.

Respondents expressed confidence that government intervention in appropriate AI public policies could help facilitate the development of trustworthy AI applications.



There was also consensus around specific policies which the government should pursue to support AI innovation:



70%

of respondents supported government investment in fundamental AI research.



61%

of respondents supported increased access to government data sets for training and improvement of AI models to reduce unwanted bias and increase accuracy.



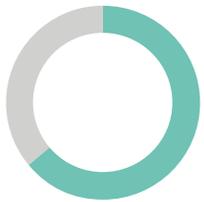
53%

of respondents noted retraining or continuing education programs targeted at adults.



50%

of respondents encouraged the government to invest in interoperability standards for edge AI hardware and devices.



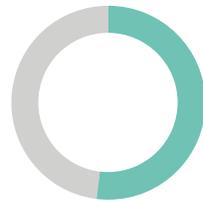
64%

of respondents supported government encouragement for establishing industry-led, voluntary consensus-based standards for the performance and reliability of AI algorithms.



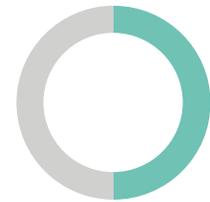
54%

of respondents supported government policies to support open-source tools and frameworks to enable development of new AI technologies.



52%

of respondents identified establishing or supporting existing international partnerships to promote common frameworks for AI use and deployment.



50%

of respondents identified curricula for youth to promote AI skills and career selection.

Emphasizing federal investments in AI research and development will lead to significant benefits for AI innovation.

When asked to prioritize AI among government R&D investments, respondents overwhelmingly supported increased investment:

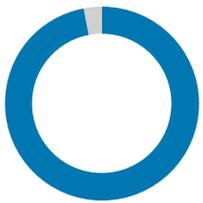


of respondents supported much more investment.



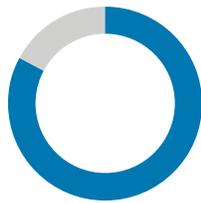
of respondents expressed support for somewhat more investment.

Respondents generally believe that government investments in AI R&D can help facilitate the development of trustworthy AI applications:



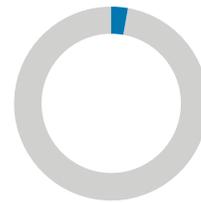
97%

of respondents indicated that government investment could influence the direction of AI innovation to at least “a small” extent.



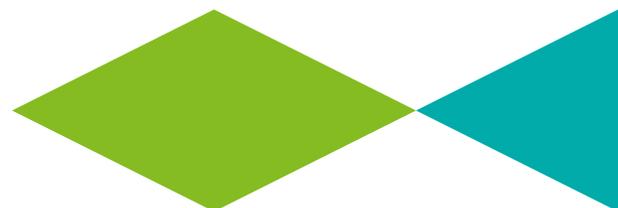
83%

of respondents agreed that government investments to a great or some extent enable trustworthy AI innovation.



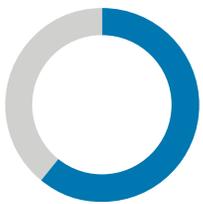
3%

Only 3% of respondents believed that government investments could pursue this objective to a little to no extent.



Emphasizing federal investments in AI research and development will lead to significant benefits for AI innovation.

Respondents generally agreed that government investment was best targeted at earlier stages of AI innovation:



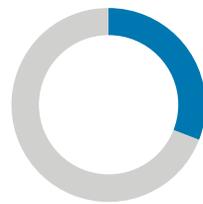
61%

advocated for government investment in fundamental research.



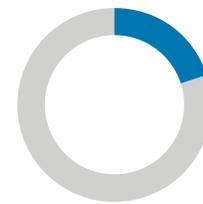
44%

suggested that government investment was useful to early-stage startups.



31%

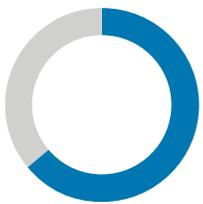
indicated that government investment was helpful in the transition of early-stage technologies to commercialization.



20%

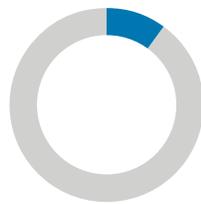
suggested that government investment was valuable in the continuing development of established products.

Respondents were also interested in working with the government and were generally open to participating in government investment programs in AI innovation:



64%

of respondents were extremely or slightly willing to receive government funding for AI.



10%

Only 10% of respondents expressing unwillingness to accept government funding for AI.

The gap between high willingness to participate in government investment programs and the low number of respondents currently engaged in such programs points to a potential opportunity to increase availability, accessibility, and visibility of government funding to private companies and thereby encourage further AI innovation. As demonstrated in Case Study 1 of this paper, the economic impact attributable to AI is estimated between \$447 billion and \$1.43 trillion over five years, which could be accelerated by increased government investments in AI R&D.

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Key policy recommendations

The U.S. Chamber's Technology Engagement Center has previously proposed³ that the federal government can best enable trustworthy AI innovation in the United States through the establishment of a national data and AI strategy, which among a number of recommendations includes leveraging federal resources to accelerate innovation, model responsible AI implementations, and support the American workforce in developing AI skills. The survey conducted in support of this paper broadly supports that previous proposal, and highlights specific opportunity areas for policymakers to consider.



Support the development of standards for AI trustworthiness, to guide AI innovation in a responsible direction. Specific public policies to support this approach include developing industry-led, voluntary consensus standards for AI trustworthiness, and an AI risk management framework to assist private sector developers and users in assessing trustworthiness.



Creation of, or support of existing, international partnerships to promote trustworthy AI for the use and deployment of AI technologies with foreign commercial partners and to advocate for US standards internationally, including through digital trade agreements.



Leverage federal resources to accelerate innovation, with specific focus on investing in fundamental research in AI, encouraging the use of shared computing resources, and improving access to government data sets for the development, and training of new AI models.



Model responsible AI implementations in government through e-government applications that serve citizens, the applications used internally by federal agencies, and the development of novel AI applications to address public crises such as the pandemic and climate change and through establishment of procurement processes for trustworthy AI technologies.



Support the American workforce in developing AI skills, including curricula for youth to promote AI skills and career selection, and retraining or continuing education programs targeted at adults to assist in transitioning to job roles that require AI skills.

Part 1: Challenges and opportunities of artificial intelligence



Overview

Why Is trustworthy AI important?

The social and economic opportunities of AI in America are enormous, but the confidence of American consumers, workers, and the general public in AI innovation will likely be crucial in unlocking these opportunities. According to Edelman's 2021 Trust Barometer Tech Sector Report, AI is only trusted by 45 percent of the public in the United States.⁴ If the public's concerns about the risks of AI outweigh their perception of the benefits, the adoption of AI technologies may slow, the private sector may be disincentivized from investing in and utilizing AI, and potential benefits from the widespread adoption of AI applications may not be fully realized. Ensuring that AI technologies evolve and are deployed in ways that consumers and workers are able to reasonably trust is likely a crucial step in building a thriving AI-enabled economy.

What is trustworthy AI?

Many leading voices in industry and government are already aligning around a similar set of ideas as to what constitutes trustworthy AI. Trustworthy AI, also known as ethical or responsible AI, share common themes such as fairness, transparency, and accountability in the development and use of AI applications. Incorporation of these conceptions into the broader national strategy for AI may be essential to realizing the opportunities of the AI-enabled future and maintaining US global leadership in this critical set of technologies.



Ensuring that AI technologies evolve and are deployed in ways that consumers and workers are able to reasonably trust is likely a crucial step in building a thriving AI-enabled economy.

U.S. Chamber of Commerce principles on artificial intelligence

In 2019, the U.S. Chamber of Commerce published ten principles intended to help ensure a stable policy environment that fosters innovation and trust in AI, advocating that:

- 1

Trustworthy AI be developed as a partnership between government, private sector, academic, and civil society;
- 2

Existing rules and regulations be leveraged to avoid creating a patchwork of subnational AI policies and to advanced sound and interoperable practices;
- 3

Risk-based rather than prescriptive approaches be taken to ensure that the highest risk use cases receive the most scrutiny;
- 4

Investment in public-private partnerships for basic AI R&D be supported in the context of flexible governance frameworks to drive needed advancements;
- 5

Workers should be supported in gaining needed AI skills and adapting to changing workforce needs;
- 6

Government data should be made more open and accessible to accelerate the training of AI models;
- 7

Robust but flexible data protection regimes should be maintained to enable AI development while protecting personal privacy;
- 8

Intellectual property frameworks that protect and promote innovation should be supported;
- 9

Data should be free to flow across borders; and,
- 10

Industry-led, consensus-based international standards should be acknowledged, developed, and promoted through international standards bodies.⁵

Deloitte's six dimensions for trustworthy AI™

These dimensions recommend that AI-enabled systems are:

1

Fair and impartial

AI systems should make decisions that follow a consistent process and apply rules fairly, as well as incorporate internal and external checks to remove biases that might lead to discriminatory or differential outcomes, to help ensure results that are not merely technically correct but considerate of the social good.

2

Transparent and explainable

AI systems may not operate as "black boxes"; all parties engaging with an AI should be informed that they are doing so and be able to inquire as to how and why the system is making decisions.

3

Responsible and accountable

The increasing complexity and autonomy of AI systems may obscure the ultimate responsibility and accountability of companies and human beings behind the decisions and actions of these systems; policies should be in place to clearly assign liability and help ensure that parties impacted by AI can seek appropriate recourse.

4

Robust and reliable

Just as we currently depend on the consistent performance of human professionals to help ensure that our daily activities are safe and healthy, we should be able to depend on equivalent or even greater reliability as we enable more of our systems with AI.

5

Respectful of privacy

As AI systems often rely on gathering large amounts of data to effectively accomplish their tasks, we should ensure that all data is gathered appropriately and with full awareness and consent, and then discarded or otherwise protected from further, unanticipated use.

6

Safe and secure

As AI systems take greater control over more critical processes, the danger of cyberattacks and other malfeasance expands significantly. Appropriate security measures should be put in place to help ensure the integrity and safety of the data and algorithms that drive AI.

The private sector has been a long-term leader in articulating and advocating trustworthy and responsible AI. In 2019, the Chamber Technology Engagement Center published ten principles intended to help ensure a stable policy environment that fosters innovation and trust in AI (see inset on page 23). Also, the Deloitte AI Institute⁶ has articulated six dimensions for trustworthy AI to guide the responsible development, implementation and governance of systems that utilize artificial intelligence. Deloitte's Trustworthy AI™ framework's dimensions were designed to preserve the ethical integrity of AI-enabled systems through their design, development, deployment, and ongoing operation.

Many other individual companies that market core AI technologies or produce AI-enabled software, including Microsoft⁷, IBM⁸, and Google⁹, have also developed frameworks or guidelines for the implementation of AI within their products, as well as recommendations for how customers can deploy their products in a responsible manner. In addition, other organizations, such as the Partnership on AI, a consortium of industry, academic institutions, and public-interest groups, have also proposed a set of eight tenets for the development and deployment of AI technologies. These tenets include engagement of stakeholders and communities in technology development, protection of the privacy and security of individuals and their data, commitment to the deployment of robust, reliable, trustworthy and secure AI systems, and the principle that AIs must be understandable by and explainable to individuals.¹⁰

Independent government commissions have pursued similar approaches. The National Security Commission on Artificial Intelligence (NSCAI), a Congressionally-established Commission, released their final report in March 2021 that affirms establishing "justified confidence" in AI systems is crucial to the long-term technological competitiveness of the United States. The report notes. "If AI systems routinely do not work as designed or are unpredictable in ways that can have significant negative consequences, then leaders will not adopt them, operators will not use them, Congress will not fund them, and the American people will not support them."¹¹



NSCAI's principles on justified confidence in AI systems

The report goes on to articulate five key principles for establishing “justified confidence” in the development and deployment of AI systems, resulting in what it calls “Responsible AI”:



Robust and reliable AI systems, especially those related to perception and classification, must be interpretable and explainable, minimizing false positives and negatives and the impacts of bias originating from their design or their data sets.



Humans must remain essential parts of AI systems, and appropriate information must be conveyed to enable humans to partner effectively with AI systems to augment decision-making, while avoiding cognitive overload and the resulting tendency to over- or under-trust the systems.



Testing and evaluation, verification and validation standards must be put in place to ensure that AI systems are performing as intended.



Organizations must have full-time, dedicated leaders with deep subject-matter expertise in artificial intelligence and the risks present in designing and deploying AI-enabled systems.



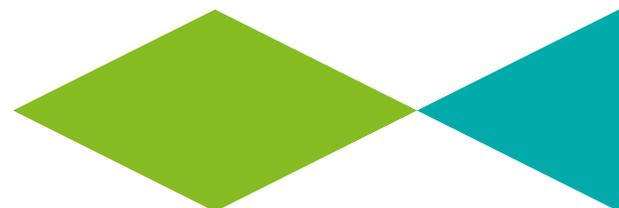
Accountability policies must be evolved to address the unique characteristics of AI systems, and individuals must have reasonable pathways to raise concerns about irresponsible practices or to appeal the actions of AI systems that have caused harm.

Finally, the federal government has also sought to conceptualize trustworthy AI. In November 2020, the Office of Management and Budget (OMB) issued a memorandum on the “Guidance for Regulation of Artificial Intelligence Applications” for the heads of federal agencies that informs the development of regulatory and non-regulatory approaches for AI. The Guidance outlines ten principles for the responsible development of AI applications through the federal government’s role as a regulator, including increasing public participation in rulemaking, ensuring that all actions are informed by high-quality scientific information, weighing risks and costs against the potential for innovation and benefits, and considering the impacts AI may have on fairness, discrimination, safety, and security.¹² In addition, the federal government is pursuing trustworthy AI concepts through the development of standards. In August 2019, the National Institute of Standards and Technology (NIST) published a plan entitled “US Leadership in AI: A Plan for Federal Engagement in Developing Technical Standards and Related Tools,” (Plan) in response to a 2019 executive order that intended to help ensure that the United States remains a leader in AI through engaging standards development for AI technologies. The Plan notes that:

“Today, the ability to understand and analyze the decisions of AI systems and measure their trustworthiness is limited. Among the characteristics that relate to trustworthy AI technologies include accuracy, reliability, resiliency, objectivity, security, explainability, safety, and accountability. Ideally, these aspects of AI should be considered early in the design process and tested during the development and use of AI technologies. AI standards and related tools, along with AI risk management strategies, can help to address this limitation and spur innovation.” —NIST¹³

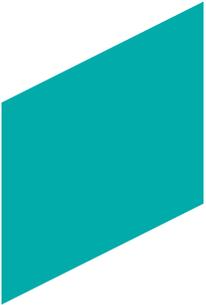
NIST’s Plan has been followed up by additional publications and workshops focused on specific topics such as AI explainability, bias, and trustworthiness. Congress has also tasked NIST, through Division E of the Fiscal Year 2021 National Defense Authorization Act to further support the development of AI standards for trustworthiness. The role played by NIST will ultimately not just assist federal agencies but likely also the private sector in developing common conceptions of trustworthy AI.

As the United States continues to develop its national approach to lead on trustworthy AI, we should consider incorporating these insights from private and public sector institutions to guide AI responsibly to help ensure that the concerns of consumers, workers, and the public about AI innovation are addressed. Development of this approach can be accelerated by leveraging the substantial work already completed by the federal government in collaboration with the private sector and other key stakeholders.



Articulating the benefits and risks of AI innovation

The exponential rate of change enabled by AI is already visible across numerous facets of our society and economy. A 2020 survey by Cognilytica showed that 40 percent of business decision-makers already have one or more AI projects in place, and fully 90 percent plan to have an in-progress AI implementation within two years.¹⁴ The use of AI in the pharmaceutical industry to identify new compounds and accelerate production processes to make possible the rapid time-to-market of mRNA vaccines for COVID-19¹⁵ is just one prominent example of how AI-enabled business transformation is yielding benefits today. Achieving a culture of AI innovation that yields medical breakthroughs and addresses pressing global challenges will require governments and the private sector to cooperate to assure citizens, workers, and the public that AI technologies are being developed and deployed appropriately. This section discusses and examines the commonly cited benefits and risks of AI in the context of how they contribute to perceptions of trustworthy AI.



Benefits of AI for consumers and workers

Building broad confidence and support for AI technologies requires the effective articulation and demonstration of the benefits that consumers, workers, and the public might see from AI-enabled changes to their day-to-day life and work. While there are a wide range of benefits unlocked by AI, some of the commonly cited economic and social benefits include the following:

Improved speed and accuracy of decision-making

The ability to prevent and respond to cybersecurity threats remains a critical challenge faced by both governments, the private sector, and the public at large. BlackBerry's AI-driven cybersecurity tools use AI to improve cyber threat protection and remediation by quickly reviewing large volumes of cyber incident data, including information drawn from previous malware attacks, while leveraging machine learning and automation to identify potential threats.¹⁶ AI and machine learning can serve as a force multiplier by helping outnumbered security teams automate tasks that usually require valuable time and resources.

Removal or mitigation of biases and subjectivity from high-impact decisions

Decisions with significant personal and professional impact, such as hiring and promotions, determination of creditworthiness, vendor selection, and admittance to institutions of higher education, can be influenced by unwanted bias, caused by the conscious or unconscious preferences of decision-makers. AI can assist in identifying and mitigating those biases, bringing objectivity to decisions that are today highly subjective today, and making complex decisions such as career paths more predictable and manageable for individuals. In 2019, the California State Assembly passed ACR-125, which encourages the state of California to invest in and support the development of AI and algorithm-based hiring technologies with the capacity to reduce bias and discrimination related not only to protected characteristics such as race or sex but also unprotected characteristics such as socioeconomic status or previous incarceration.¹⁷

Improved speed of innovation and pace of discovery of new medicines, materials, and technologies

Consumers and the public stand to benefit enormously from the faster rate at which AI-enabled processes can improve the quality, durability, and cost of existing goods, as well as from the introduction of entirely new products to benefit consumers. AI innovation promises novel medicines, improved flavors, more energy-efficient electronics, and a host of other small and large improvements to goods and services enjoyed every day. Project Dreamcatcher, a collaboration between Autodesk and General Motors, generates thousands of options for part designs that address constraints and performance criteria input by designers, resulting in novel, often complex structures able to then be built with additive manufacturing techniques.¹⁸

Increased scale of operations through deployment of partially or fully autonomous agents

AI enabled agents can operate continuously, accelerating the pace at which product selection, packaging, transportation, and delivery can be accomplished, whether through the use of robotic assistants in warehouses or automated vehicles or drones in delivery. Ultimately, improvements in business processes can lead to significant benefits for consumers. Amazon leverages over 100,000 autonomous guided vehicles within its warehouses to augment the capacity of its human workforce and meet the expectations of its Prime customers for fast and accurate deliveries.¹⁹

Increased ability to detect patterns or anomalies in complex data sets or across diverse sources of input

Fraud and other types of illegal activity cost consumers both directly and in the form of higher costs across all goods and services.²⁰ The Nilson Report indicates that in 2019, payment fraud alone amounted to over \$9.6 billion in losses for US consumers.²¹ Better detection of anomalous behavior could stop this activity early and limit the consequences of fraud. Similarly, small, day-to-day changes from poor diets or posture could be detected and addressed earlier, before long-term and high-impact health changes could result; a 2018 study showed that small, positive changes in day-to-day lifestyle choices could add as much as 12 to 14 years of additional life expectancy for Americans.²² Verizon uses pattern recognition AI to predict network failures from temperature, weather, and equipment sensor data, significantly reducing the occurrence of network downtime experienced by customers.²³

New types of work and specialized occupations focused on creating, managing, and maintaining AI systems

New types of work stemming from AI include jobs directly focused on the development and deployment of AI systems, such as designing and training models or implementing new AI applications, but also include a range of indirect opportunities that come from gathering and normalizing data with which to train models, testing and validating the performance and robustness of AI applications, and training workers to work alongside AI systems that augment their jobs. As AI applications increasingly reach edge and device computing, the development and installation of new hardware environments such as camera systems, listening devices, and temperature sensors could create a range of field services, “blue collar” and “white collar” jobs similar to those created by the widespread deployment of communications networks in the previous century.²⁴

Reduction of repetitive tasks due to AI-enabled automation

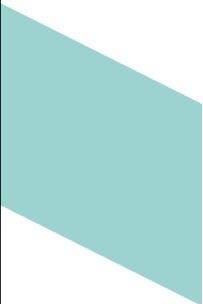
On an industrial scale, AI systems can assist in sorting agricultural products, identifying damaged or inferior goods during their journey through an assembly line, automating the formatting and creation of many types of digital documents and assets, and even fielding common support and customer services queries. Within the home, AI systems can reduce chores, and the planning and scheduling burdens associated with managing a household, and support for personal development activities such as improved health and fitness. For example, Amtrak's "Julie" AI-enabled chatbot has answered over 5 million common customer queries, saving more than \$1 million in customer service expenses annually.²⁵

Increased wages or improved working conditions associated with higher-value work made available by AI systems

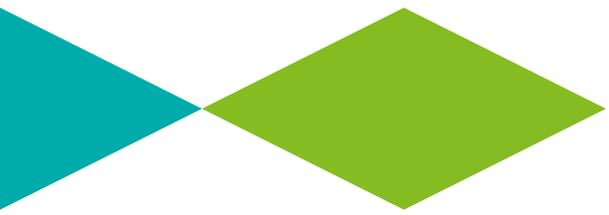
Many of the jobs that are created by AI are more likely to involve quantitative skills, manipulation and management of data, and more specialized maintenance and field service activities, all of which have historically been associated with higher wages.²⁶ The Montreal Economic Institute notes that AI is likely to enable workers to migrate to higher-value tasks due to the effects of human-machine complementarity observed in previous cycles of automation, as well as by enabling less experienced workers to become more productive more quickly.²⁷

Improved safety on job sites or in transit due to AI monitoring or control of equipment and vehicles

AI systems, especially when combined with sensors, can be deployed to monitor hazardous conditions that might be caused from faulty equipment or exposure to noxious chemicals. These systems can also be put in place to assist workers in maintaining safe distances from operating equipment, or to track wakefulness of operators of heavy equipment or drivers of field service or delivery vehicles. In the long term, automated vehicle technology may reduce accidents and minimize worker exposure to risks associated with transportation. For example, in the United Kingdom, Cisco has deployed AI-SAFE, an AI-enabled computer vision system to help detect whether workers are wearing appropriate protective equipment.²⁸

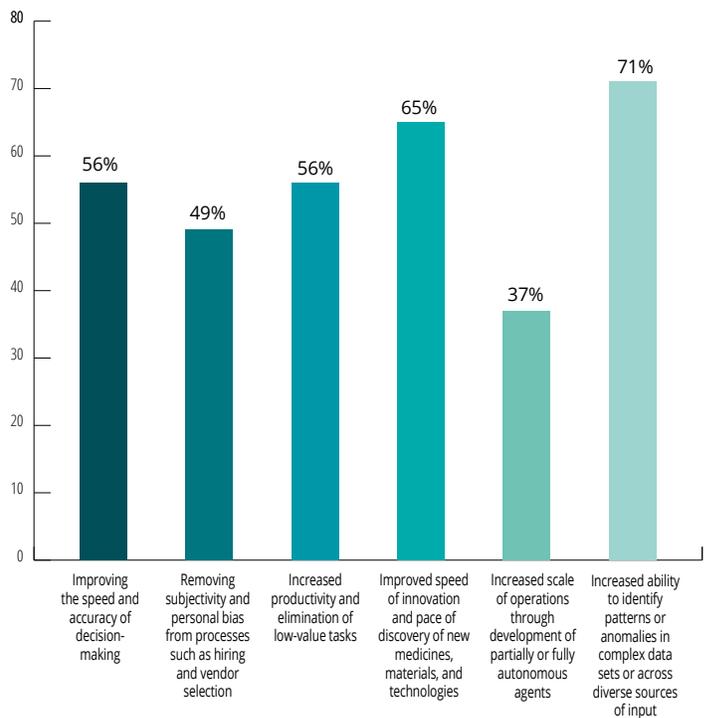


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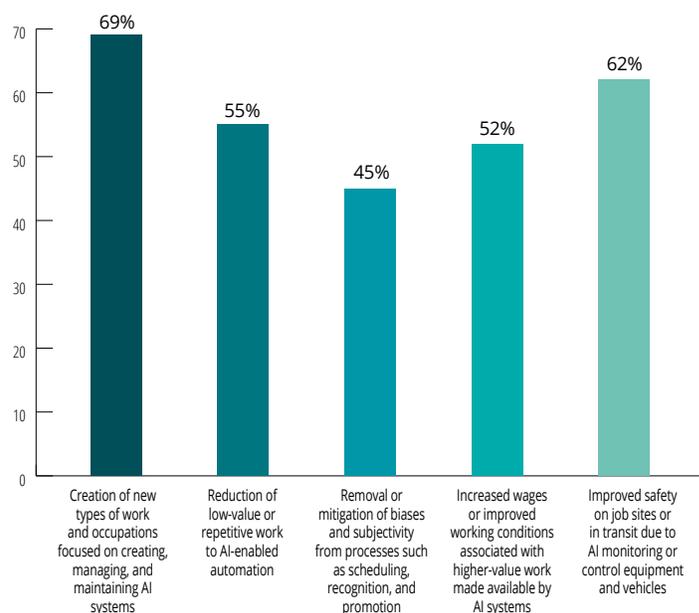
Survey respondents were asked to evaluate these benefits in terms of their positive impact on the confidence of consumers and workers in AI. When survey respondents were asked to identify which of these benefits would have an impact on improving consumer trust in AI systems, AI's role in identifying patterns in complex data and accelerating the pace of innovation had the highest support. Pattern and anomaly detection, identified by 71 percent of respondents, helps consumers by helping them detect the "needle in the haystack," and includes applications that can track and improve physical health, monitor and proactively recommend better financial choices, and improve personal safety. 65 percent of respondents identified access to new products and solutions generated by AI as another key driver of consumer trust. A majority of respondents also signaled that AI's ability to increase productivity (56 percent of respondents) and improve the speed and accuracy of decision-making (56 percent of respondents) could also improve consumer trust in AI systems. Consumers benefit from better productivity both in terms of reduction of their own work, and in faster and higher-quality service in their interactions with AI-enabled businesses and governments. Similarly, consumers may both use AI directly to improve their personal decision-making, such as the selection of entertainment options, and benefit from better decision-making in the retail context, such as improved assortment planning and display of products.

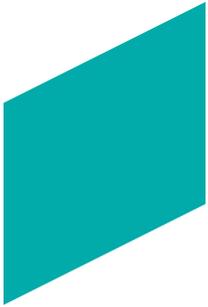
Among the following benefits attributed to AI technologies, which do you regard as significant in terms of improving customer and consumer trust in AI systems?



Similar trends were found in responses regarding worker or employee trust in AI systems. While some have concerns about job loss stemming from automation—a 2019 CNBC poll indicated that 27 percent of American workers feared the loss of their job due to AI-related automation within five years²⁹—respondents indicated that workers were more likely to embrace AI systems that had positive impact on their careers and working conditions. 69 percent of respondents identified the creation of new types of work as likely to build worker trust in AI, as this could directly mitigate concerns about automation and demonstrate the potential for future careers working alongside AI systems. This is also supported by 55 percent of respondents noting increases in productivity through reductions of repetitive work resulting from use of AI technologies and 52 percent of respondents who express support for the idea that increased wages and improved working conditions derived from AI could increase trust. This is a pattern seen over the past decades with the rise of the information technology: few workers today fear being replaced by a personal computer, but many make use of computers to perform professional tasks that were scarcely imaginable fifty years ago. Respondents also strongly emphasized the value of AI-driven improvements to work safety in building worker trust in AI systems, through improved safety on job sites due to AI monitoring or control (62 percent of respondents). This supports prior studies showing that job satisfaction and general engagement in all work tasks are highly correlated to perception of the safety of the work environment.³⁰

Among the following benefits attributed to AI technologies, which do you regard as significant in terms of improving worker or employee trust AI innovation?





Risks to consumer and worker confidence in AI

Despite the many benefits of AI to consumers and workers, some have raised concerns over the risks posed by certain AI applications. Some of these applications, for example, may have unwanted bias through flawed or unrepresentative data, and consumers may be subject to the decisions of “black box” systems without understanding how and why they were impacted. As discussed earlier, some also fear job losses due to increased AI-enabled automation, and AI may exacerbate existing social and economic divides between workers with different skillsets. Finally, some may be concerned about rogue or unanticipated behavior from partially or fully autonomous agents such as robots or software systems, and are cognizant pertaining to risks to critical infrastructure, public safety, and human health. The survey asked respondents about several commonly cited risks posed by AI systems including:

Biases influencing decisions made by AIs

Perceived, and actual, discrimination by AI systems undermines the confidence individuals have in whether they are being given a fair opportunity when AI is involved. Bias has the potential to be introduced, intentionally and unintentionally, throughout the lifecycle of the AI system, including during deployment. Intentional or unintentional discrimination against specific types of people may occur in the following situations: hiring AIs trained on resumes primarily submitted by men may disadvantage women who apply for jobs, and visual AI systems trained on younger faces or individuals with lighter complexions may misidentify or fail to recognize older faces or individuals with darker complexions.

Lack of human accountability or liability for AI decisions

A key challenge will be to determine how to assign responsibility when AI systems are involved and to what extent AI systems will be subject to the same legal frameworks regarding non-AI systems. Some existing incentives for entities to design and maintain systems in a safe and responsible manner hinge on legal and financial obligations for accidents and errors. Like all technological systems, AI systems are ultimately designed and deployed by humans, so human accountability for the impacts of AI systems is an important aspect of AI risk mitigation.

Rogue or unanticipated behavior of partially or fully autonomous agents

As the use of AI becomes more widespread, workers, consumers, and the public should have assurance that AI systems are safe. A patient seeking medical treatment in a hospital should be confident that an AI-enabled surgical system is properly controlled, and a worker who depends on AI-enabled system to safely maintain temperatures or power levels should have certainty they will not be injured by an unexpected or unwanted AI decision.

Lack of explainability of AI algorithms

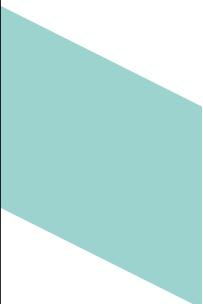
The “black box” nature of certain AI models could feasibly lead to unfair decisions and confusion for workers and consumers. Insufficiently explainable AI applications can create situations where it is difficult to determine why or how the overall system operates. As noted by NIST’s “Four Principles of Explainable Artificial Intelligence” explainability is necessary in many contexts to ensure social acceptance of AI applications and be transparent to the public.³¹

Potential loss of jobs due to increased AI-enabled automation

While the AI economy will likely create many new jobs and occupations, the introduction of AI systems may require some workers to transition to new jobs. A 2019 Brookings report found that 25 percent of all American jobs were at high risk of elimination due to automation and AI. In previous cycles of technology transformation, job losses were concentrated among lower-skilled workers, but in the near-term the transition to an AI-enabled economy is likely to also affect “white collar” and higher-skilled workers.³²

Acceleration of social and economic divides between workers with and without AI skills

As the AI-enabled economy accelerates, a new type of “digital divide” could arise that may negatively impact communities or exacerbate social tensions if access to AI skills is not broadly available, or if wage differentials between AI-augmented work and non-augmented work increase more than is already observed between “high tech” and “low tech” occupations.³³

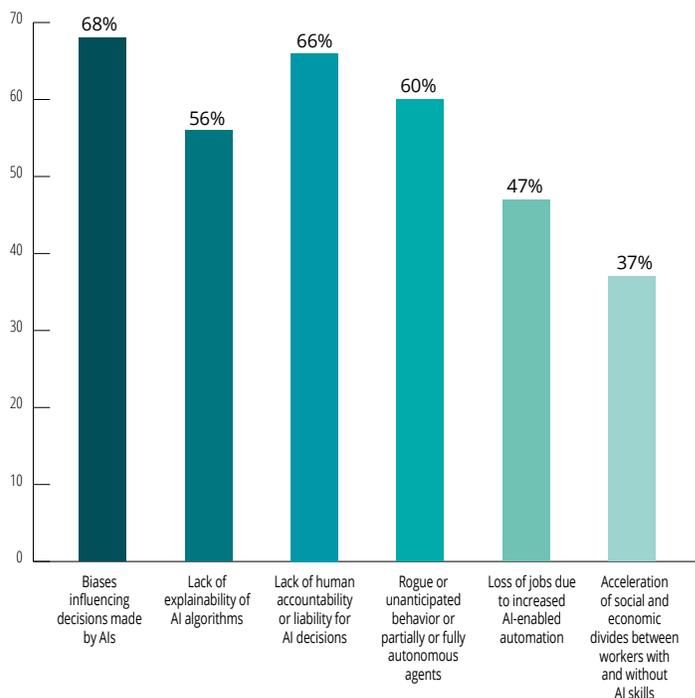


Some may be concerned about rogue or unanticipated behavior from partially or fully autonomous agents such as robots or software systems, and are cognizant pertaining to risks to critical infrastructure, public safety, and human health.



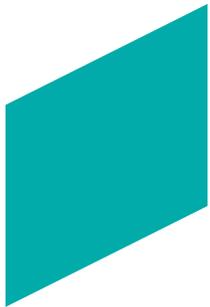
Survey respondents were asked to evaluate whether these risks raised with regard to AI might reduce the trust of consumers and workers in AI systems. When asked to identify which of these risks was likely to reduce trust in AI systems, respondents were especially concerned about biases in decision-making (identified by 68 percent of respondents) and lack of human accountability or liability for AI decision-making (identified by 66 percent of respondents). Consensus was also found around concerns related to rogue behavior of partially or fully autonomous agents and lack of explainability of AI algorithms, identified by 60 percent and 56 percent of respondents, respectively. Some respondents also noted loss of jobs (47 percent of respondents) and acceleration of social and economic divides (37 percent of respondents) as significant risks to overall consumer trust in AI systems.

Among the following concerns related to AI technologies, which do you regard as significant in terms of reducing customer and consumer trust in AI systems?



While AI systems promise substantial benefits, the development and deployment of trustworthy AI also requires mitigating the risks posed by AI. Moreover, the survey data strongly suggests that bolstering the benefits of AI could also improve AI trustworthiness. Overall, this suggests that conceptions of trustworthy AI should consider the risks posed by AI, but also the potential benefits to provide a balanced perspective on the impact of AI.



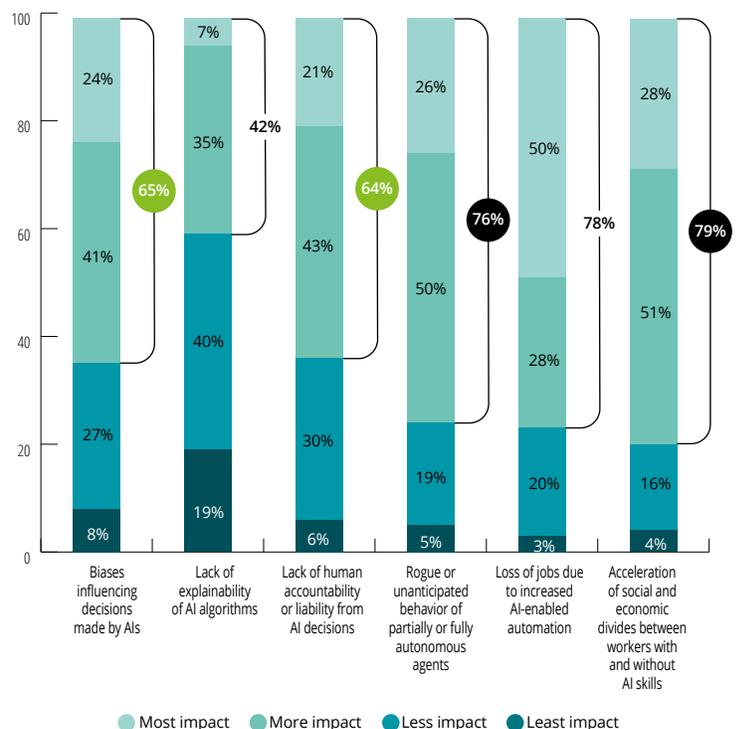


Impact of trustworthy AI on economic growth

If the risks posed by unmanaged development of AI are left unaddressed, reductions in consumer and worker trust may inhibit the long-term growth and adoption of AI technologies, and discourage the private sector from investing in AI-enabled solutions and limit the benefits of AI and on overall economic growth. The consequences of the inhibition of the AI market are significant, with long-term risks to the ability of the United States to compete globally if it fails to maintain leadership in AI. IDC estimated for instance, that revenues for the AI market are projected to reach \$327.5 billion in 2021, which does not even consider the secondary benefits from implementing and utilizing AI systems.³⁴

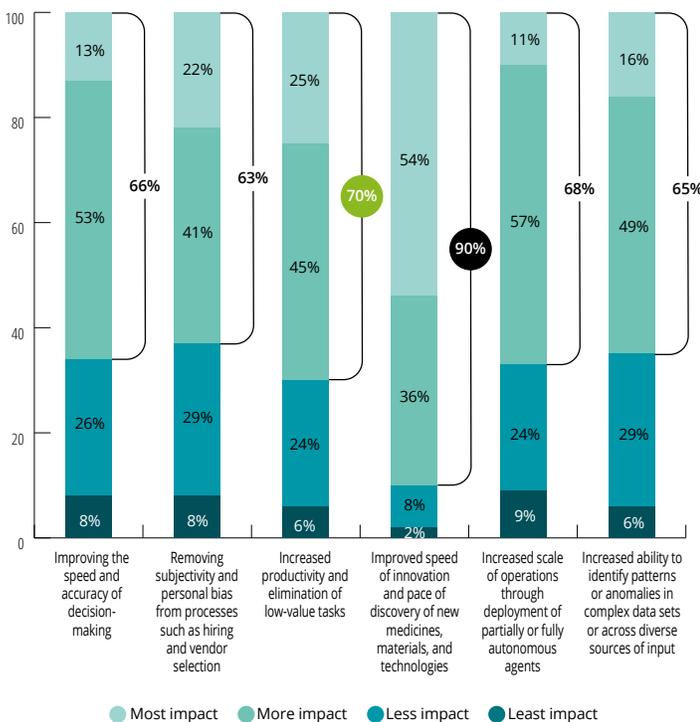
Respondents to the survey were asked to indicate the relative economic impact of common concerns about AI in the absence of solutions to mitigate them. Overall, the risks of social disruption due to loss of jobs from increased automation and the potential acceleration of social divides between workers with and without AI skills were considered to have the largest economic impact, with 76 percent and 79 percent of respondents, respectively. Also, lack of accountability for AI decisions and concerns over bias also ranked highly, with 64 percent and 65 percent of respondents respectively who acknowledged these challenges indicating that these areas could have a negative economic impact if left unchecked. Overall, untrustworthy AI technologies could negatively impact economic growth, reinforcing the importance of government or non-government solutions in addressing AI risks.

Among these concerns, which are likely to have the greatest negative economic impact if left unaddressed?



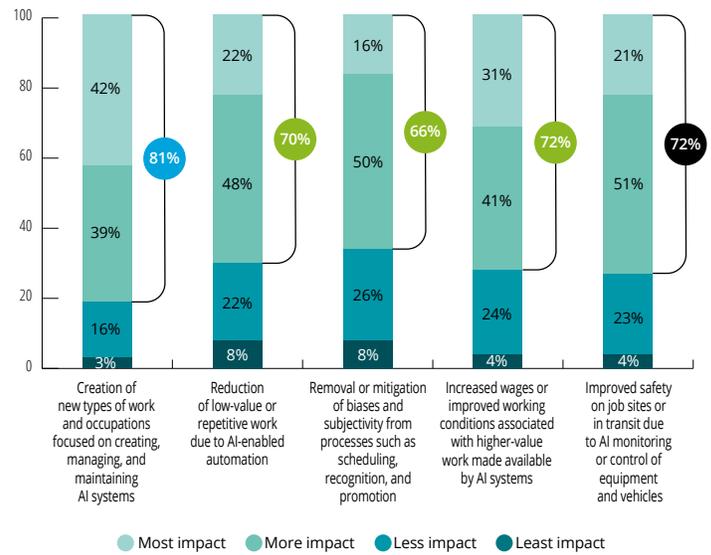
Respondents also indicated that government policies that enable the benefits of AI could have significant positive economic impacts, which indicates that the federal government can contribute to increasing public trust in AI applications. 90 percent of respondents who identified increased speed of innovation as a benefit of AI affirmed that positive economic impacts could result from new beneficial products generated by AI such as improved materials and novel medical treatments reaching the market, demonstrating the wide-ranging positive impact of AI on innovation across sectors. 70 percent of respondents who identified increased productivity as a benefit of AI indicated that this increase in productivity could result in positive economic impacts. In fact, each of the benefits attributed to AI was held by a majority of its identifying respondents to be likely to have a positive economic impact if realized with the support of government investment, including improved speed of decision-making, increased scale of operations, improved pattern and anomaly detection, and reduction of subjectivity and bias in core business processes.

Among these benefits, which are likely to have the greatest economic impact if encouraged by government investment or intervention?

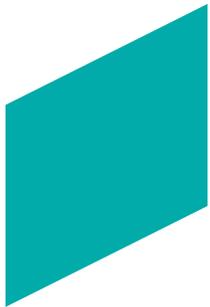


A similar trend was found regarding the positive economic impact of increasing trust in AI on the part of workers. 72 percent of respondents who identified improved worker safety as a benefit of AI suggested that improvements to worker safety resulting from AI innovations could create economic benefits, and 81 percent of respondents who believed that AI would create new types of work indicates that government policies could encourage the AI economy to grow. Also, respondents who indicated that AI could improve the quality of the work experience through mitigating subjectivity in scheduling and hiring processes, reducing repetitive work, and increasing wages and working conditions, generally believed that these benefits could be bolstered with appropriate government policies and could contribute to greater overall economic impact (66 percent, 70 percent and 72 percent of respondents respectively).

Among these benefits to workers, which are likely to have the greatest positive economic impact if encouraged by government investment or intervention?



While the introduction of AI technologies is already showing significant economic impacts in the United States and abroad, the survey results demonstrate that both risks to AI trustworthiness and the benefits if AI can lead to negative or positive economic impacts. This demonstrates that policy solutions addressing trustworthiness could play a role in strengthening the economic potential of AI applications. The next section discusses what types of government policies are likely to enable trustworthy AI and ultimately increase trust in AI technologies.

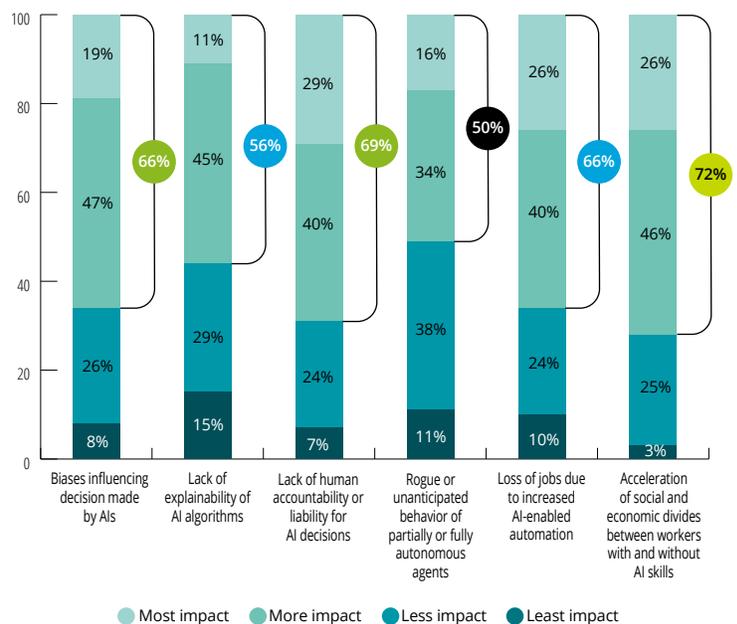


How policy interventions can improve AI trustworthiness

While the federal government can pursue a number of different policy options, not every investment or intervention can make a meaningful impact on their intended outcomes and could instead inhibit innovation. Thus, it is important to assess whether specific risks and benefits of AI technologies can be effectively addressed by particular policy interventions.

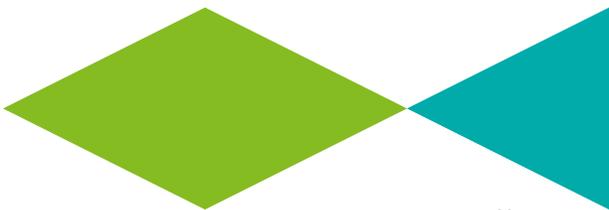
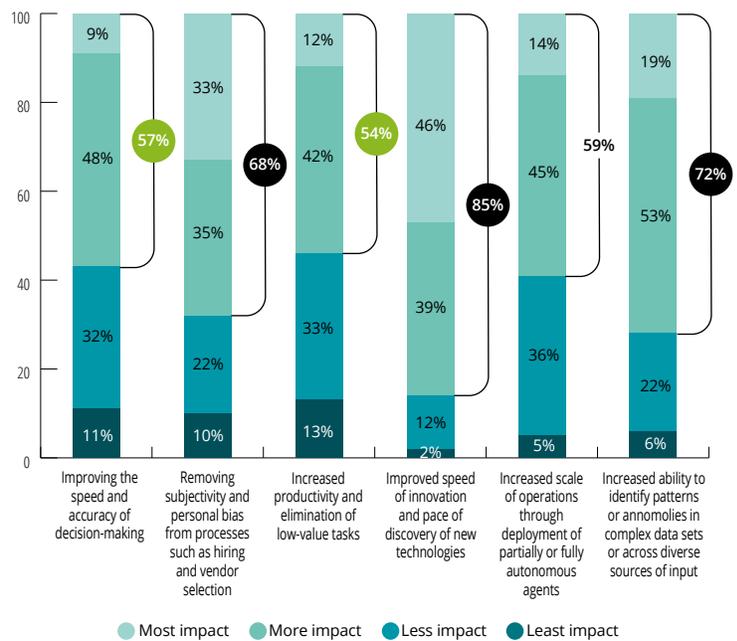
Survey respondents were first asked to identify the areas of concern around AI most likely to be mitigated or reduced by government investment or intervention. In general, respondents had a highly favorable perception of the ability of public policies to influence the direction of AI innovation through the adoption of trustworthy AI. Respondents who acknowledged the risks of accelerating social divides between workers with and without AI skills largely agreed (72 percent of respondents) that government intervention could mitigate this risk, likely due to perception of government's existing role in providing social services. Providing accountability for AI decisions and mitigation of AI biases were also seen as meriting government policy interventions, with 69 percent and 66 percent of respondents, respectively, identifying that these risks could be mitigated by government action. Respondents concerned about loss of jobs due to automation and lack of explainability of AI algorithms also exhibited confidence that government could address these issues (66 percent and 56 percent of respondents). Only 50 percent of respondents who had identified the risk of rogue or unwanted behavior from fully or partially autonomous agents believed that government could address this concern, with the somewhat weaker support perhaps attributable to the nature of rogue behavior being unanticipated or resulting from existing oversight mechanisms.

Among these concerns, which are the most likely to be mitigated or reduced by government investment or intervention?



In addition, respondents were asked whether government policy interventions could accelerate or improve the likelihood that some of the potential benefits of AI technologies to consumers and customers could materialize. Broadly, respondents overwhelmingly supported the notion that government intervention could enhance the benefits of AI and thus contribute to increased AI trustworthiness. The vast majority (85 percent) of respondents who had highlighted the potential of AI to create new products expressed confidence that government policies could increase the likelihood that new materials, medicines, and other products would result from AI innovation. 72 percent of respondents who highlighted the benefits to consumer trust in AI from identification of patterns or anomalies indicated that this beneficial use could be accelerated or improved through government intervention, such as expanding the availability of training data sets or open-source models. Similarly, 68 percent of respondents who acknowledged the capacity of AI to build trust by removing subjectivity and personal bias from business processes believed that government policies could be supportive of this goal, again likely in the form of improved training data and models, and through publication and adoption of standards for AI robustness. Respondents were more divided as to whether government policies could improve the ability of AI systems to help make faster and more accurate decisions and increase productivity, but the majority of respondents, 57 and 54 percent respectively, still indicated they could be boosted by government policies.

Among these benefits for consumers and customers, which are the most likely to be accelerated or improved by government investment or intervention?

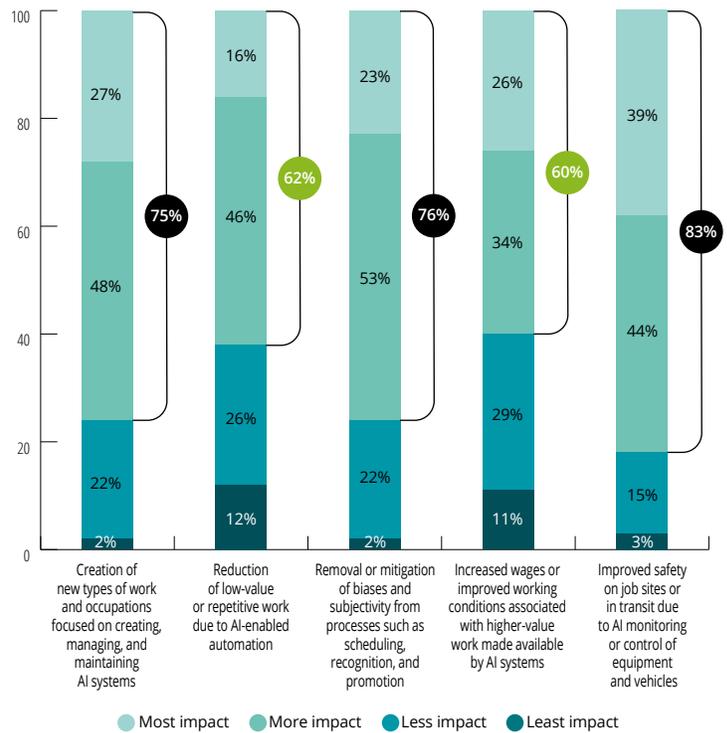




Respondents who indicated the positive impact of new job creation on worker trust in AI believed that government policies could positively impact the pace and scale at which new jobs could be created.

Finally, respondents generally agreed that the benefits of AI that enhanced employee and worker trust in AI could be bolstered by government intervention. Job safety improvements resulting from AI were considered by 83 percent of respondents as a trust-building benefit of AI likely to be accelerated by government policies. Also, 76 percent of respondents who had identified AI in removing biases from hiring, scheduling, recognition, and other traditionally subjective processes agreed that this use of AI could be accelerated by government policies. 75 percent of respondents who indicated the positive impact of new job creation on worker trust in AI believed that government policies could positively impact the pace and scale at which new jobs could be created. Smaller, but still significant majorities, also believed that government could accelerate the reduction of repetitive work, and increased wages and improved working conditions (62 percent and 60 percent respectively).

Among these benefits for employees and workers, which are the most likely to be accelerated or improved by government investment or intervention?



The high degree to which respondents indicated that government has the capacity to invest and intervene in both the mitigation of AI risks and the acceleration of its benefits indicates the importance of advancing public policies centered around trustworthy AI. This support may take the form of federal investments in R&D, the publication and adoption of AI-related standards or other policy opportunities. We explore some of these potential public policies in Part II of this paper.

Part 2: Solutions to enable AI trustworthiness



Support for trustworthy AI Innovation

History of federal government support for trustworthy AI

The federal government has traditionally acted to provide both financial support and the establishment of other policies for the safe and responsible implementation of transformative technologies. In the 1910s, early adoption of automobiles was accompanied by accidents and reckless driving, leading to the National Safety Council's promotion of safe driving practices and collaboration with industry to introduce innovations such as shatter-resistant windshields by the 1920s.³⁵ This early impetus encouraged later market-led innovations such as steel frames and hydraulic brakes as manufacturers competed to earn the trust of consumers that their vehicles were safe.

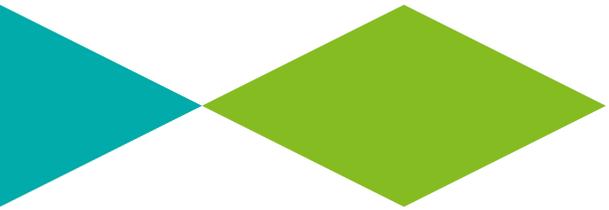
Automobiles enhanced the American economy in numerous ways, bringing increased mobility to millions of Americans, connecting communities, expanding the speed and opportunity to deliver goods and services between far-flung markets, and fostering dynamic cultures of sport and even art. The impacts of the automotive industry have played out across American society over a period of more than 100 years and the introduction of AI is potentially greater, and we may experience the impacts of AI in a much more compressed timeframe.

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Important activities have already been pursued by both the Legislative and the Executive branches on a bipartisan basis to embed trustworthy AI within a broader AI policy agenda. The federal government should continue its efforts to formalize, promote, and build off existing efforts to advance trustworthy AI. Some of these key activities from the Executive Branch include:

- **The National Science and Technology Council (NSTC), part of the Office of Science and Technology Policy (OSTP), released a National Artificial Intelligence Research and Development Strategic Plan in October 2016 presenting 23 specific policy recommendations for the development and deployment of trustworthy AI systems.³⁶ This plan was updated in June 2019.³⁷**
- **A number of agencies also participated in a report published by the Executive Office of the President in December 2016 on “Artificial Intelligence, Automation and the Economy” which explored the specific ways in which the government could support private enterprise in ensuring that the “enormous benefits of AI and automation are developed by and available to all.”³⁸**
- **Executive Order 13859, Maintaining American Leadership in Artificial Intelligence, issued in February 2019 and parts of which were codified into law as the National AI Initiative Act of 2020, emphasized the respect for existing laws and national values, and development of trustworthy AI in government that is safe, secure, resilient, explainable, and accountable.³⁹**
- **Pursuant to Executive Order 13859, the Office of Management and Budget (OMB) provided guidance to federal agencies on regulatory and non-regulatory approaches towards AI technologies in a memorandum finalized in November 2020.⁴⁰**
- **Executive Order 13960, issued December 2020, specified nine principles for trustworthy AI development and deployment within federal agencies, as well as a specified timeline for inventory of existing AI applications that might be inconsistent with these principles.⁴¹**

Congress has also acted to advance trustworthy AI. In the 116th Congress, lawmakers enacted the AI in Government Act to enable the responsible federal government use of AI as well as Division E of the FY 2021 NDAA (National Artificial Intelligence Initiative Act of 2020) to advance US leadership in AI, establish AI R&D programs across the federal government, and lay the foundation to establish AI-related standards. Also, Representatives Will Hurd (R-TX) and Robin Kelly (D-IL) introduced a concurrent resolution in September 2020, recommending a comprehensive national approach to AI including workforce transformation, research and development, national security, and ethical considerations, which was adopted by the House of Representatives in December 2020. As the use of AI applications continues to accelerate, these activities are likely only the beginning of Congressional engagement in AI policy.



International approaches to AI strategies

The United States' pursuit of AI is not occurring in a vacuum. While the United States was an early leader in AI, the rapid rise of China and other global competitors in this space makes it important for the United States to maintain global leadership in international forums where the rules of the road for the appropriate uses of AI are established. Maintaining global competitiveness in AI should include a continuous awareness of the strides that other nations are making in developing their own national strategies. HolonIQ assembled a list of 50 large economies that had developed their own national AI strategies,⁴² but the examples of several key global partners and competitors provide specific insight into the types of comprehensive investment that the United States should make to help remain competitive:

China

China's New Generation Artificial Intelligence Plan targets a domestic AI industry worth more than \$150 billion by 2030. Key to China's strategy is active partnership between the state and its large technology companies and the use of government-sponsored applications to collect and provide data to support the creation of new AI systems. China's approach of active government intervention in commercial development and expansive regime of digital protectionism is especially important for the United States to counter. The US's success in AI will demonstrate that democratic states with market-driven strategies for innovation can be equally or more effective in driving innovation and economic benefits.⁴³

Russia

Russia has been explicit in its commitment to AI as a competitive differentiator of its military technologies, especially the development of autonomous and robotic military platforms, but its broader National Strategy for the Development of Artificial Intelligence identifies key investments that will support its internal software industry and maintain its competitiveness in key sectors such as cybersecurity.⁴⁴ The Russian government has supported these efforts by adopting an import-substitution policy that restricts US companies' access to the Russian software market and supports local rivals.

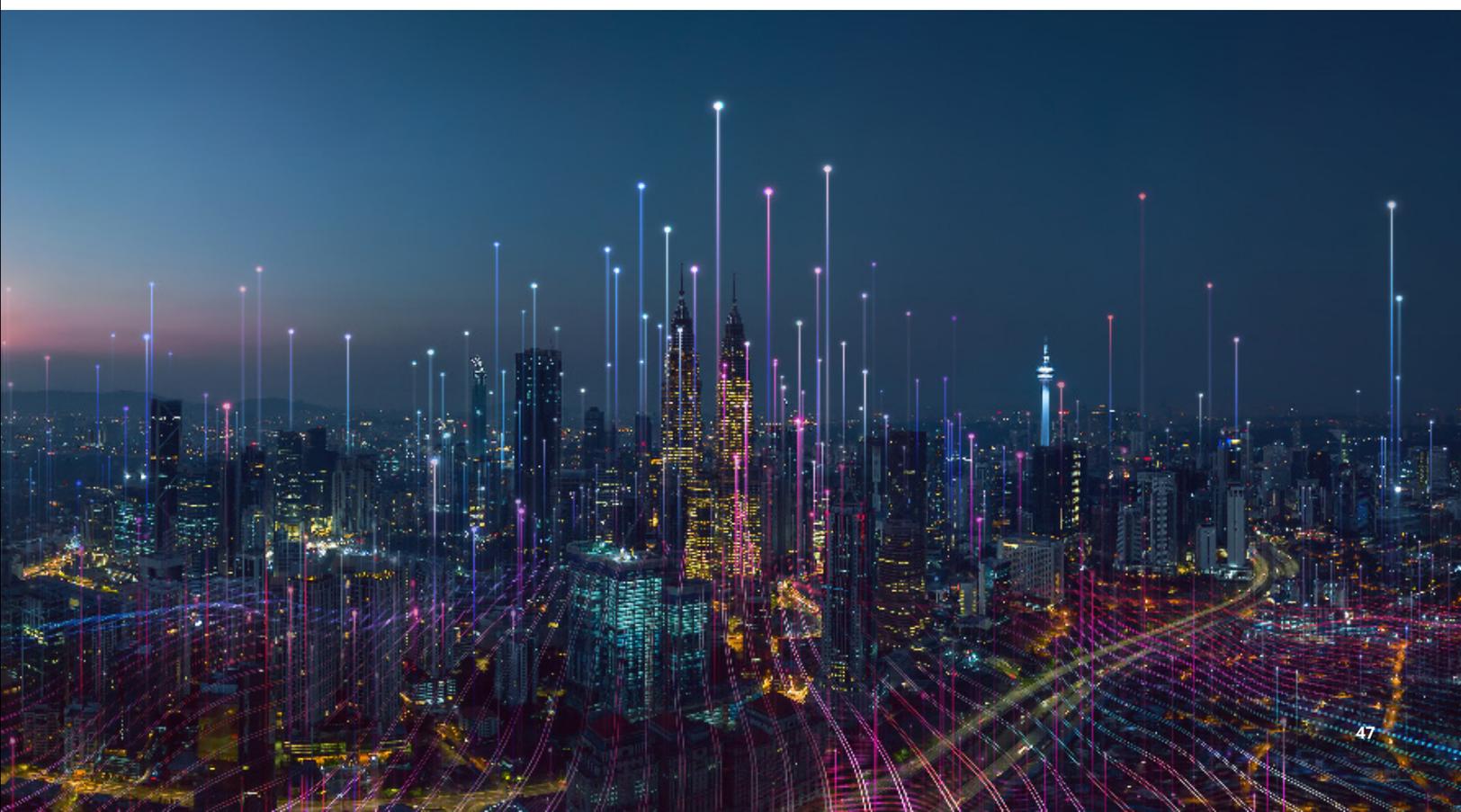
European Union

The European Union, led by the European Commission, is putting regulation at the center of its AI strategy. In April 2021, the Commission published a draft AI law that would subject a long list of AI applications deemed as "high risk" to new requirements.⁴⁵ Enterprises would need to undergo a conformity assessment process illustrating their compliance with these requirements in order to place high risk applications on the European market. The proposal is broadly extraterritorial, reflecting the desire of many EU policymakers to export European legal standards globally, as it had done with the General Data Protection Regulation. As part of its broader efforts to advance "technological sovereignty," EU institutions and Member States are developing new rules relevant to AI, many of which raise concerning questions about the bloc's commitment to open markets. These include restrictions on cross-border data flows and US cloud computing providers, and a new legal framework for data sharing. Just as it is important for the United States to

While the United States was an early leader in AI, the rapid rise of China and other global competitors in this space makes it important for the United States to maintain global leadership in international forums where the rules of the road for the appropriate uses of AI are established.

demonstrate an economically successful counterexample to the centrally planned strategies used by China, the United States should also address concerns raised by stakeholders about the protection of citizen's safety and privacy without ceding its competitiveness. As in other areas of digital policy, the EU may choose to prioritize the former at the expense of the latter.

The United States should lead not only in technology and economic growth, but also in values. Establishing norms of trustworthy AI within the American market and internationally should be a core focus of government policies that advance AI technologies. Just as international standards for digital trade, and monetary policy, create a more stable world and a healthier global economy, US leadership in trustworthy AI can maintain open and competitive markets for AI vendors and protect citizens from threats to their privacy, safety, and civil rights at home and abroad.



Public policies to enable trustworthy AI

The United States has a significant opportunity to support the benefits of AI innovations while mitigating concerns over the risks of AI while being a global leader in trustworthy AI. A proactive policy strategy focused on facilitating the development of trustworthy AI could:

- **Harness private sector expertise to take a leading role in the development of human-centered AI innovations;**
- **Foster the emergence of new business opportunities stemming from those innovations;**
- **Increase the enfranchisement of American workers in the benefits of the AI economy; and**
- **Build the trust of consumers and the general public that AI innovations offer greater economic and social benefits than risks.**

Broadly, this support should be focused on policies that can drive AI innovation in a trustworthy and responsible direction while maintaining a policy environment suitable for innovation. A wide range of policy options exist to increase trust in AI applications given that AI crosses sectors and involves a variety of different inputs such as data, compute power, and a skilled workforce. While there are a number of policy options that have been proposed by lawmakers, industry bodies, think tanks, and civil society groups, this paper focuses on solutions derived from in-depth conversations with leaders from industry, academia, and public policy. These solutions particularly focus on standards and frameworks, research and development, the workforce, and leveraging AI in government. Collectively, these solutions can promote innovation, maintain US AI global leadership, and support the growth and competitiveness of American businesses while embracing the trustworthy AI principles that can help address the social, ethical, safety, security, and privacy concerns.

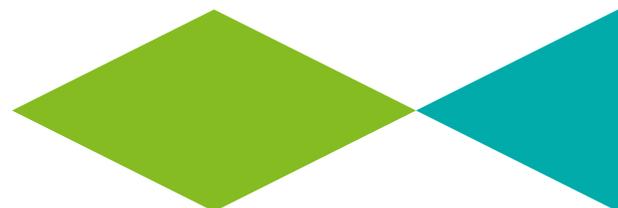


Collectively, these solutions can promote innovation, maintain US AI global leadership, and support the growth and competitiveness of American businesses while embracing the trustworthy AI principles that can help address the social, ethical, safety, security, and privacy concerns.

Respondents were asked about ten different categories of policy solutions that could enable the development of trustworthy AI, which include:

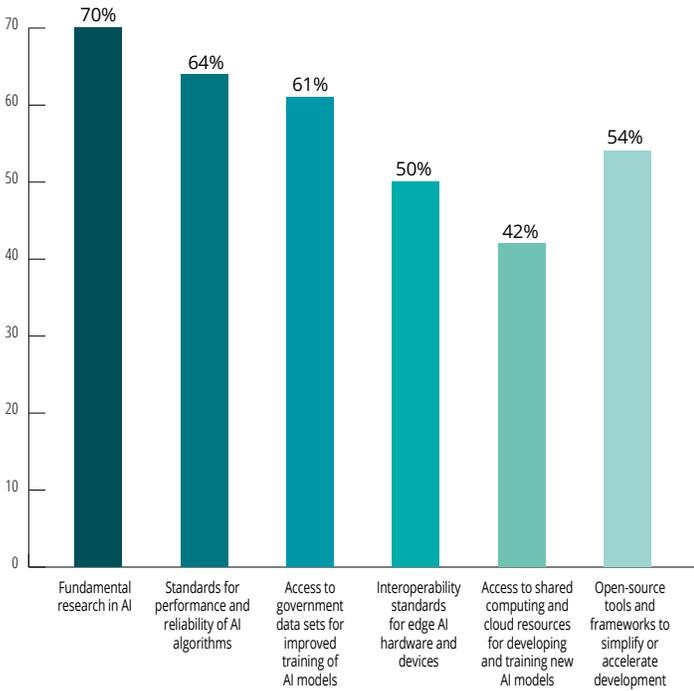
- **Fundamental research in AI**
- **Standards for performance and reliability of AI algorithms**
- **Access to government data sets for improved training of AI models**
- **Interoperability standards for edge hardware and devices**
- **Access to shared computing and cloud resources for developing and training new AI models**
- **Open-source tools and frameworks to simplify or accelerate development**
- **Curricula for youth to promote AI skills and career selection**
- **Retraining or continuing education programs targeted at adults to assist in transitioning to job roles that require AI skills**
- **Establishment or support of existing international partnerships to promote common frameworks for the use and deployment of AI**
- **Model the implementation of trustworthy AI systems within government**

When respondents were asked about their public policy priorities, a clear preference emerged for three specific interventions. 70 percent of respondents identified fundamental research in AI as an enabler of broader innovation in the marketplace, as businesses and entrepreneurs could leverage public investments in R&D as a foundation for their own R&D (a topic explored more fully in Case Study 1 of this paper). 64 percent of respondents recommended that government support in the development and publication of standards for the performance and reliability of AI algorithms. Industry-driven, voluntary consensus standards are essential components in the design of trustworthy AI that represents a significant cost and effort for an individual business to develop, and collaboration on standards is valuable to ensure consistency in the marketplace. 61 percent of respondents identified improving access to government data sets for the training and improvement of AI models as a top priority, which is important to maximize access to a key ingredient of developing AI applications (a topic explored more fully in Case Study 2 of this paper).

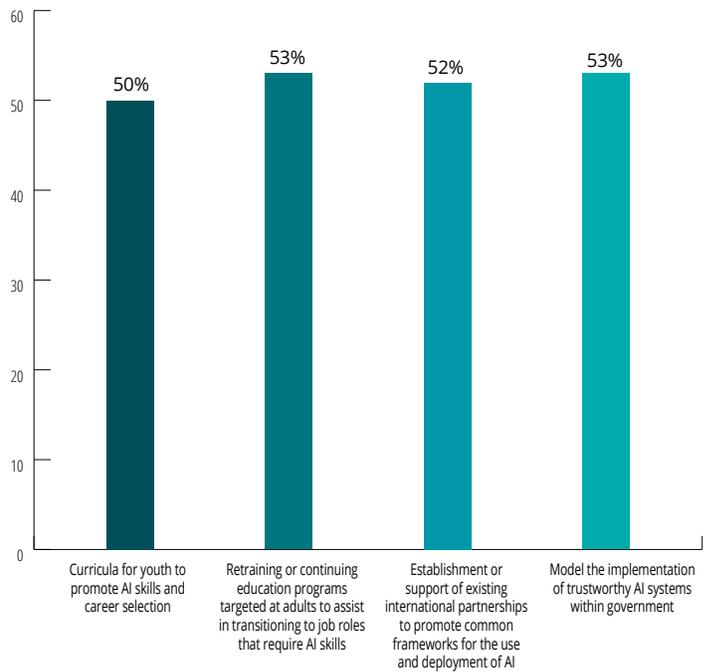


Smaller, but still significant percentages of respondents, 54 percent, 52 percent and 50 percent of respondents, respectively, identified open-source tools, participation in international partnerships and interoperability standards for edge AI hardware and devices as enablers of trustworthy AI development meriting government policy intervention. Also, respondents generally supported education and workforce policy solutions to bolster trustworthy AI, with 53 percent of respondents supporting programs to retrain existing workers and/or provide continuing education for adults, and 50 percent supporting the creation of curricula for youth to promote AI skills and career selection. Finally, 42 percent of respondents supported government investment in shared computing resources such as a national AI research cloud, especially for the computationally intensive task of training new AI models.

Among the following enablers of the development of trustworthy AI technology, which should be targets for government investment or intervention?

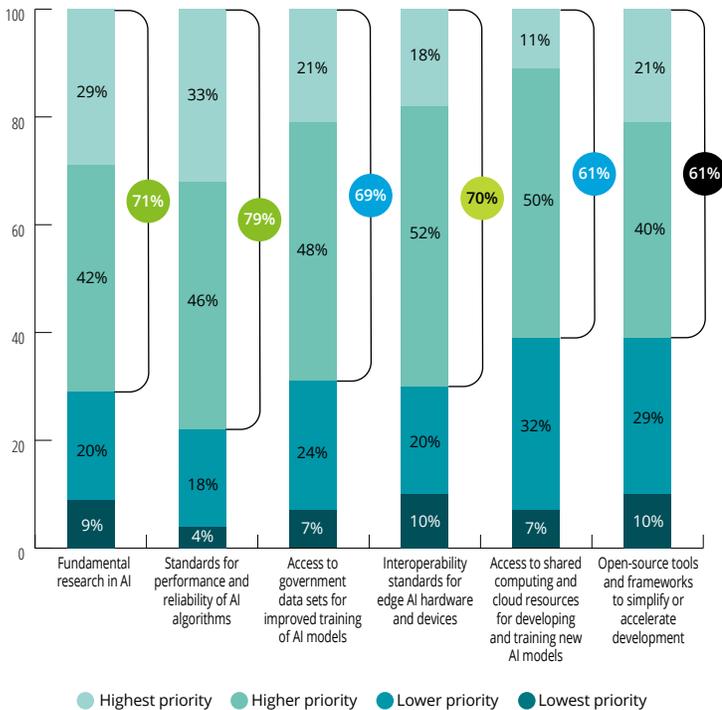


Among the following policies and government interventions, which are likely to support trustworthy AI innovation?



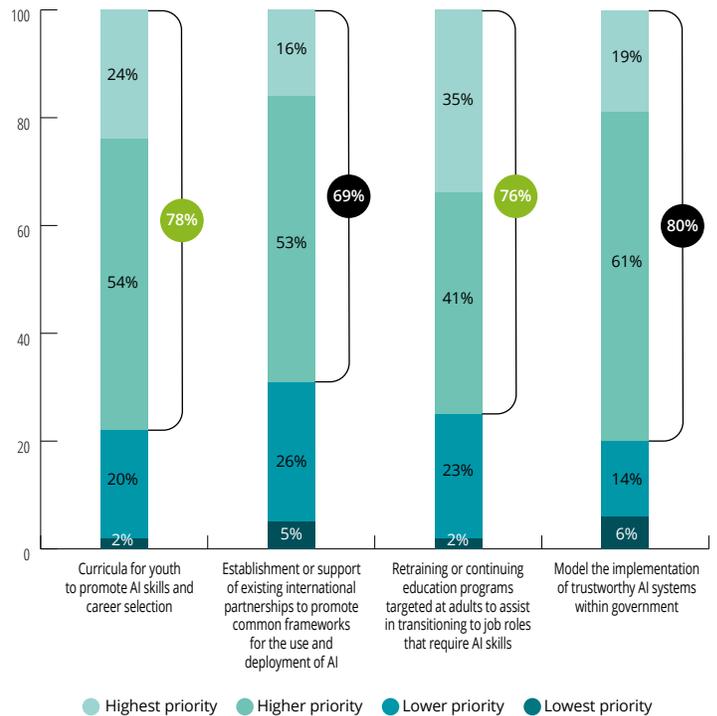
Once they had identified investments and interventions that the federal government should make to support the development of trustworthy AI, respondents were then asked to prioritize among the areas they had selected. Supporting the development of standards and fundamental research in AI were most commonly considered higher priorities relative to other possible investments, by 79 percent and 71 percent of respondents respectively. 70 percent of respondents identified interoperability standards for edge AI systems as a high priority, followed closely by expanded access to government data assets for model training, and access to shared computing and cloud resources for developing and training new models (considered as a high priority by 69 and 61 percent respectively).

Among these enablers of the development of trustworthy AI technology, which should be the highest priorities for government investment or intervention?



In addition, modeling the implementation of trustworthy AI systems within government was the highest priority among respondents who had selected this intervention, with 80 percent of respondents noting it should be the highest priority for policymakers. This solution was followed closely by other policies such as development of AI curricula for youth and retraining programs for older workers (considered high priorities by 78 percent and 76 percent of their advocates, respectively). Support for international partnerships, prioritized by 69 percent of respondents, received the lowest support relative to the other solutions, but still retained significant support.

Among these policies and government interventions that might support trustworthy AI innovation, which should be the highest priorities for government investment?



Promote the establishment of standards for trustworthy AI

International, industry-driven, voluntary consensus standards underlie a number of technologies and products, and are often necessary to foster an effective market and can serve as the foundation for future regulations. The long-term development of trustworthy AI likely depends on the establishment of evidence-based standards regarding AI transparency, fairness, explainability, bias, and accountability. Identified as a priority by 64 percent of respondents, the process of developing these standards is often contingent on substantial investments in the core research required to establish effective methods for determining appropriate standards in ways that actually mitigate real-world risk while enabling continued innovation.

The National Institute for Standards and Technology (NIST) plays a central role in supporting the development and promotion of standards. NIST's 2019 plan entitled "US Leadership in AI: A Plan for Federal Engagement in Developing Technical Standards and Related Tools," posits that "standards should be complemented by related tools to advance the development and adoption of effective, reliable, robust, and trustworthy AI technologies." Collectively, this plan and NIST's other recent work represent a useful blueprint for the federal government to follow in building effective standards that incorporate the insights of many different stakeholders and that are likely to be adopted voluntarily by industry, minimizing the need for explicit and onerous regulations. Putting NIST's Plan at the center of efforts to build AI trustworthiness standards would also align with the direction Congress has signaled through recent legislation to focus on the development of AI standards, which authorizes several AI standards programs at NIST.⁴⁶ Policymakers should consider taking the following steps to accelerate the establishment of standards for trustworthy AI:

- **Congress should provide sufficient appropriations to NIST to execute its existing AI standards activities and new activities authorized by the National Artificial Intelligence Initiative Act of 2020. Funding can help ensure that NIST can accomplish its own fundamental R&D activities, in conjunction with industry, to support the development of standards while positioning the United States to be a global leader in AI standards development among its partner nations.**
- **NIST should expeditiously implement its programs authorized by National Artificial Intelligence Initiative Act of 2020 and develop a timeline on key AI standards activities to provide transparency to stakeholders and Congress.**

Expansion of access to government data sets to train AI models

Federal, state, and local government agencies maintain large and relevant data sets that can be of tremendous value to developing innovative and trustworthy AI applications. Identified as a priority by 61 percent of respondents, these data sets can be valuable due to improved training of AI models and the mitigation of biases stemming from insufficiently diverse sources of data. For example, government data sets often include anonymized data relating to large cross-sections of the American population, a larger and more diverse group of individuals than the customer or user base of many commercial products. For example, government data sets may also integrate writing samples and spoken language examples from numerous linguistic, ethnic, and socioeconomic groups, enabling systems that depend on interpretation of natural language to be tested across a very wide range of inputs.⁴⁷

Overall, the federal government should develop and support shared data models and public data sets, following the approach taken by the OPEN Government Data Act to ensure that government data sets are of high quality and made available in structured, widely used, and machine-readable formats. To effectively leverage government datasets and models for AI, policymakers should consider the following recommendations:

- **Congress and federal agencies should ensure that appropriate funding is made available, and captured in annual budget requests, to support the implementation of the OPEN Government Data Act and for the continued improvements of quality and accessibility of federal government data.**
- **Federal agencies should work to encourage both state and local governments to share their data sets on a voluntary basis, and in coordination with any existing standards and with respect to any applicable law. This collaboration can enrich federal data sets and identify resource needs by state and local governments, such as technical expertise and funding, to execute this objective.**
- **The federal government should explore creating a pilot program to enable the voluntary sharing of private sector data to address pressing national challenges and bolster existing government data sets to improve the quality and usability of the data. The pilot program should be voluntary and should consider methods to encourage private sector participation.**
- **The federal government should also consider publication of non-sensitive and unclassified AI models to act as patterns on which further improvements and innovations might be built by the private sector.**

Encourage sharing computing resources to advance AI

The development of AI applications often requires significant computing resources that some in academia and in the private sector do not possess. Enabling shared resources for AI research and development can spur the development of new technologies by giving both government agencies, private-sector startups, and academia the tools they need to rapidly prototype and test novel and innovative AI applications. Identified as a priority by 42 percent of respondents, public computational resources for training AI models could expand access to AI research similar to the way that the National Science Foundation's Computer Science Network expansion of the early ARPANET to academia expanded participation in networking that would eventually lead to the commercial Internet.⁴⁸ Specifically, government agencies should aim to enable collaboration on core computational resources including:

- **Implement Section 5106 of the Fiscal Year 2021 National Defense Authorization Act, the National AI Research Resource Task Force, which creates a task force of industry, academia, and government to develop a roadmap and implementation plan to create a national shared computing resource for AI.**
- **Support investments in hardware, optimized software, and computational strategies, leveraging partnerships with private sector leaders, to increase the efficiency and performance of the research cloud, as a strategy to maintain global leadership in computational aspects of AI. These activities should be conducted in coordination with any other relevant plans and programs.**
- **Create interactive curricula and sandbox training environments to support students and early-stage professionals in developing the skills to build high-performing AI applications, including the shared computing resources needed to train AI models.**

Establish interoperability standards for edge AI hardware and devices

As use cases such as visual inspection, sound and vibration analysis, and automated vehicles become a more significant part of the economy, more attention should be paid to edge AI hardware and software. Edge hardware and software enable AI models to run locally on devices to improve speed of decision-making and faster response times and protect data privacy by filtering sensitive data before it is stored or crosses the network. Identified as a priority by 50 percent of respondents, interoperability standards for edge AI hardware and devices can enable more efficient design of complex systems of edge AI devices, as well as providing common standards for testing the reliability of devices and securing them from new types of threats. Key policy recommendations to help enable edge AI includes:

- **Support for interoperability standards for edge AI devices, through the expansion and codification of existing collaborations between the private sector, enabling new innovators to contribute to an expanding ecosystem by providing additional capabilities to existing configurations.**
- **Establishment of leading practices for securing edge AI devices, which due to their wide distribution can be more difficult to monitor and more vulnerable to physical manipulation or intrusion.**

Support the creation of open-source tools and frameworks

Collaboration between government, academia, and the private sector can be a critical aspect of the development of AI innovations in the United States. Identified as a priority by 54 percent of respondents, open-source tools and frameworks can be used for designing and training AI data models and for assessing and mitigating issues of AI trustworthiness. Improved access to AI development through the use of open-source development tools and frameworks further expands the range of participants involved in the AI innovation ecosystem. Also, open-source tools and frameworks can help ensure that the insights and leading practices into trustworthy AI practices and techniques are shared widely within the AI stakeholder community. To better leverage open-source tools and frameworks, policymakers should consider several policy solutions:

- Encourage federal agencies to develop standard operating procedures to facilitate the publishing of open-source software as an output of their internal trustworthy AI development efforts, including models, tools, and training data sets, to enable reuse of government-developed resources to accelerate academic and commercial projects, except in cases where such publication would compromise national security or other confidential information.
- Expediently implement an AI Risk Management Framework, as required by Section 5301(c) of the Fiscal Year 2021 National Defense Authorization Act. The risk management framework is a voluntary, consensus-based process intended to mitigate risks throughout the development and deployment of an AI system through developing common definitions of key AI terms, create guidelines and best practices, and provide case studies to effectively implement the framework.

Enfranchising the American workforce in AI innovation

Ensuring that American workers are full participants in the AI economy of the future is likely a crucial issue for the long-term maintenance of American leadership in AI. The United States should look to have the broadest possible segment of its workforce to have the necessary skills to engage in AI-enabled industries and occupations. This can also help ensure that workers and the public can trust that AI applications will augment existing jobs and create new job opportunities rather than eliminate jobs. The federal government, in collaboration with employers and mindful labor market trends, should support the successful transition of the American workforce into a future AI-enabled economy by:

- Funding employer-led reskilling and retraining programs that emphasize AI literacy and support workers in finding roles that complement AI systems, or in using them productively to augment existing skills.
- Providing resources to assist state and local governments in modernizing K-12 and higher education in partnership with the private sector, to include more opportunities for students to interact with, train, and develop AI models, helping enable a seamless transition into a professional life where AI is ubiquitous.
- Promoting resources including financing tools, that enable lifelong learning and continuing education to help ensure that even the workforce's newest members can continue to evolve their skills in a world of continuous technological change.

Building and supporting international partnerships in the adoption of trustworthy AI worldwide and to counter digital protectionism

Ninety-five percent of consumers worldwide are located outside the United States. American companies therefore should access foreign markets to grow their businesses and remain globally competitive.⁴⁹ Governments around the world, including China, the European Union, and India, are increasingly turning to protectionist measures to discriminate against US companies with new taxes and regulations that diminish US market access, and steal American intellectual property.^{50, 51} The rise of digital protectionism, which is well catalogued in the US Trade Representative's annual *National Trade Estimate*,⁵² directly and negatively affects American competitiveness in artificial intelligence. Strategies to counter these measures by negotiating high-standard digital trade commitments with new trading partners and vigorously enforcing existing trade obligations where they are violated may be needed.

Interoperable frameworks for operating across markets also can make it easier for companies to ensure compliance with the widest possible range of regulatory environments while minimizing market-specific adjustments to the design and operation of their products and services. Thus, it can be in the interest of the United States to maintain continuous communication with its trading partners on the evolving definition of trustworthy AI and to help establish interoperable frameworks for the governance of AI technologies.

The Department of State, the Department of Commerce, the US Trade Representative, as well as regulatory authorities, all play important roles in ensuring that foreign governments do not create barriers to trade in AI technologies or to services enabled by AI technologies; favor their own domestic AI technologies unfairly; or establish permanent bans or unreasonably high regulations relating to the use of specific AI technologies or techniques.

There are a number of international partnerships around AI trustworthiness that can be leveraged by the United States for global cooperation on AI. Some of these include:

- **The Global Partnership on Artificial Intelligence (GPAI),⁵³ was launched in June 2020 as “a mechanism for sharing multidisciplinary research and identifying key issues among AI practitioners, with the objective of facilitating international collaboration, reducing duplication, acting as a global reference point for specific AI issues, and ultimately promoting trust in and the adoption of trustworthy AI.”** This organization enacts a key principle of the Organization for Economic Cooperation and Development's (OECD) Recommendation on Artificial Intelligence to “provide a forum for exchanging information on AI policy and activities.”⁵⁴
- **Existing bodies for the study and dissemination of information related to trustworthy AI sponsored by the OECD, including the OECD AI Policy Observatory (OECD AI).⁵⁵**

In addition, high-standard digital trade agreements, which may be needed to counter the growth of digital protectionism more broadly, are increasingly incorporating specific commitments on trustworthy artificial intelligence. The *Digital Economy Partnership Agreement*,⁵⁶ signed by Singapore, New Zealand, and Chile, as well as the *Australia-Singapore Digital Economy Agreement*⁵⁷ include first-of-their-kind disciplines on artificial intelligence. These commitments complement high-standard protections for algorithms and source code included in the *US-Mexico-Canada Agreement*⁵⁸ and the *US-Japan Digital Trade Agreement*.⁵⁹

By taking a proactive role in the establishment of thoughtful guidelines for trustworthy AI in international standards-setting bodies, global initiatives, and trade organizations, the federal government, in partnership with industry leaders can establish leadership and encourage consensus around solutions that mitigate risks while enabling innovation. Specifically, the federal government should consider taking the following steps to champion trustworthy AI policies internationally:

- **Negotiate international trade agreements that incorporate high-standard commitments on the digital economy, including in bilateral, regional, and plurilateral settings.** These agreements should continue to incorporate protections that are foundational to the use and development of AI in global markets. The US Trade Representative, in consultation with the business community and other stakeholders across the federal government should consider whether new trade disciplines specifically devoted to AI may be needed.
- **Proactively and regularly engage with US trading partners on matters of AI governance.** As recognized in the OMB's AI regulatory guidance, regulatory agencies should engage with their foreign counterparts to promote consistent regulatory approaches to AI that promote compatible regulatory approaches to AI and to promote AI innovation. These dialogues serve as valuable opportunities to share leading practices, data, and lessons learned, and help ensure that the US remains at the forefront of AI development. Importantly, international regulatory engagement can minimize the risk of unnecessary regulatory divergences from risk-based approaches implemented by US trading partners. US engagement on international AI governance should extend to multilateral and regional forums, including the OECD, GPAI, and APEC, among international institutions. Consider advancing important standards policy in support of open and competitive markets, particularly with emerging technology initiatives. The development of global standards in collaboration with the private sector is likely the best way to promote common approaches that are technically sound to deliver on technology solutions and policy objectives. Such standards should be voluntary, open, transparent, globally recognized, consensus-based, and technology-neutral. On AI technical standards, the federal government should consider the following actions to exercise leadership internationally: 1) Create a strategy to demonstrate global leadership in and support initiatives to develop AI standards; 2) Play a convening role with the private sector to help ensure appropriate industry representation at standards-setting bodies and organizations; and 3) Promote the use and broad adoption of standards developed by non-government organizations.

CASE STUDY 1

Driving trustworthy AI through research and development investments



Overview of AI research and development investments

An important function of the federal government in supporting innovation is providing federal investments towards R&D. Federal investments will likely be needed to remain competitive with the increased R&D investments of other nations. Overall R&D expenditures in the United States, both public and private, have not risen significantly, as a share of GDP, since 1996. As the Bipartisan Policy Center notes, in the same time period, China increased its R&D expense four-fold, while countries like Israel and South Korea also significantly ramped up spending. The result is that the United States' share of global R&D has declined over the past several decades, falling from 69 percent in 1960 to 28 percent in 2016. From 2000 to 2015, the United States accounted for 19 percent of global R&D growth, while China accounted for 31 percent, and in purchasing power parity-adjusted dollars, China has already outpaced the United States in total R&D investment.⁶⁰

Expansion of federal AI R&D capacity can be accomplished through increasing investments in existing programs as well as creation of new programs, especially for agencies such as the Department of Energy, the National Science Foundation, Department of Defense, and NIST. While the enacted FY2021 federal AI non-DoD R&D budget was \$1.5 billion, a 34 percent increase over the FY2020 figures,⁶¹ many organizations have suggested this number should grow. In April 2020, the National Security Commission on Artificial Intelligence (NSCAI) recommended a doubling of non-DoD AI R&D funding to \$2 billion, focusing on the value of fundamental research and particularly microelectronics technologies as crucial enablers of American competitiveness. The Bipartisan Policy Center has further recommended a continuing increase of total federal AI R&D spending to reach \$25 billion by FY2025. To meet this objective, federal AI R&D investment would need to significantly grow year over year.

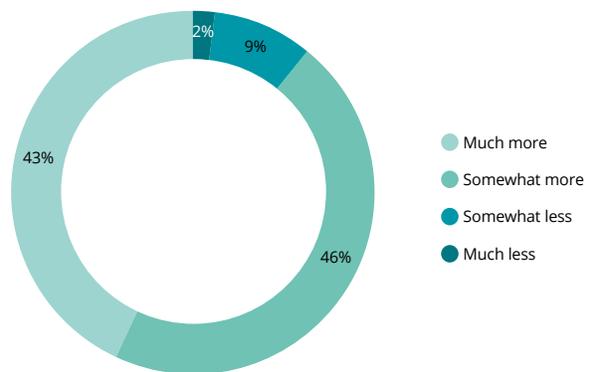
While government support can lower barriers for innovation and entrepreneurship, ultimately the market provides resources more efficiently to help enable companies to commercialize their technology.

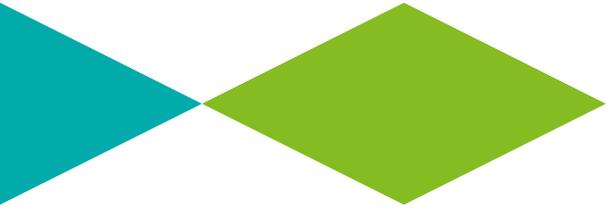
To keep pace with the demand for AI innovation, the federal government should increase its investments in AI R&D and encourage partnerships with the private sector. A recent review by the Congressional Budget Office (CBO) highlights two basic themes about how government R&D investments translate into broader economic impacts. First, fundamental research takes approximately 20 years to manifest its full economic impact as it works its way from the laboratory to commercial products. Second, federal R&D spending is more valuable to the overall economy when directed toward early-stage technology development, as private interests have incentives to focus on development of technologies closer to the stage of commercialization and are less likely to incubate promising research that has not yet shown commercial potential.⁶² Overall, government involvement in early development of critical technologies can have numerous benefits: fundamental research serves as the foundation of new innovations, accelerates the growth and maturation of these technologies, and reduces barriers to entry for startups and entrepreneurs to bring their novel insights to market.

Survey results on AI research and development

Respondents to the survey strongly supported expansion of the AI R&D capacity of the federal government, with over 70 percent of respondents recommending prioritization of this area. Respondents also agreed that the federal government should invest more in research and development of AI technologies, with 43 percent supporting “much more” investment relative to other R&D priorities, and another 46 percent supporting “somewhat more” investment.

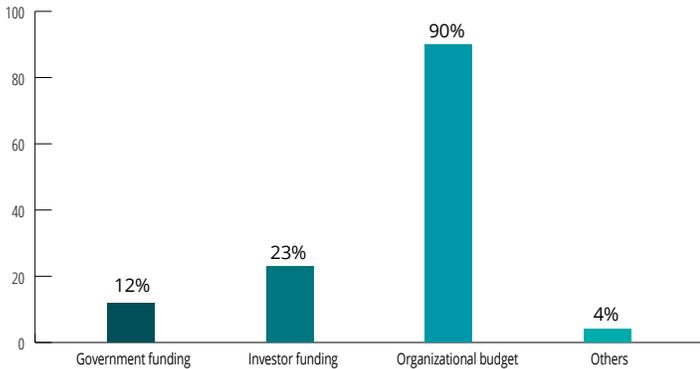
Relative to other priorities for R&D funding, should the government invest more, or invest less, in AI technologies in general?





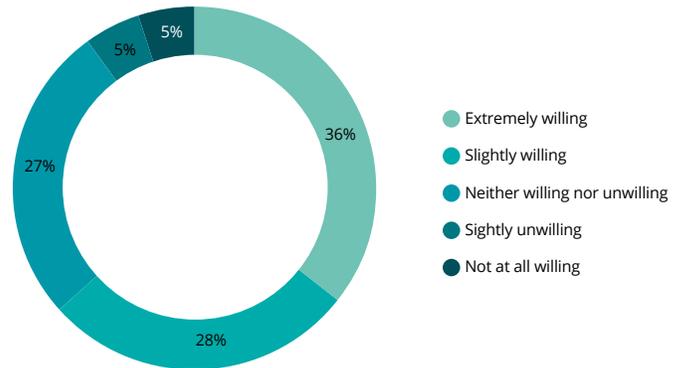
Respondents to the survey were also asked to identify how their organization currently funds AI innovation to determine the opportunity for expanding government R&D partnerships with the private sector. 90 percent of respondents funded AI innovation in whole or in part with their own internal, organizational budget. 23 percent received some form of sole or supplemental investor funding, and 4 percent had identified other sources of funding such as donations or project-based revenue. Only 12 percent of respondents indicated that some or all of their AI innovation funding came from government sources.

Which of the following best represents how your organization funds new AI innovation?



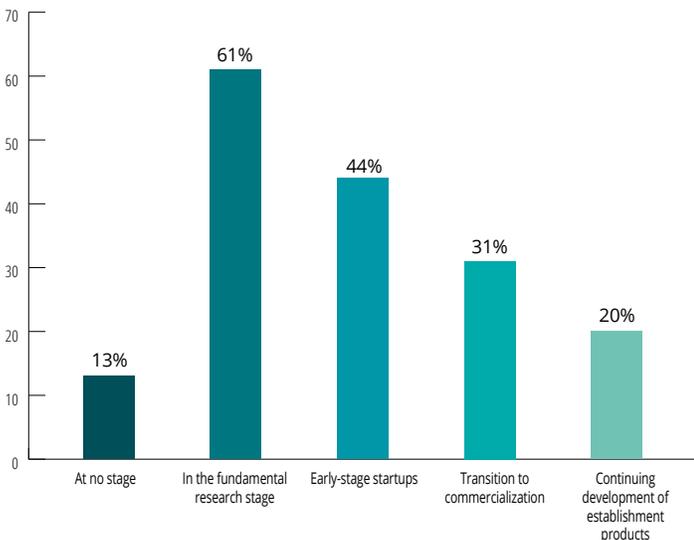
Among the 88 percent of respondents who were not currently receiving funding for new AI innovation from the government, the majority expressed willingness to do so, with 64 percent indicating that they were either “extremely” or “slightly willing.” Only 10 percent expressed active uninterest, a relatively low number given the administrative requirements that can come with seeking or receiving government support. The high willingness on the part of organizations to receive government funding for innovation is likely a recognition that the challenges of developing trustworthy and reliable AI systems are large, and that many of the largest costs associated with AI innovation, such as building high quality data sets and training models appropriately, can effectively be achieved in partnership with public sector entities.

You previously indicated your organization does not currently receive funding for new AI innovation from the government. Which of the following best represents your organization’s willingness to receive government funding for AI?



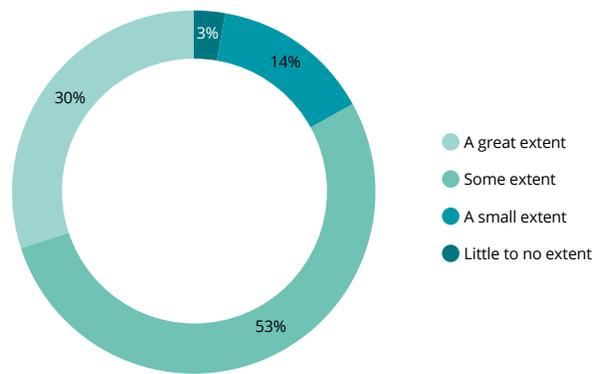
Respondents to the survey strongly agreed that government investment was more important at the fundamental research stage and for early-stage startups, with 61 percent of respondents agreeing that government support was an important source of funding for fundamental research and 44 percent agreeing that government support was of benefit to early-stage startups. A diminishing number of respondents identified government funding as important to companies progressing through the stages of commercialization. While government support can lower barriers for innovation and entrepreneurship, ultimately the market provides resources more efficiently to help enable companies to commercialize their technology. This indicates that government should consider seeking connections with academic institutions, incubators, the venture arms of larger companies, and other organizations that foster new initiatives, rather than focusing partnerships commercializing products for the market.

In your observation, across the wide range of companies that produce AI innovations, at which stage of development would government investment provide a significant source of funding?



Respondents to the survey were generally confident that government policies could in fact support the development of trustworthy AI applications, with 30 percent of respondents suggesting that government involvement could ensure trustworthy AI development to a “great extent” and an additional 53 percent of respondents agreeing that this involvement could ensure trustworthy AI development to at least “some extent.” Interviews with AI experts and industry leaders conducted during the development of the survey reinforced the idea that many researchers, entrepreneurs, and businesses involved in AI would welcome government investment in research, standards, and training data required to produce more trustworthy AI systems.

To what extent can government investment or intervention ensure that research and development in AI leads to innovation in trustworthy AI applications?



Modeling the impact of increased government AI R&D

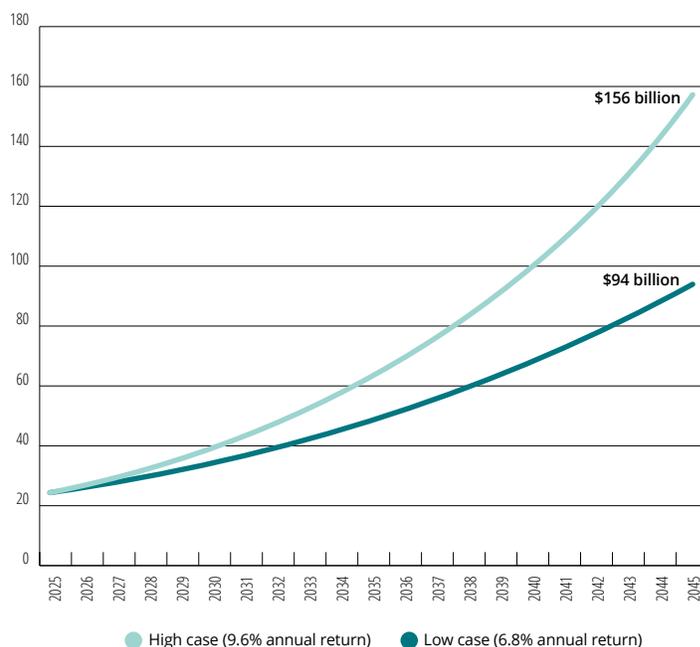
Assessing the total economic impact of federal R&D investments in AI typically requires extrapolation from previous examples where government intervention in an emerging technology sector provided a foundation for accelerated growth in the private sector. In recommending an overall investment of \$40 billion in AI research and development, inclusive of both defense and non-defense R&D, the NSCAI report notes that the equivalent of \$96 billion was put into the development of the Interstate Highway System in 1956. The implication is that the long-term economic and social transformations enabled by earlier investments that could potentially be exceeded by an investment not even half as large. While individual states had initially made great strides in linking local and regional centers with roads, the standardization and comprehensiveness of the Interstate Highway System made it possible for all parts of the country to benefit from increased access to raw materials and talent, in addition to providing a resilient infrastructure for national defense purposes. By 2011, the Department of Transportation attributed \$15 trillion of economic activity to trucking and freight transportation enabled by the Interstate Highway System.⁶³ This is an increase of over 150 times the original investment, or approximately 9.6 percent of annual compounded growth on the original investment over the 55-year period.

Also, a National Research Council study from 2001 discussed the \$7 billion (1999 dollars) of investments of the Department of Energy in a range of energy efficiency and storage technologies over a 22-year period led to approximately \$30 billion (1999 dollars) in the form of economic net benefits. These benefits include commercialization of energy-saving technologies and cost savings to businesses and consumers from increased energy efficiency, slightly more than a fourfold return on the original investment, or approximately 6.8 percent annual compounded growth over the 22-year period.⁶⁴

Taking these two examples indicate a broader pattern of return on government R&D investment, we can begin to establish a picture of the return on R&D investments that might occur if recommendations for increasing AI R&D investments were enacted. Extrapolating over a 20-year period, and assuming that return on AI is similar to the pattern seen in previous productivity-increasing transformations, the yield on the Bipartisan Policy Center’s total recommended federal AI R&D expenditure of \$25 billion would result in between \$94 billion and \$156 billion of incremental economic impact by 2045. This assumes a low case of 6.8 percent compound annual return and a high case of 9.6 percent compound annual return per the historical examples.

Return on government AI R&D

(US dollars in billions)



Relative to previous technology revolutions, however, there is evidence that AI has a potentially higher total economic value than many previous technologies. A 2018 paper looking at the impacts of robotic automation technologies implemented between 1993 and 2007 determined that they contributed a net 0.36 percentage points of annual labor productivity to the economy.⁶⁵ Also, a 2017 NBER paper compared the period after portable power became available in production (1890 to 1940) with the period of the uptake of information technology (1970 to 2017) and showed that both periods showed a similar trend in increasing contribution to productivity over time after a slower period of adjustment as the new technologies became integrated into business processes.⁶⁶ A productivity-based approach to modeling economic impact was taken by an Analysis Group paper from 2016, which argued that if the overall effects of AI were similar in impact to that of the diffusion of mobile phone technology throughout the 1990s and 2000s, it would contribute between 0.31 and 0.43 percentage points of incremental GDP annually. If instead, AI had an even broader impact, equivalent to that of the widespread adoption of all forms of new information and communications technology throughout the same period, the economic impact would be equivalent to an incremental 0.8 percentage points of GDP.⁶⁷

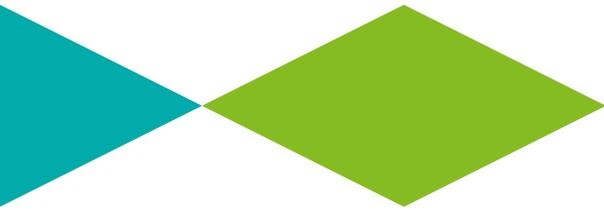
Moreover, a 2019 European University Institute paper suggests that due to its capacity for self-improvement, AI should not be conceptualized simply as a new type of automation, but as a “completely new input of production,” potentially increasing not only labor productivity or return on capital investments but making entirely new tasks possible.⁶⁸ This would imply that AI’s contribution to productivity could significantly exceed that of previous transformative technologies. Even if AI is taken to contribute only the equivalent of robotics or mobile telephones, this could represent over \$477 billion in GDP growth through 2025. However, if AI is truly unlike previous generations of technologies and yields productivity improvements in excess of all previous information technology investments, with a 1.2-point contribution to productivity growth, the impact could be as great as \$1.4 trillion of additional GDP through 2025.

Finally, the likelihood of achieving a higher outcome from AI R&D investments relative to previous transformative technologies could also be accelerated by the significant investments that the private sector is making in AI R&D. Private companies in the United States are expected to spend almost \$100 billion annually on AI R&D by 2025.⁶⁹ Though only a portion of overall increase in productivity from AI can be directly attributed to public R&D investments, making federal investments in AI R&D a significant priority to help facilitate the continued growth of an AI economy.

Year	GDP Estimate	Low Case (0.4 points)	High Case (1.2 points)
2021	21,921.6	87.7	263.1
2022	22,967.7	91.9	275.6
2023	23,913.1	95.7	287.0
2024	24,833.8	99.3	298.0
2025	25,783.4	103.1	309.4
		477.7	1,433.0

GDP estimates from October 2020 edition of IMF World Economic Outlook, all figures in US dollars in billions

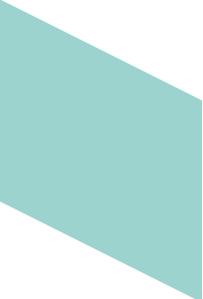
The yield on the Bipartisan Policy Center’s total recommended federal AI R&D expenditure of \$25 billion would result in between \$94 billion and \$156 billion of incremental economic impact by 2045.



Investing in trustworthy AI

The overall strategy for allocation of investment and prioritization of federal government AI research and development will require leadership from the White House Office of Science and Technology Policy in coordination with other federal agencies engaged in AI R&D activities given that AI crosses a number of different sectors and applications. Given the significant potential economic impact of AI innovation for the United States economy, the policymakers should prioritize investments in AI R&D through:

- Enacting the recommendations of the NSCAI final report, the Bipartisan Policy Center, and other organizations that suggest dramatically investing in AI R&D by the federal government.
- Fully appropriating programs established in the National Artificial Intelligence Initiative Act of 2020 at the National Science Foundation, Department of Energy, and the Department of Commerce that focus on AI R&D.
- Identifying new opportunities to bolster federal government investments in trustworthy AI R&D and that can contribute to AI-related research and create of pipeline of innovation that can be further developed and commercialized by the private sector.



Given the significant potential economic impact of AI innovation for the United States economy, the policymakers should prioritize investments in AI R&D.



CASE STUDY 2

Government modeling of trustworthy AI



The federal government should lead in trustworthy AI innovation from the front, acting as a role model for states, local governments, and the private sector in the responsible use and implementation of AI systems that serve citizens and conduct government business. Federal agencies are already putting AI-enabled solutions in place to improve government services. For example, in 2015, US Citizenship and Immigration Services (USCIS) had deployed a chatbot “Emma,” which fields over 14 million queries related to immigration issues each year.⁶⁹ When asked about government interventions that were likely to support trustworthy AI innovations, 53 percent of respondents indicated that the government itself model the implementation of trustworthy AI systems. This finding was emphasized by the NSCAI’s Final report, which noted that:

“Public trust will hinge on justified assurance that government use of AI will respect privacy, civil liberties, and civil rights. The government must earn that trust and ensure that its use of AI tools is effective, legitimate, and lawful. This imperative calls for developing AI tools to enhance oversight and auditing, increasing public transparency about AI use, and building AI systems that advance the goals of privacy preservation and fairness. It also requires ensuring that those impacted by government actions involving AI can seek redress and have due process.”

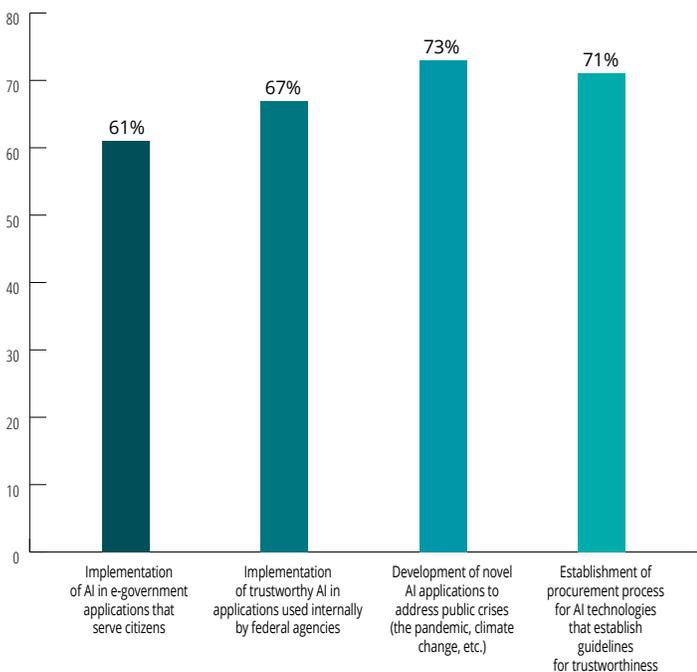
This case study takes a deeper dive into how the federal government can promote trustworthy AI through its own use of trustworthy AI applications, focusing on four different categories of policy solutions:

- **Implementation of AI in e-government applications that serve citizens**
- **Implementation of AI in applications used internally by federal agencies**
- **Development of novel AI applications to address public crises**
- **Establishment of procurement processes for AI technologies that establish guidelines for trustworthiness**

Survey respondents were asked how they would prioritize government engagement in modeling implementations of trustworthy AI systems. 73 percent of respondents indicated support for the development of novel AI applications to address public crises such as the pandemic or climate change. 71 percent of respondents also saw value in the establishment of procurement processes for AI technologies that incorporated guidelines around AI trustworthiness. There was also substantial support for the implementation of trustworthy AI in applications used internally by federal agencies (supported by 67 percent of respondents) and in e-government applications oriented toward citizens (supported by 61 percent of respondents).

Prioritization of these four areas can build public awareness of, and confidence in, the positive applications of AI. Many government systems today are widely used by the public and are some of the most important and influential points of interaction through which the public can understand and trust AI systems. Moreover, government modeling of AI applications can serve as an example for the private sector and other governments to encourage the use of trustworthy AI technologies. We will now examine each of these four areas in more depth and provide policy recommendations to help further government adoption of trustworthy AI applications.

Among the ways in which government can model implementation of trustworthy AI system, which of the following should the government prioritize?



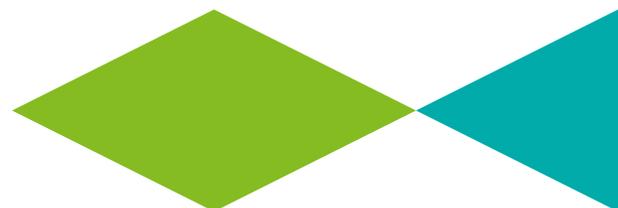


Leverage AI to address national and global crises

To build trust in AI technologies, there may be no greater opportunity than the government advance of AI innovations that directly and publicly address the most consequential crises that pose a threat to our nation and our world. Some AI systems are able to predict and mitigate significant threats to human life and property from extreme events such as pandemics, and climate disruptions such as extreme weather events, and crippling disruptions of essential utilities and supply chains. Also, AI can be used to improve forecasting of extreme weather and provide earlier warning in cases of potential disasters, as well as model impacts of exceptional flooding, seawater intrusion, and other early indicators of sea-level rise. As the COVID-19 pandemic becomes more manageable in the United States through mass vaccinations and improved public health awareness, AI can be used to rapidly identify clusters of new cases or the spread of novel variants, enabling more targeted public health interventions that protect the economy while helping mitigate rapid increases in cases.⁷⁰

While private sector partners can contribute insight and technology to these challenges, government has a unique role in driving development of novel applications in these spaces as a result of both its scale and its capacity to invest in long-term, transformational initiatives. To effectively leverage AI applications to help address national and global crises such as COVID-19 and climate change, policymakers should consider the following recommendations:

- **Federal agencies should identify and prioritize the use of AI applications that could be used by government and by private sector and civil society stakeholders to address pressing public crises. Agencies should also identify any barriers that prevent or inhibit the development and use of identified AI tools.**
- **Federal agencies should sponsor public contests or prizes to encourage private citizens, academia, and the private sector to incentivize the development of novel, AI-driven solutions to address public crises.**

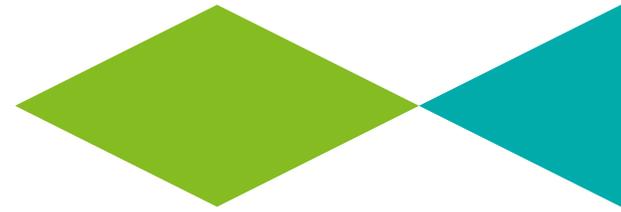


Establish trustworthy AI procurement policies

The federal government is a major purchaser of information technology (IT) and services, spending \$90 billion on IT annually.⁷¹ Federal government standards often become the de facto baseline for many vendors in designing security, privacy, compliance, and other features, and aligning private sector procurement policies with these standards can help mitigate risks and costs associated with noncompliance. As applied to AI, by building ethical guardrails based on the core principles of trustworthy AI into its procurement policies, the federal government can incentivize vendors into adopting trustworthy AI concepts in the design of their AI products and services. This can be analogous to Executive Order 13834, “Efficient Federal Operations” which encouraged suppliers to offer more eco-friendly and sustainable products.⁷² Moreover, these standards can even encourage consistency internationally just as the costs and complexity of complying with the EU’s General Data Protection Regulation drove many American companies to adopt GDPR obligations as a baseline for their domestic products and services even in the absence of equivalent legislation within the United States.

Policymakers can take several steps to position the United States government as a leader in trustworthy AI through procurement:

- **Through the General Services Administration’s AI Center of Excellence, the federal government should conduct an assessment of how to integrate trustworthy AI principles in the procurement of AI technologies. The assessment should account for existing federal policies and guidelines, and ongoing efforts to define trustworthy AI, and should involve consultation with external stakeholders, including industry.**
- **The federal government should publish its procurement standards, best practices, and other processes for use, on a voluntary basis by the private sector and subnational governments to inform the development of their own processes to adopt trustworthy AI technologies.**



Implement AI technologies in internal and external federal agency applications

Executive Order 13859, “Maintaining American Leadership in Artificial Intelligence” emphasized the importance for federal agencies to adopt AI technologies in their own operations, noting that agencies applying for purposes such as regulatory compliance, combatting waste, fraud and abuse, identifying and mitigating cybersecurity threats, among many other uses.⁷³ Facilitating progress in AI adoption across federal agencies has been a priority of the General Services Administration (GSA), which established an Artificial Intelligence Center of Excellence within its Technology Transformation Services (TTS) division in 2017 to accelerate the use of AI as part of IT modernization initiatives within federal agencies. Krista Kinnard, Director of the Artificial Intelligence Center of Excellence, describes four key areas where federal agencies are already seeing success in the adoption of AI technologies:

“Broadly, we see a lot that focus on four outcomes: increased speed and efficiency, cost avoidance and cost saving, improved response time, and increased quality and compliance... One of the biggest areas we’ve started to see advancement is in data management. Agencies are using intelligent systems to automate both collection and aggregation of government data, as well as provide deeper understanding and more targeted analysis. We have seen that the potential for the use of natural language processing (NLP) is huge in government... So much of government data exists in government forms with open text fields and government documents, like memos and policy documents. NLP can really help to understand the relationships between these data and provide deeper insight for government decision making.”
—Forbes⁷²

Ultimately, federal agencies should leverage their growing expertise in AI to extend a greater range of AI capabilities to citizens through e-government applications and other agency applications. Accelerating decision-making and simplification of processes enabled by AI technologies can reduce the time and effort associated with common tasks undertaken by the public such as filing taxes, applying for licenses and certificates, and engaging in the development of public policies. The improved experience of government services enabled by AI can build citizen trust both in AI technologies and in the functions of government itself. Policymakers should take the following steps to implement AI applications in the federal government:

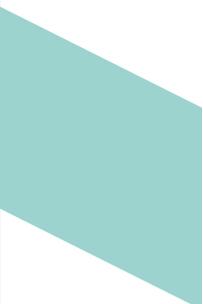
- **Fully implement the AI in Government Act, including the timely development of guidance for federal agency use of AI applications and the codification of the AI Center of Excellence.**
- **Maintain and implement Executive Order 13960, “Promoting the Use of Trustworthy Artificial Intelligence in the Federal Government,” in coordination with the AI in Government Act.**
- **Federal agencies should issue a request for information to gather private sector input to identify how cutting-edge AI applications can assist federal agencies in their public-facing responsibilities.**



Conclusion



The United States has an enormous opportunity to transform its economy and society in positive ways through leading in AI innovation. While AI technologies can pose risks, appropriate policies, as outlined in this paper, can help mitigate and address those risks, which could help increase public trust in AI. Moreover, the numerous benefits of AI also will likely improve AI trustworthiness among the public, which can be accelerated through public policy solutions. Guiding AI innovation in accordance with trustworthy AI can ultimately encourage the social and economic benefits derived from AI and empower the United States to maintain global competitiveness in this critical technology sector. The federal government should support the development of trustworthy AI through common-sense policies that foster growth and innovation while ensuring that new technologies are deployed responsibly. A dynamic future of human-centered AI innovation is available to us, one that can encourage economic growth and social development within the United States and across the world.



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Appendix



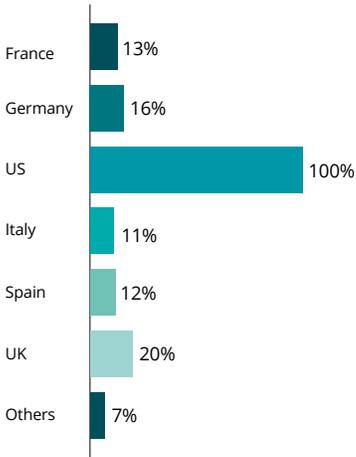
Survey methodology

The recommendations and results in this paper are supported by a survey of 250 respondents involved in AI research and development or decision-making by companies based in or operating primarily in the United States. These respondents came from a wide cross-section of industries, with 32 percent in the IT or telecommunications sectors, 20 percent from industrial sectors including automotive, electronic equipment and instruments, semiconductor, aerospace and defense, and other manufacturing verticals, 11 percent from the healthcare and pharmaceuticals sector, 10 percent from financial services firms, 8 percent from business or professional services firms, 6 percent from the retail sector, 4 percent from the energy sector, 4 percent from the media and entertainment sector, and 5 percent from other sectors of the economy. 46 percent of respondents came from companies with over \$1B+ in annual revenue, 29 percent from companies between \$100M and \$1B in annual revenue, and 25 percent from companies with less than \$100M in annual revenue or undisclosed revenue.

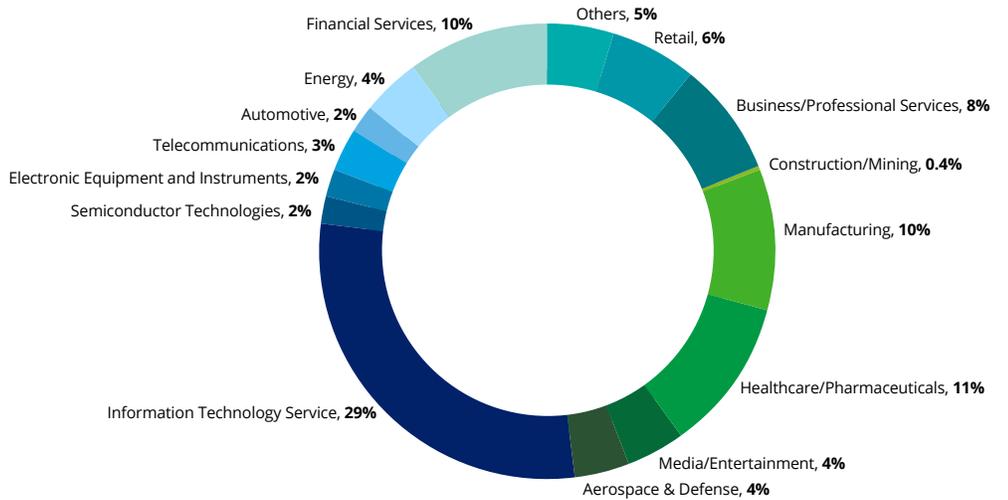
Respondents were generally senior, with 44 percent in C-level or equivalent roles, 21 percent in SVP or VP roles, 28 percent in director or manager roles, and 7 percent working as individual contributors or in other roles. 70 percent held an IT- or technology-related role in their company, 28 percent came from research and development groups, and 2 percent came from human resources roles, segments targeted by the survey because of their likely exposure to AI technologies and their impacts. The complete survey results are located in the appendix of this paper.

Survey respondent population

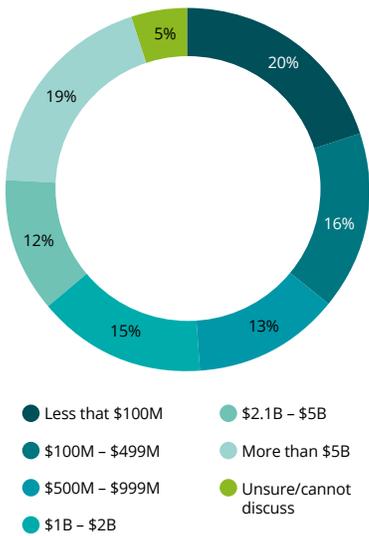
In which of the following countries does your organization operate?



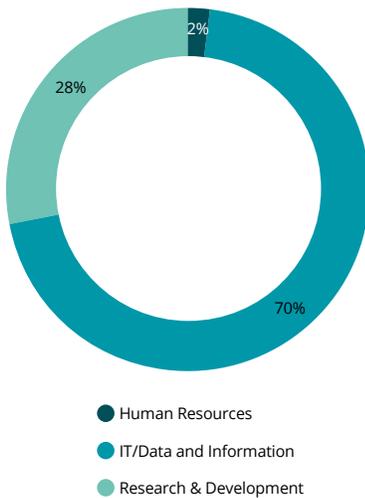
Which of the following most accurately reflects your industry?



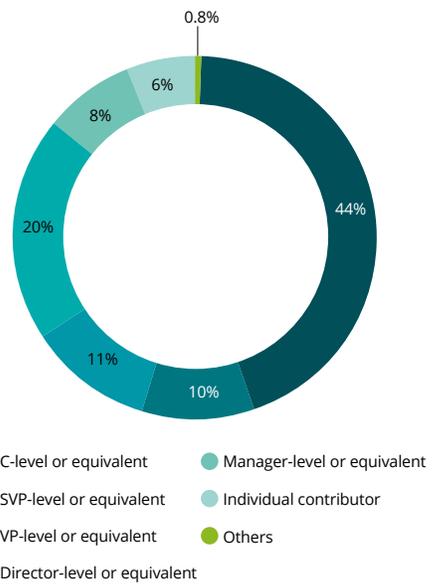
What was your organization's approximate total revenue in the last fiscal year?



Which of the following best describes your department within your organization?



Which best describes your title?



About the authors



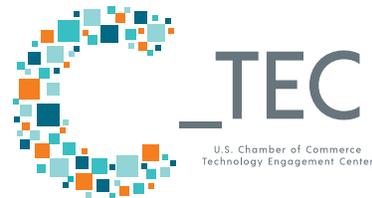
Kate Schmidt

Kate Schmidt is COO for the Global Deloitte AI Institute. Kate focuses on amplifying Deloitte's Age of With™ messaging in the market, and connecting Deloitte's clients to the AI ecosystem. Prior to her role within the Deloitte AI Institute, Kate led large scale global finance transformation programs in consumer and industrial products, life sciences, and high tech industries.



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