U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HEARING CHARTER

Artificial Intelligence and the Future of Work

Tuesday, September 24, 2019
4:00 p.m.
2318 Rayburn House Office Building

PURPOSE

On Tuesday, September 24, 2019 at 4:00 p.m., the Subcommittee on Research and Technology of the Committee on Science, Space, and Technology will hold a hearing to examine the impact of machine learning and artificial intelligence on the workforce, including issues related to worker displacement, retraining of the current workforce, and developing a skilled technical workforce of the future that can thrive in an economy in which AI increasingly plays a role. The Subcommittee will also explore the disparate impacts on different industry sectors and different populations, as well as issues of safety, privacy, and security relevant to the human-technology interface.

WITNESSES

- **Dr. Arthur Lupia**; Assistant Director, Directorate for Social, Behavioral and Economic Sciences; National Science Foundation
- **Dr. Erik Brynjolfsson**; Schussel Family Professor of Management Science and Director, The MIT Initiative on the Digital Economy; Massachusetts Institute of Technology
- **Ms. Rebekah Kowalski**; Vice President, Manufacturing Services; ManpowerGroup
- **Dr. Sue Ellspermann**; President; Ivy Tech Community College

OVERARCHING QUESTIONS

- How will advances in artificial intelligence (AI) technologies, which includes machine learning (ML), affect work today and in the future? How are the potential workforce impacts of AI different from previous eras of technological advances?
- Will increased use of AI technologies exacerbate existing economic inequalities? If so, how, and what policies or practices may mitigate these impacts?
- What needs exist for retraining the current workforce to be successful in an economy with increased use of AI systems? How can educational institutions adapt their curriculum to prepare the future workforce?

- What are the key research questions to improve understanding of AI impacts on the workforce and to inform evidence-based policies and practices to support a well-trained workforce and minimize unintended consequences?

Background

Previous Technological Disruptions

Today, many Americans are concerned about the impact robots and computers will have on jobs. A recent survey conducted by the Pew Research Center found that 65% of respondents think that robots and computers will definitely or probably take over many jobs currently performed by humans. Additionally, only 25% of respondents believe there would be new, better-paying jobs and only 43% believe that the economy would be more efficient if robots and computers were able to perform much of the work currently done by humans.[1] A 2017 Pew Research Center survey found that most Americans (64%) believe it is likely that people will have a hard time finding things to do with their lives.[2]

Major changes brought about by advances in technology and the fears that accompany them are not unique to the fears surrounding advances in AI technologies. An early example of anxiety related to technological advancement dates to the 19th century. The Luddite movement was born out of a fear among some British textile workers that they would be replaced by machines. In another example, advances in manufacturing allowed for production in greater volumes and with interchangeable parts, greatly reducing the amount of work for skilled artisans such as blacksmiths.[3]

Developments in AI

Rapid advances in computing power and the availability of large data sets have made AI systems increasingly efficient and accurate at tasks such as object and speech recognition, and data analysis. AI systems are also being used to aid in weather predictions[4] and medical diagnoses.[5] Much of the advances in these AI systems stem from advances in machine learning (ML), a type of algorithmic model that "learns" from patterns in input data – often but not always labeled training data - and applies that "knowledge" of such patterns to analyze new data. This self-improvement happens continuously as new data is fed into the system. Machine learning is currently used for numerous applications including photo tagging[6] and email spam filters.[7] A particular subset of machine learning algorithms called deep neural networks (DNNs) have been particularly responsible for increases in the accuracy, speed and applicability of ML systems. Despite recent progress, however, humans are still more effective than computers at a wide array of tasks, particularly those that involve creativity, human connection or physical dexterity.[8]

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[1] https://www.pewresearch.org/global/2018/09/13/in-advanced-and-emerging-economies-alike-worries-about-job-automation/
[2] https://www.pewinternet.org/2017/10/04/americans-attitudes-toward-a-future-in-which-robots-and-computers-can-do-many-human-jobs/
[3] https://www.britannica.com/technology/interchangeable-parts
[4] https://spacenews.com/ai-for-earth-observation-and-numerical-weather-prediction/
[5] https://medicalxpress.com/news/2019-05-artificial-intelligence-lung-cancer-radiologists.html
[6] https://hbr.org/2016/11/what-artificial-intelligence-can-and-cant-do-right-now
[7] https://www.sciencedirect.com/science/article/pii/S2405844018353404
[8] https://www.nap.edu/catalog/24649/information-technology-and-the-us-workforce-where-are-we-and

Workforce Impacts of Machine Learning and Artificial Intelligence

Today, most economists characterize jobs as a collection of individual tasks. In general, all or most of these tasks are performed by the worker, and some subset of tasks are done by technology. Technological advances primarily affect these tasks in three ways. The first of these is substitution. A technology can be substituted for certain tasks that were previously performed by a person. One example of this involves automated teller machines (ATMs). ATMs substituted for bank tellers at performing the specific task of withdrawing cash but did not substitute for the entire occupation.[9]

The second way in which technology can affect tasks is to complement the worker. Continuing with the ATM example, ATMs complemented bank employees by freeing up the time they previously spent distributing cash, allowing them to spend more time on customer service and assisting with individual financial issues, tasks that cannot be performed by an ATM.[10]

Finally, technological advances can create new jobs. ATMs decreased the cost of operating a bank and allowed bank employees to spend more time focusing on customer needs. In turn, this led to an increase in the number of bank branches in the U.S. and in more people being hired to work in banks.[11] Technological advances can also create jobs that previously didn't exist; the invention of MRI imaging, for instance, created the need for MRI technicians, a previously nonexistent occupation.[12]

A recent report released by the Brookings Institution found that artificial intelligence and machine learning systems will have some effect on almost all tasks and occupations, though the nature and degree of impact will vary.[13] The strengths of current AI systems include classification and prediction, tasks that are repeatable, that do not need an explanation for how a decision was made, tasks for which a certain amount of error is acceptable and tasks that do not require a high amount of mobility or dexterity.[14] These systems may predominantly affect some of the low-wage, low-skill jobs with repetitive tasks.[15] One such occupation is customer service, with many companies now using AI-powered chatbots to interact with customers who have questions.[16]

Some high-wage, high-skill jobs could also be affected by AI systems. One prominent example of a high-skill, high-wage field where AI systems could increasingly play a role is medicine.[17] Radiology is one of the fields in which AI systems potentially have the greatest utility, given

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[9] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2690435
[10] https://www.pnas.org/content/116/14/6531
[11] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2690435
[12] https://www.nap.edu/catalog/24649/information-technology-and-the-us-workforce-where-are-we-and
[13] https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf
[14] https://science.sciencemag.org/content/358/6370/1530
[15] https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf
[16] https://www.salesforce.com/products/service-cloud/best-practices/how-ai-changed-customer-service/#
[17] https://www.ahajournals.org/doi/full/10.1161/circulationaha.115.001593

their efficiency in pattern recognition.[18] AI systems can be "trained" using x-ray and MRI images that are known to contain certain pathologies and then used by radiologists to scan new images to help detect those pathologies.[19] Another potential application that takes advantage of the strengths of machine learning is scanning documents to classify them or determine their relevance to a specific project. This could be used by any number of professionals including lawyers[20] or law enforcement professionals.

There are a number of factors that will determine how AI systems affect tasks and jobs and these factors are measured differently in different reports. A 2018 report from The Brookings Institution estimates that approximately 25% of U.S. employment will face high exposure to automation (defined as at least 70% of tasks being automatable) in the coming decades.[21] A 2017 study from the McKinsey Global Institute uses a slightly different metric and says that approximately half of current work tasks could be automated with current technology.[22] It is also difficult to predict what new jobs will be created by increased use of AI systems without knowing how sophisticated a technology will become or what industries it could enable.

An example of this can be seen in autonomous vehicles. While one report indicates that the introduction of autonomous vehicles (AV) could directly eliminate 1.3 to 2.3 million jobs in the next 30 years,[23] it is possible that the introduction of autonomous vehicles will produce more jobs than they eliminate both directly related to AV production and maintenance or in related fields such as infrastructure or city planning. However, it is difficult if not impossible to forecast these effects because it is unknown how quickly the technology will develop or how sophisticated it will become.[24]

Disparate Impacts Across Race/Ethnicity and Income

Because of existing structural inequalities and the related demographic distributions across different job categories, there are concerns about AI exacerbating existing racial and ethnic inequalities. Underrepresented minorities are predicted to face greater impacts from automation than white or Asian populations. A 2018 report by The Brookings Institution assessed that on average, 47 and 44 percent of tasks currently performed by Hispanic and black workers, respectively, have the potential to be automated, compared with 40 and 39 percent for white and Asian populations.[25]

In addition to fears that robots and computers will displace workers, Americans are concerned about the impact this displacement will have on wage inequality. In a 2018 Pew Research Center

[18] https://www.sciencedirect.com/science/article/abs/pii/S1361841512000333
[19] https://medicalxpress.com/news/2019-05-artificial-intelligence-lung-cancer-radiologists.html
[20] https://www.forbes.com/sites/bernardmarr/2018/05/23/how-ai-and-machine-learning-are-transforming-law-firms-and-the-legal-sector/#3f83acc432c3
[21] https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf
[22] https://www.mckinsey.com/~/media/mckinsey/featured%20insights/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works-Full-report.ashx
[23] https://avworkforce.secureenergy.org/wp-content/uploads/2018/06/Groshen-et-al-Report-June-2018-1.pdf
[24] https://www.nap.edu/catalog/24649/information-technology-and-the-us-workforce-where-are-we-and
[25] https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf

survey, 76% of respondents said they believe inequality will be worse than it is today as a result of job automation.[26] Between 1980 and 2017 real earnings rose among adults with college and post-college degrees while they fell for adults without a college degree.[27] A 2017 report by the National Academies of Science, Engineering and Medicine notes that "New computerized technologies do appear to have contributed to increased income inequality and are likely to continue to do so as long as they replace skills and tasks historically associated with low-wage or middle-wage occupations."[28] Given these effects, it is not surprising that people are apprehensive about the potential effects of AI systems on inequality.

Developing a Skilled Technical Workforce

Experts believe AI systems will not eliminate the need for skilled technical workers. Rather, these systems will change the tasks these workers perform and the skills they need to perform them. Predicting what these new tasks and occupations will consist of is difficult, but experts predict there will be a need for workers who can maintain AI systems and workers who can safely work alongside AI-enabled technologies. A recent report by the National Academies of Sciences, Engineering and Medicine noted that by 2022, there may be a shortage of almost 3.4 million skilled technical workers.[29] The same report notes that "The demand for a skilled technical workforce is changing so rapidly that workers, employers, educators, policy makers and civic organizations need to be highly flexible and forward looking."[30]

Issues of Safety, Privacy and Security

AI systems have the potential to introduce several challenges pertaining to safety, privacy, and security. As robots powered by AI systems are increasingly integrated into workplaces, workers need to be able to work alongside those robots safely and to have confidence in the robot's movements and ability to detect people. The use of collaborative robots, which are designed to work alongside humans, will also require companies to rethink their approach to the safety of their workers. Numerous companies today use AI systems to monitor and analyze their workers. These systems can incorporate cameras and other sensors that watch what workers do or analyze their email and meeting habits. The companies may be gathering these data not in the name of surveillance, but in the name of efficiency and even in the name of worker happiness (e.g. creating workspaces more responsive to worker needs). However, the privacy issues associated with these systems are vast and it can be unclear what rights workers have regarding AI monitoring. The increasing use of AI systems in the workplace also presents security concerns. As with any computer system, there is a risk that the AI systems could be corrupted in a way that potentially harms workers.

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[26] https://www.pewresearch.org/global/2018/09/13/in-advanced-and-emerging-economies-alike-worries-about-job-automation/

[27] https://workofthefuture.mit.edu/sites/default/files/2019-09/WorkoftheFuture_Report_Shaping_Technology_and_Institutions.pdf

[28] https://www.nap.edu/catalog/24649/information-technology-and-the-us-workforce-where-are-we-and

[29] https://www.nap.edu/catalog/23472/building-americas-skilled-technical-workforce

[30] https://www.nap.edu/catalog/23472/building-americas-skilled-technical-workforce

Role of the Federal Government

There are a number of Federal efforts focused on the workforce issues presented by advances in AI. In 2016, NSF Director France Córdova unveiled the 10 Big Ideas for Future NSF Investments that are "meant to define a set of cutting-edge research agendas and processes that are uniquely suited for NSF's broad portfolio of investments, and will require collaborations with industry, private foundations, other agencies, science academies and societies, and universities."[31] One of the 10 Big Ideas is the "Future of Work at the Human-Technology Frontier" which features four research themes: building the human-technology partnership, augmenting human performance, illuminating the socio-technological landscape, and fostering lifelong learning.[32] The Big Idea is also the focus of a Convergence Accelerator track; the track is funded at $30 million in the FY 2020 budget proposal with the intention to raise $20 million from external partnerships.

The 2019 *Executive Order on Maintaining American Leadership in Artificial Intelligence* directs the National Science and Technology Council Select Committee on Artificial Intelligence to provide recommendations to the NSTC Committee on STEM Education "regarding AI-related educational and workforce development considerations that focus on American citizens."[33] The Select Committee will also provide technical expertise to the National Council for the American Worker on "matters regarding AI and the American workforce."[34] The 2019 "National Artificial Intelligence Research and Development Strategic Plan" contains a strategy titled "Develop Effective Methods for Human-AI Collaboration" and a strategy titled "Understand and Address the Ethical, Legal, and Societal Implications of AI."[35] "The Networking & Information Technology Research and Development Program Supplement to the President's FY2020 Budget" also details a key program titled "Promote safe and effective methods for human-AI collaboration" and one titled "Develop methods for designing AI systems that align with ethical, legal and societal goals."[36]

[31] https://www.nsf.gov/about/congress/reports/nsf_big_ideas.pdf
[32] https://www.nsf.gov/news/special_reports/big_ideas/human_tech.jsp
[33] https://www.whitehouse.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/
[34] https://www.whitehouse.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/
[35] https://www.nitrd.gov/pubs/National-AI-RD-Strategy-2019.pdf
[36] https://www.whitehouse.gov/wp-content/uploads/2019/09/FY2020-NITRD-AI-RD-Budget-September-2019.pdf?utm_campaign=the_algorithm.unpaid.engagement&utm_source=hs_email&utm_medium=email&utm_content=76813461&_hsenc=p2ANqtz-9YwlzM0xzEZXjAp9IJ9TDAORRDSDf0IYgS3XXyApa81aE6sjWrwk4YzCe_bhLX-UPfbbvEUMVDpvOuLLjU69oK8HOj9cBEfUFIz3lak83mNfCXFrs&_hsmi=76813461