TECHNOLOGY IN THE PUBLIC SECTOR AND THE FUTURE OF GOVERNMENT WORK

Sara Hinkley, Ph.D.

JANUARY 2023

UC BERKELEY
LABOR CENTER

Acknowledgments

I would like to first thank the workers, experts, and public officials who spoke with me about their experiences with technology in the public workplace, especially during a time of so much workplace disruption and transition. I also want to thank Jessie HF Hammerling, Annette Bernhardt, and Lisa Kresge of the Labor Center's Technology and Work team for guidance and feedback throughout the project. And I'm grateful to those who reviewed drafts, generously shared their own ideas, and helped me understand the idiosyncrasies of public sector labor data.

This report is part of a larger multi-industry project generously supported by the Ford Foundation, the W.K. Kellogg Foundation, and the Open Society Foundations.

About the Author

Sara Hinkley, Ph.D., is a policy research specialist at the UC Berkeley Labor Center. She has published research on public finance, economic development, job quality, education, and workforce development. She is the author of several reports at the Labor Center including *California can't afford to repeat the Great Recession: State spending is critical to economic recovery* and *Public Sector Impacts of the Great Recession and COVID-19*.

Suggested Citation

Hinkley, Sara. 2022. *Technology in the Public Sector and the Future of Government Work*. Berkeley: UC Berkeley Labor Center. https://laborcenter.berkeley.edu/technology-in-the-public-sector-and-the-future-of-government-work/

Contents

Contents

Executive Summary

More than 20 million people—about 15% of the United States workforce—work for a local, state, or federal government entity. A majority of these work in local government (e.g., schools, police and fire departments, county social service agencies), about a third in state government (e.g., universities, tax bureaus, state hospitals), and the remainder in federal government (e.g., post offices, national parks). Millions more work for private employers who receive most or all of their funding from public contracts or grants.

With the exception of the military, government has been generally slower to adopt technology than the private sector. Reasons for this include lack of funding, higher public scrutiny, complex contracting processes, lack of internal IT capacity, and agency fragmentation. The slow pace of technology adoption in some cases has led to both costly and cumbersome service provision; the vision of digital government outlined by federal policymakers in the 1990s has yet to be realized. Greater use of technology by governments holds a lot of promise for both workers and the public: it can remove some of the time-consuming and glitchy processes that frustrate everyone, allow workers to focus on the complexity inherent in providing public services, make government more accessible to more people, and get assistance more quickly into the hands of people who need it.

But there are reasons to be attentive to how technologies are rolled out, especially as the recent jump in technology funding opens up the floodgates of consultants and contractors pitching their products. Technology cannot be used to paper over the lack of investment in the public sector that has characterized the past two decades. In fact, technology presents the greatest risk when it's simply layered on top of already overwhelmed workers and processes, because there is no capacity built in for evaluation and recalibration to ensure that the technology is working as intended. Within the public sector there is enormous variation in size, resource capacity, mission, and political and social context, all of which affect whether and how technology is implemented. But nearly all public sector employers have spent the past decades watching revenues fail to keep up with the costs of providing government services. Since 2008, public sector employment has been stagnant or declining, while private sector employment has grown by 12% and the U.S. population—a measure of demand for government services—by nearly 7%.

Some technologies also present inherent risks, such as those intended to replace or supplement human decision-making. Research suggests that people are reluctant to make different decisions

than those suggested by analytics designed to supplement human decision-making, sometimes leading to worse outcomes than those the technology was intended to remediate. There has been considerable evidence that advanced technologies can replicate or even exacerbate racial and ethnic biases. Governments should be deliberate and cautious as they adopt such technologies. Involving workers in the scoping, design, implementation, and evaluation of advanced technologies in particular can help safeguard public trust. Technology as a cost-saving measure must be implemented within a framework that recognizes the role public workers play in assessing whether systems are serving the people the programs are intended to serve.

How governments use technology

The public sector covers an enormous set of occupations and activities, and technology plays many different roles within that landscape. This report sorts technologies into five overlapping categories:

- **Manual task automation:** technologies that replace physical processes or tasks performed by a person. This includes such technology as document scanners, mail sorting machines, digital printers, "smart" parking meters, transcription software, driverless transit, robotic vacuums, and automated toll collectors.
- **Process automation:** technologies that process information or automate interactions between workers and clients. This includes e-Government processes like online payments and benefit applications, as well as more complex automation such as customer service chatbots and "robotic process automation" (RPA). More complex process automation technologies may use artificial intelligence to "learn" from interactions, rather than relying entirely on human programming.
- **Automated decision-making systems:** the use of complex computer programming to replace or augment human decision-making. This group of technologies includes artificial intelligence, machine learning, and predictive analytics. By processing large amounts of data and using human-programmed algorithms or more complex artificial intelligence, ADM systems generate decisions and assessments.
- **Integrated data systems:** integrated data systems and networked cloud storage allow vast amounts of public data to support automation and automated decision-making technologies, as well as provide public access to information about government activities and enable more robust performance evaluation and management.
- **Electronic monitoring:** technologies such as cameras and drones may be used to enforce laws or regulations and feed information into other government processes. Monitoring technologies built into software used by workers can also enable new forms of performance evaluation.

Key findings on government technology use:

- There are many examples of innovative agencies using cutting-edge tech, but it is generally true that governments have been slower to modernize than the private sector. Financial constraints, reliance on external contractors, limited in-house IT expertise, and the challenges of providing equitable services to millions of people are just some of the most significant constraints faced by public technology adopters.
- Process automation is widely used by governments, and much of it has made public services easier for people to access and while freeing up workers from often overwhelming amounts of paperwork. But there is still much to negotiate about how to serve clients with limited access to electronic services, and how to integrate technology with the complex and idiosyncratic knowledge that humans (caseworkers, counselors, parole officers) use every day to provide effective and personalized support.
- Advanced technologies—algorithms, artificial intelligence, robotic process automation—have begun to change some public jobs significantly, either augmenting or replacing some human decision-making, especially in areas of public safety and welfare services. Community and civil liberties advocates are concerned about government's increasing reliance on technologies for complex decision-making and monitoring.

Drivers of technology adoption

In the public sector there are many different (and often overlapping) motivations for adopting new technologies, which in turn shape the design of the tech, the goals of implementation, and how these systems are evaluated. Nothing about the process of change is inevitable; it is highly dynamic and contingent.

Given these complex structures, this report looks at four driving forces underlying the expansion of technology in the public sector:

- **Efficiency and cost reduction.** In many areas of government, per capita revenue has declined over time as a result of tax-cutting politics, forcing governments to figure out how to provide services in an increasingly constrained environment. Promises that technology can increase efficiency and reduce labor and other costs carry a lot of weight in this context. On other hand, prolonged austerity has constrained funding for technology and other infrastructure.
- **Performance.** Technology is framed as a core element of promises to make government serve people better and reinstill confidence in government. Technology can potentially improve many aspects of government service: speed, reliability, accuracy, convenience, and even program outcomes (although digitization or automation can also lead to deterioration of service quality).

- **Transparency and accountability.** Technological advances in secure data storage, data sharing, data analytics, and data visualization have the potential to enhance government transparency and accountability. Increased data accessibility allows citizens to understand how resources are being used and whether programs are effective. Transparency is a necessary step toward accountability; advocates for robust data sharing hope it will enable the public to hold their governments accountable to specific objectives and values.

- **Crises.** Crises can offer important pivotal moments for innovation—and in the case of COVID-19, large amounts of funding for new technologies—but they can also leave agencies too overwhelmed to incorporate technology strategically. The COVID-19 pandemic dramatically accelerated the adoption of technology in the public sector, as agencies had to figure out how to quickly pivot to offering services while complying with public health orders. As the pandemic unfolded and unprecedented numbers of people needed government services, the public sector's outdated technological infrastructure was exposed along with other areas of underinvestment.

Key findings on technology drivers:

- Technology use has allowed many government agencies to restructure cumbersome processes, becoming more user-friendly and increasing productivity by allowing workers to focus on more complex tasks.

- The fiscal and workload pressures faced by governments have led many agencies to see technology as a way to bridge the deficit of resources needed to adequately perform their core functions. Technology use can normalize the inadequacy of public staffing rather than resolving it. Chatbots might allow clients to interact with a system 24 hours a day instead of waiting in line in a benefits office and never getting to the front, but if the chatbot is ultimately unable to provide entitled benefits, technology has provided only the illusion of better service.

- The COVID-19 pandemic sparked a wave of technology adoption across the public sector, in some cases hastening already planned transformations. Areas like education, where there has typically been significant skepticism about the role of technology, saw an explosion of "edtech" vendors eager to capitalize on schools' experience with using technology for remote learning. The apparent permanency of hybrid and remote work is likely to continue to drive increased automation, monitoring of workers, and reliance on cloud-based data systems.

- The public sector must contend with complicated policy, social, ethical, and legal contexts that don't similarly constrain private sector actors. Public sector technology projects are accountable to a more diverse set of stakeholders (often with diverse needs) than private employers. Values of transparency and fairness make adopting

new technologies much more complex for the public sector, which must ensure that its services are accessible to everyone and accountable to a broad set of public values.[1]

- The public sector has struggled to attract and sustain internal IT expertise, and has often relied on outsourcing many IT functions; this has led to a significant reliance on "govtech" companies and consultants. Building internal IT capacity could help address some of the cost overruns and poor outcomes associated with large technology projects.

Impacts on work and workers

The extent to which technology will displace workers or fundamentally change workplace dynamics is uncertain and will vary across the public sector. There are many logistical, ethical, legal, institutional, and social dynamics that affect the trajectory of technology adoption. The growing adoption of complex technologies is likely to restructure work processes as well as to reshape the interactions between workers and the public. Whether these changes ultimately benefit or harm workers will depend significantly on how this restructuring is managed.

This report looks at four categories of impacts on public sector workers:

- **Employment impacts:** when technology is introduced into a workplace, tasks are transformed and redistributed, possibly reducing the need for some occupations and increasing demand for other types of work. It is hard to attribute job fluctuations to technology directly—especially given the cyclical nature of government funding—but this report discusses occupations where automation has likely contributed to declining employment, as well as growing occupations that require more technical skills to oversee and manage computerized processes, including providing direct IT services.
- **Job complexity:** Working with new technologies may require new skills, which aren't always accompanied by training or the time to adapt. Automating technologies may take over the more mundane aspects of work, making jobs more complex and rewarding for workers. But more advanced technologies—such as automated decision-making systems—may have the opposite effect, taking over complex thinking tasks and leaving workers to simply verify outcomes.
- **Managerial control:** incorporating new technologies can lead to work intensification and stress for workers if the tech does not produce the expected efficiency or performance improvements, leaving workers to make up the difference. When tech is adopted without sufficient understanding of how work is actually performed, service quality can suffer. New technologies can also permit additional worker surveillance; chatbot technology can include real-time feedback to workers on their tone and speed during customer interactions, information that feeds into a workers' performance evaluation.

- **Outsourcing:** Bringing in new technologies often involves an increased role for private contractors, with the outsourcing of both the development and implementation of new tech as well as increasing reliance on private entities to perform even highly sensitive public functions. Technologies like cloud-based storage and virtual call centers can facilitate the outsourcing of jobs to private contractors by enabling work to be done from anywhere and shifting tasks out of established job descriptions.

Key findings on worker impacts:

- Technologies have taken over some of the tasks performed by government workers, predominantly in areas involving basic paperwork-processing and financial transactions. Occupations like clerks and secretaries have been declining for several years and are projected to continue to decline, likely in part because of technological changes. The growing automation of government processes and adoption of more complex technologies has likely contributed to the increase in higher-level business and financial occupations and computer-related occupations.

- The growth of complex technologies has begun to restructure work in significant ways, raising fundamental questions about how technology changes responsibility for decision-making and who is responsible for overseeing and fixing the inevitable malfunctions, mistakes, and negative impacts of digitized processes. Workers often feel stressed and uncertain as their jobs are transformed. They value the improvements technology can bring, but they also see technology projects rolled out without a clear plan for training and worker involvement, without clear expectations of workers, and without internal IT capacity adequate to managing the impacts of technology on the lives of clients.

- Despite the relatively high share of public sector workers represented by a union, technological solutions are still frequently developed without involving workers. Governments are just beginning to put policies and regulations in place to manage the impacts of technology on citizens, but there are few examples of such policies addressing the impacts on workers.

People who go into public service often have aspirations to improve people's lives, and are concerned about how technology can deepen existing inequities, make it harder for people to access critical services, and jeopardize the trust between citizens and their government. The possibilities for technology to greatly improve public services are significant, and recent public investments in infrastructure and internal technology capacity development present an important opportunity. A high road approach to this rapidly expanding use of technology will require policies and regulations that bring transparency, accountability, evaluation, and worker and client voices into the process of designing and implementing technology.

Section One:
Introduction

More people have interacted directly with government to obtain a service or benefit over the last two years than ever before, as demand for unemployment insurance, basic needs assistance, and public health services skyrocketed. And many of those people used computers or mobile phones to obtain services that until March 2020 had required in-person appointments and paper applications. Some of these transitions to remote services happened virtually overnight. Across the country, schools and universities closed and teachers had to figure out how to teach online, often over spotty internet connections to students who had only a shared cell phone to access class. In some states, plans to gradually replace workers with automating technology instead happened abruptly and at once, costing hundreds of workers their jobs. Millions of government office workers were sent home to figure out how to work remotely, conducting everything from client interviews to court hearings on Zoom.

The COVID-19 pandemic has highlighted the important role government plays in people's everyday lives and the value of being able to effectively and quickly distribute sound information, goods, and services. The challenge of rapidly scaling up service delivery along with the need to deliver services remotely highlighted areas of profound underinvestment in the public sector, particularly in the area of technology.

Technology use in the public sector has always been uneven—some employers have steadily increased the use of machines and technology-enabled automation to manage internal processes and organize work, and some are using advanced technologies to analyze data and supplement decision-making. But many areas of government went into the pandemic heavily reliant on in-person interactions and paperwork, with limited capacity to analyze or manage the large volumes of data they collect.

The recent infusion of funding for technology investments has added to the push for broad technology adoption in the public sector. Governments are engaging in a range of efforts to use technology to transform how they do work, pushed by calls for the public sector to catch up to the private sector in its ability to serve clients using a variety of platforms. And ideas of how technology can more fundamentally transform government are fueling growth in the usage of artificial intelligence and related technologies to inform policy, target resources, make decisions, and much more.

All of these factors make now a critical moment to examine how these changes will affect workers, the public, and the relationship between government and citizens.

Research questions

This report sets out to explore four questions:

- **What are the relevant technologies in the public sector?**
  - What technologies (new, old, or on the horizon) have the potential to significantly affect employment and job quality (wages, skill requirements, the organization of work, etc.)?
- **What factors drive technological choices?**
  - What drives decision-making about which technologies are adopted and how they are implemented in the workplace?
- **How will technology change the experience of public sector work?**
  - How are technologies likely to impact specific occupations—and how might those effects be distributed across types of workers?
  - How do different technologies alter the working conditions of public sector workers?
  - How might technology alter the relationship between workers and the public, especially as it shifts the relationship between citizens and their government?
- **What kinds of interventions can protect against the potential downsides of technology use in the public sector?**

Scope and methods

This report focuses on the 15% of the U.S. workforce that is directly employed by a federal, state, or local government entity, with the exception of public health services and hospitals, which are covered by the Labor Center's previous report on technology and healthcare.[2]

Technology is a broad and ambiguous term, including everything from printers to machine learning. In the public sector, there is an enormous range of technologies: license plate readers, driverless public buses, facial recognition cameras, online application portals, and predictive analytics software. In some places, governments are still grappling with the impacts of

technologies that have been around for decades; in others, they are facing existential questions about how technology may impact fundamental civil rights.

Most of the research in this report is qualitative, gathered by attending virtual conferences, reviewing public contracts and procurement and technology policies, reading academic and industry reports, and interviewing public workers, experts on technology and work, government agency staff, community watchdogs, union representatives, consultants, and technology providers. That research encompassed all aspects of technology adoption: marketing, development, contracting, implementation, and evaluation. Bureau of Labor Statistics and Census data were used to identify public sector jobs across levels of government, the characteristics of workers doing those jobs, and how government employment has changed over recent decades.

A note on terminology: the terms "clients" or "citizens" are used interchangeably to refer to the members of the public who interact with the government and government workers. Because of the many different functions government performs, there isn't a single term that always fits. Citizens is intended to mean anyone interacting with the government, not the legal definition of national citizenship.

Section Two:
About the Public Sector

A. Public sector employment

In 2022, about 15% of the U.S. workforce—more than 22 million people—work for a federal, state, or local government entity. Local governments employ the most workers (63% of the public workforce), followed next by state (24%) and then federal (13%) (Figure 1). Local government education (K-14) accounts for 35% of public sector jobs, and state education (higher education) accounts for 12% (Figure 2).

The number of workers in the public sector—and their share of the total workforce—has declined overall over the past two decades. This decline has been most significant in local government, which has 3.6% fewer workers in July 2022 than in July 2008, the peak of public sector employment before the impact of the Great Recession. Over that same period, total private employment has grown by 12%, and the U.S. population by almost 7%. This trend includes a sharp decline from 2008-2012 followed by a weak recovery. Most areas of government had only just recovered the employment losses from the Great Recession by February 2020, with one exception: local education was still below pre-recession levels at that time, and as of July 2022 it remained 5% below July 2008 levels.

This history of long-term stagnation in public sector employment is an important piece of the context of technology implementation. Population growth combined with public health and economic crises have increased the demand for government services at the same time that employment declines have left agencies struggling to maintain service levels, especially during times of crisis.

Figure 1. Public sector employment, 2008-2022

	July 2008	July 2022	Change 2008-2022	2022 share of nonfarm
Federal	2,767	2,865	4%	2%
State	5,191	5,248	1%	3%
Local	14,610	14,114	-3%	9%
Public	22,568	22,227	-2%	15%
Private	114,923	130,202	13%	85%

Employment in thousands, seasonally adjusted
Source: BLS Current Employment Statistics

Figure 2. Public sector employment, 2008-2022

	July 2008	July 2022	2008-22 change	Share of public (2022)
Federal	**2,767**	**2,865**	4%	**13%**
Hospitals	274	357	30%	2%
Department of Defense	497	552	11%	2%
Postal Service	750	603	-20%	3%
Other	1,247	1,353	9%	6%
State	**5,191**	**5,248**	1%	**24%**
Education	2,365	2,607	10%	12%
Hospitals	360	410	14%	2%
Gen admin	1,931	1,775	-8%	8%
Other	535	455	-15%	2%
Local	**14,610**	**14,114**	-3%	**63%**
Education	8,119	7,716	-5%	35%
Utilities	246	245	0%	1%
Transportation	268	277	3%	1%
Hospitals	659	675	2%	3%
Gen admin	4,229	4,161	-2%	19%
Other	1,084	1,010	-7%	5%

Employment in thousands, seasonally adjusted
Source: BLS Current Employment Statistics

B. Types of government employers

There are many types of employers in the public sector. Federal and state agencies range from some of the largest employers in the country to agencies with a dozen staff serving a rural state. Local governments are even more diverse and numerous: in 2017 (the most recent government census) there were 90,126 local governments, of which 51,146 were special-purpose governments (entities that perform only one or a very limited number of functions, including 12,880 independent school districts), 3,031 counties, 19,519 municipalities, and 16,360 townships.[3] These governments represent an enormous range of size, governance, funding, and mission:

- Federal agencies: defense, postal service, veteran affairs, homeland security, justice, commerce, environment protection
- State agencies: health and human services, labor and employment, environmental protection, financial administration (including taxation), general administration
- Education: state university systems, local K-12 and community college districts
- County agencies: county governments, county social services, sheriff departments, probation departments, library systems
- Municipal governments (cities, townships): police and fire departments, public works, recreation, general administration
- Public authorities and special districts: utilities, transportation systems, ports, airports, hospitals
- Court systems: city, county, state, federal

The federal government is the single largest employer in the United States with 2.1 million civilian employees (followed by Walmart with an estimated 1.5 million). The largest federal agency is the Department of Veteran Affairs, with about 337,000 workers.[4] The Department of Defense has 2.91 million service members and civilians.[5] In most states, a state entity (usually the university system) is the largest employer.[6] Cities and counties (or their school districts) are often the largest employers in their jurisdiction. Some of the largest non-federal public employers in the U.S. include:[7]

- University of California (230,000)
- New York City Department of Education (140,000)
- City of New York (106,000)
- Los Angeles County (106,200)

- State University of New York (91,000)
- New York Metropolitan Transportation Authority (75,000)
- Los Angeles Unified School District (73,800)
- City of Los Angeles (61,600)
- California State University (55,700)

Public employers have significant differences in their capacity to invest in new technology, manage its implementation, and evaluate whether a new technology use is producing the expected benefits. Variations in technology use, as well as the impacts of technology on stakeholders, are shaped by several factors:

- **Laws and regulations:** Public employers face varying local and state regulations on contracting for services, financial accounting, data privacy, accessibility, and more. Some are subject to specific regulations in their sphere—such as healthcare and education—and some must follow federal rules tied to funding streams.
- **Size:** Larger employers may realize more benefits from capital investments in technology because of economies of scale, purchasing power, and greater IT capacity (including expertise in procurement and contracting). Off-the-shelf technologies that can be paid for per user are more accessible to smaller employers than customized programs that require significant development.
- **Funding:** Funding streams come with different levels of flexibility: the activities allowed by earmarked versus general funds, one-time versus ongoing, capital versus operating, and rules tied to intergovernmental funding all determine how readily available new technologies will be. For very large agencies, seemingly simple upgrades (such as new Windows operating systems) require significant cash outlays and staff time.
- **Autonomy and accountability:** Public entities have varying levels of autonomy and different accountability structures. For example, some police departments are overseen by independent commissions that set rules for how electronic data is gathered and used, or that may mandate technological strategies for accountability. Agencies that are accountable to higher levels of government may adopt widely-used technological systems to facilitate reporting and outcome evaluation.
- **Political context:** There are also political motives that affect technology decisions or how technology is used (either its intent or its impact). For example, in some states, governors and legislatures have taken strong stances against accepting federal funding (such as increasing Medicare) and take the position that public benefit programs should be harder to access, not easier. In such an environment, technology could be adopted to create barriers to access (for example by raising the threshold of technology access

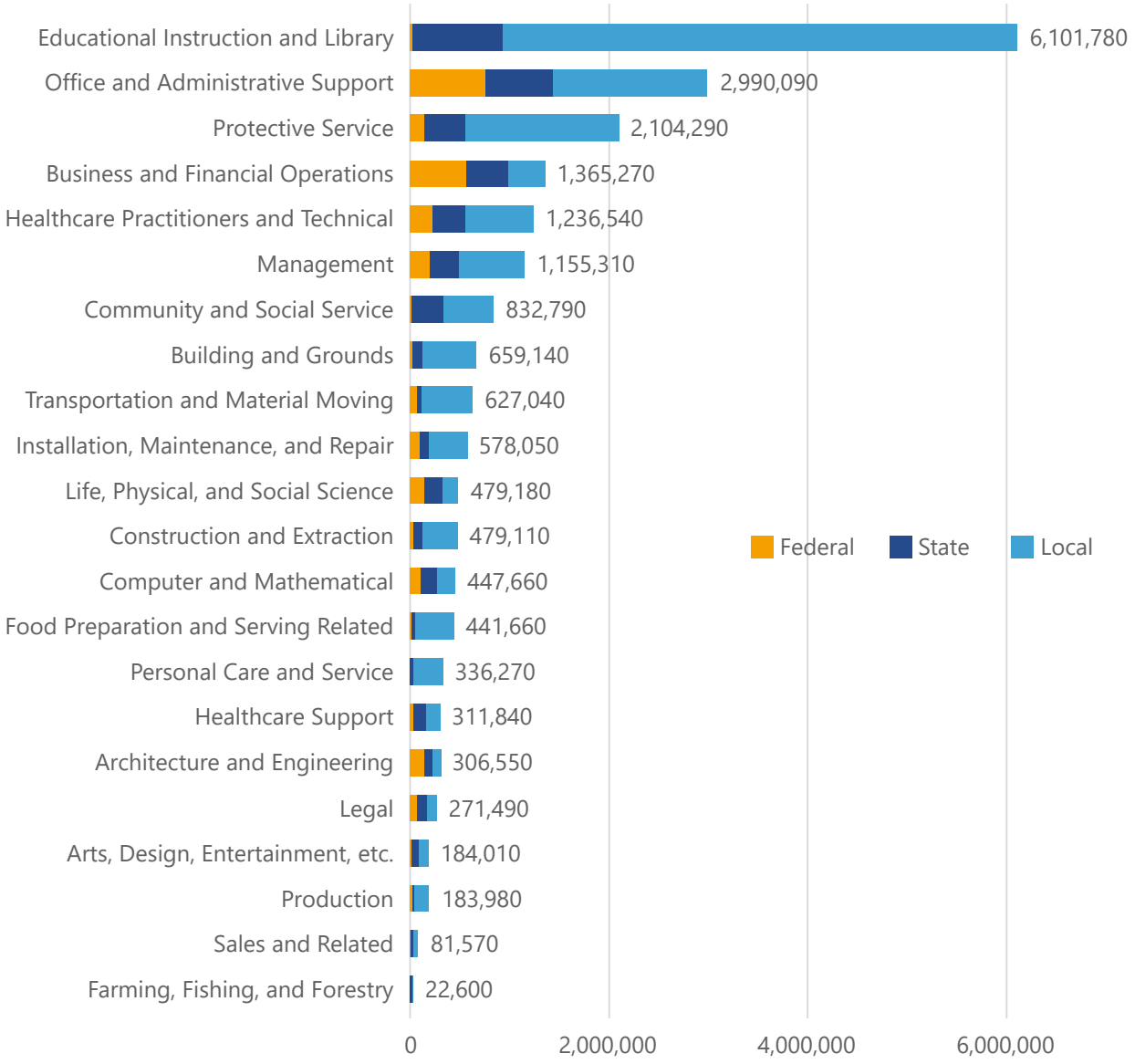
required for someone to access benefits or designing programs that weed out many eligible applicants), thereby reducing costs not just in staffing but in program spending. In other states, significant efforts are made to measure and expand the share of eligible beneficiaries who obtain benefits, and technology is viewed as a way to reach more people, not fewer.

C. What public sector workers do

Public sector workers cover almost the entire spectrum of occupations and tasks in the labor market. More than 6 million (29%) public sector workers perform educational instruction and library services; more than 5 million of those work in local education (which includes, in most states, 2-year colleges in addition to K-12) (Figure 3). Another 4.3 million (14%) are in office & administrative support (OAS) or business & financial operations. Two million work in protective services (police, fire, and corrections), and 1.2 million in healthcare. The full breadth of public sector work includes:

- **Financial transactions:** purchasing and selling goods and services, collecting fees and fines, issuing payments (e.g., benefits, tax refunds).
- **Application processing:** processing paperwork and determining eligibility for services, such as benefits (e.g., unemployment insurance, social security, food stamps), licenses (e.g., drivers', business licenses, passports), and official documents (e.g., property records).
- **Management and administration**: human resources, program evaluation, financial planning performed by managers, business and financial analysts.
- **Direct service:** counseling and social workers, teachers, healthcare services (vaccinations and medical care).
- **Public safety**: fire prevention and firefighting, policing (e.g., emergency call centers, crowd protection), national defense, emergency response.
- **Compliance:** monitoring compliance with laws and regulations (e.g., environment, food safety, parks, business and labor regulations)
- **Law enforcement:** collecting fines, arresting and processing individuals, conducting court procedures, running detention facilities, monitoring people on probation and parole.
- **Infrastructure and maintenance:** building and maintenance of public facilities, including everything from bridges to subways to park landscaping.
- **Public transportation**
- **Mail processing and delivery**

Figure 3. Major public sector occupations, May 2021



Source: BLS OEWS

This occupational mix has changed over time as government priorities shift and jobs are restructured, with some of that restructuring likely the result of expanded technology use. During the decade before the pandemic, occupations in office and administrative support (OAS) lost more than a quarter of a million jobs (-256,050) (Figure 4). Other significant declines from 2011-2019 were in food preparation (-41,330), building and grounds (-51,710), and personal care (-41,020).[8]

Over that same period, occupations with the most growth included educational instruction and library (113,950), business and financial operations (115,980), management (98,230), protective service (83,760), and community and social service (64,830). (See Figure 5 for distribution of those changes across federal, state, and local government.)

The pandemic changed these trends in some key areas: educational instruction occupations declined by 7% (-469,070) from 2019-2021 (Figure 6), as school districts closed down and laid off staff; building and grounds maintenance took a similar hit as more public buildings were closed.[9] Declines in OAS, food preparation, and personal care continued, as did growth in business and financial operations.

Figure 4. Government employment by major occupation, 2011-2019

Occupation	2019	2011-19 change	Percent change
Educational Instruction and Library	6,570,850	113,950	2%
Office and Administrative Support	3,102,970	-256,050	-8%
Protective Service	2,117,600	83,760	4%
Business and Financial Operations	1,290,300	115,980	9%
Healthcare Practitioners and Technical	1,209,350	25,890	2%
Management	1,111,530	98,230	9%
Community and Social Service	812,330	64,830	8%
Building and Grounds Cleaning and Maintenance	690,510	-51,710	-7%
Transportation and Material Moving	662,140	-13,050	-2%
Installation, Maintenance, and Repair	569,250	41,900	7%
Food Preparation and Serving Related	509,200	-41,330	-8%
Construction and Extraction	480,690	-16,900	-4%
Life, Physical, and Social Science	459,620	7,950	2%
Computer and Mathematical	445,110	46,620	10%
Personal Care and Service	428,400	-41,020	-10%
Healthcare Support	314,080	11,070	4%
Architecture and Engineering	309,030	-12,210	-4%
Legal	272,250	14,690	5%
Arts, Design, Entertainment, Sports, and Media	205,160	9,450	5%
Production	192,890	9,580	5%
Sales and Related	87,940	1,180	1%
Farming, Fishing, and Forestry	24,920	-2,920	-12%

Source: BLS OEWS

Figure 5. Government employment change by occupation, 2011-2019

Source: Bureau of Labor Statistics, OEWS

D. The public sector workforce

Both white and Black workers are overrepresented in the public sector compared to Hispanic and Asian workers but are concentrated in different segments of the workforce (Figure 6). Black workers make up 12% of the U.S. workforce but 21% of federal workers. White workers are overrepresented in local and state government (they hold 68% of local government jobs).

That distribution has changed very little over time, except to follow demographic changes in the overall workforce and with an increase in the relative concentration of white workers in the public sector. Hispanic and Asian workers are even less likely to work in the public sector now than in 2008, while the share of Black workers has held steady.

There is significant occupational segregation within government, which means that restructuring of public sector jobs can affect the demographic composition of the workforce. The K-12 teaching workforce, which accounts for the largest share of local government employees, is estimated to be to 80% non-Hispanic white, and 75% female.[10] More than 20% of Postal Service employees are African American. Black workers are also more concentrated in lower-grade clerical positions in the federal government and overrepresented in clerk positions across the government—positions that are more susceptible to automation and projected to decline.[11]

Specific occupations in the public sector that have high rates of racial segregation are listed below:

- Occupations with the highest percentage of white workers: K-12 and preschool teachers (including speech pathologists, special education, and librarians); education administrators; chief executives, general and operations managers, computer and information systems managers; EMTs and paramedics, firefighters, and police officers; judicial workers; secretaries and assistants.[12]
- Occupations with the highest percentage of Hispanic workers: home health aides; childcare workers; and repair, engineering, construction occupations.
- Occupations with the highest percentage of Black workers: bus drivers and other drivers; crossing guards; correctional officers and supervisors including probation officers; nursing assistants; cleaners (both housekeeping and janitors); transportation screeners; customer service representatives; nursing-related and home health care; billing clerks; postal clerks and sorters; social workers and social service; human resource workers; purchasing managers.

Figure 6. Race and ethnicity of government workers, 2021

Race	Local	State	Federal	All public	Private
White	68%	64%	58%	65%	61%
Black	13%	16%	21%	15%	12%
Hispanic	14%	12%	11%	12%	19%
Asian	4%	7%	7%	6%	8%
Other	1%	1%	3%	2%	1%

Source: Economic Policy Institute. 2022. Current Population Survey Extracts, Version 1.0.33

E. Public sector job quality

Public sector jobs generally provide more job security and benefits than private sector jobs. Although there is some debate about how to structure apples-to-apples comparisons between private sector and public sector wages, incomes for state and local workers are generally lower than those of comparably situated private sector workers, but pension and health benefits largely compensate for the gap.[13] In some occupations, the private-public sector differential is more significant; teachers, for example, typically earn much less than similarly-educated workers in other professions.[14] The gap between public and private sector wages has widened since 2020, leaving many agencies struggling to fill positions.[15]

When controlling for education and occupation, public sector wages are typically lower than those of equivalently-positioned private sector workers, but many researchers have found that benefit packages and job stability make up for those differences.[16] Broadly speaking, the public sector has offered an important pathway to economic stability for millions of Americans, particularly Black workers, nearly 20% of whom work for government. While private sector workers have seen their wages and benefits eroded significantly over the past decades—some of which has been attributed to growing use of automating technology—public sector job quality has not deteriorated to the same degree. There are several measures of public sector job quality:

- Public workers are more likely to have quality health insurance, sick leave, vacation, and paid family leave.
- Public workers are more likely to have a defined benefit pension plan (and access to those plans is one reason the white-Black wealth ratio for public sector workers is 2:1 compared to 10:1 in the private sector).[17]
- Public workers are slightly more likely to have bachelor's degrees, and about twice as likely to have an advanced degree, although that varies significantly by occupation.[18]
- Public sector earnings are less unequal than those in the private sector: gender and racial wage gaps are smaller and the earnings distribution for Black and Hispanic workers is higher in the public sector.[19]
- Public sector workers are far more likely to be represented by a union: 33.9% compared to 6.1% of private sector workers.[20] Half of all union members in the U.S. work in the public sector. The Supreme Court's *Janus v. AFSCME* decision in 2018, which allows public sector workers to decline union membership at their worksite without paying an "agency fee," was expected to diminish public sector union membership, but that does not appear to have happened.[21]

- The National Labor Relations Act does not cover public sector workers, so state laws govern union and collective bargaining rights for public employees.[22] Some states ban or limit collective bargaining rights for public sector workers, so there is significant variation in public sector unionization rates between states, from less than 10% in North Carolina and South Carolina to almost 80% in New York and Connecticut.[23] Most Southern states ban public sector unions, as does Arizona, and several other states have restrictions on public sector unionization[24] and bargaining for all or some types of workers.

Section Three:
How Governments Use Technology

"The technologists tell us that the machines are coming, but our data show that they have been here—in public service, working on problems of great public importance—since 2009." (Whitford 2020)[25]

Many of the technologies used in the public sector are familiar workplace tools that have gradually taken over work processes across the economy: e.g., computers, cloud storage, mobile apps, smart cameras, data analytics, and basic automating machinery. Other technologies are less apparent in people's everyday work but are quickly growing as employers identify new ways to use them: machine learning, robotic process automation, integrated data systems.

Understanding how technology use impacts work requires understanding how technologies interact with different tasks. Every job is comprised of many types of tasks, for example: data entry, analyzing information, monitoring physical or electronic activity, making decisions, interacting with clients, operating vehicles, maintaining machinery, putting out fires, making decisions, or recording court testimony. This report examines how tasks performed by public sector workers interact with five overlapping types of technology:

- Manual task automation
- Process automation
- Automated decision-making systems
- Integrated data systems
- Electronic monitoring

A. Manual task automation

Manual task automation technologies perform a physical task otherwise performed by a person—such as lifting, driving, inspecting. These technologies may automate a single task or a chain of tasks; how much of a job they can perform will depend not just on the technology's capabilities but on how the job is structured. These technologies may also collect, store, and process data that can then be used to perform additional functions or automate processes.

Examples of manual task automation used in the public sector:

- **Driverless transit:** Although automated fixed-rail transit (such as airport shuttles) has been around for a while, automation of buses that drive on streets is still very limited.[26] Several cities have plans for automated buses, sometimes involving "bus platooning" in which several buses follow each other and share information about traffic and obstacles. Automated buses on roads have been piloted in several European cities, and the City of Las Vegas has automated rail and bus routes, but as with driverless cars, progress has been slower than early predictions.[27]
- **Mail sorting machines:** Address readers and sorting machines used by the U.S. Postal Service scan mail for destination information and distribute it through sorting facilities and onto trucks.
- **Automatic meter readers:** Automatic meter reading collects usage and status data from water, electric, and gas meters. These data are still predominantly gathered by meter readers, who also document obstacles to physically accessing meters, contact customers to arrange access, and other functions.
- **Digital document printing**: As printing technology has advanced over the past 20 years, productivity increases have steadily reduced the number of workers needed to produce printed materials. Advances in digital communication technologies have led to declining use of printed material as agencies rely instead on computer graphic design and distribution of digital materials.
- **Personal computers, voice recognition and transcription software and equipment**: The expansion of personal computer use across occupations has largely eliminated the need for secretaries to take dictation and type up memos and reports, manage calendars, and other administrative tasks. As computers become better at deciphering and transcribing human language, the remaining secretarial and clerk tasks are being eliminated.
- **Robotic cleaning and landscaping equipment:** Machinery that can perform maintenance tasks self-directed or controlled by a worker.

- **Smart parking meters:** Meters that take electronic payments, read license plate numbers, and reset meters automatically when cars leave parking perform nearly all of the tasks currently done by meter readers and parking enforcement.
- **Digital scanners:** Equipment that can scan tickets, payments, or identification at entry points that would otherwise be staffed, such as toll booths or building entrances.

B. Process automation

"Automation makes it possible to do more with less, enabling agencies to leverage technology for speed and efficiency. In the contact center, this lets agents focus on more complex issues instead of handling simple inquiries and administrative tasks." (Talkdesk marketing book)[28]

"Today's modern workforce needs advanced technology solutions that empower them to excel in new digital service delivery models. Robotic Process Automation (RPA) has gained traction for the ability to automate repetitive, high-volume manual processes across multiple applications. RPA enhances employee productivity by freeing up their time to concentrate on more important work and engage with customers. All this while lowering costs." (USDA RPA website)[29]

Process automation takes an entire work process—such as an application for benefits, from the entering of information to the distribution of payments—and moves it into a digital environment. The complexity of process automation varies widely; it can involve simply moving from paper forms to computerized ones, or automating a multi-step process such as validating data, checking for errors, and matching to eligibility criteria. The public sector has been increasingly embracing process automation as technologies become more readily available and "off-the-shelf."

The transformations taking place in benefits administration illustrate these different processes. Clients now submit applications over a computer or mobile device, instead of submitting paper forms in person. Supporting documentation—such as identification and income records—can also be uploaded electronically. Technology can enable functions that previously had to be

performed in person—verifying someone's identity visually, for example—to be performed using secure facial recognition programs. Process automation can also streamline cross-agency data linkages, enabling additional forms of automation, such as notifying clients of eligibility for additional programs.

As government processes become digitized, the work is changed not just by shifting data entry and file storage from paper to computers, but by enabling the use of computer processes to replace some human interactions. Where a client might once have asked questions of a caseworker while filling out paperwork in their office, they now consult a chatbot or receive smart prompts from the online application system. Where a worker might have personally called or sent mail reminders to their clients to submit missing information, now a digitized process identifies needed information and generates reminders and notifications.

Robotic process automation (RPA) is a more "intelligent" form of process automation in which artificial intelligence enables processes to learn from data and interactions to fuel chatbots or direct processes (e.g., sending notifications to clients or assigning tasks to workers). RPA is a central component of the federal digitization strategy and has been used widely across federal agencies.[30]

Chatbots are software applications that conduct online conversations with clients, either through text or speech. Chatbots can be relatively simple—programmed to respond to particular questions or statements, with the ability to use natural language processing to correctly interpret different phrasings—or more complex—including machine learning that allows them to "learn" from conversations and use predictive analytics to anticipate and personalize interactions.[31] Chatbots can shift more elements of application processes to customers by providing assistance as they navigate online systems, and are accessible 24 hours a day. Chatbots can also be used to provide basic customer services, by being programmed to answer specific questions before directing someone to a human customer service agent.

Examples of process automation used in the public sector:

- The City of Mesa, Arizona, uses an automated chatbot to answer residents' questions about licenses, payments, account status, and other services.[32]
- The State of Ohio uses RPA bots to perform many functions in health services, including eligibility notifications for disability beneficiaries and helping caseworkers in Medicaid offices fill out paperwork.[33]
- Companies have developed chatbots to embed into classroom websites to answer questions, provide personal tutoring, and score multiple choice tests.[34]

- The Internal Revenue Service (IRS) uses bots in its procurement office to automate vendor compliance reviews and contract language updates (addressing a backlog created after staffing cuts),[35] as well as voice bots to authentic taxpayers and allow them to perform automated transactions.[36]
- The U.S. Department of Agriculture (USDA) has an entire enterprise division devoted to implementing RPA across several federal agencies including FEMA and the GSA.[37] These agencies use hundreds of bots for automating document processing, monitoring task orders, extracting reports from incoming emails, and conducting research on contractors.[38]
- Several California counties use chatbots to support customers filling out CalFresh (California's SNAP program) applications, building on an application portal originally designed by Code for America (GetCalFresh).[39]
- U.S. Citizenship and Immigration Services (USCIS) uses a product called "RPA in a box"[40] to automate aspects of processing applications for citizenship status as well as internal HR processes. A chatbot called "Emma" answers questions to site visitors in both English and Spanish.[41]
- UIPath sells an RPA product for the Supplemental Nutrition Assistance Program (SNAP) that can process applications in about one-fifth the time of non-automated processes—New York City is their biggest customer.[42]
- Code for America[43] has helped cities develop automated processes for clearing criminal records for people convicted of drug offenses, restoring people's rights to vote and making it easier for them to find employment.[44]
- Several cities are incorporating RPA into 311 and 911 systems, using artificial intelligence to take information and direct calls, in an effort to manage high call volumes for non-emergency calls and alleviate overwhelmed 911 systems.[45]
- NASA implemented an algorithm that automates routine internal tasks such as copying and pasting emails into support tickets.[46]
- The General Services Administration (GSA) has used an RPA bot to streamline procurement, automating routine vendor evaluation tasks such as pulling DUNS numbers, validating the company's identity, printing validation results, and emailing documentation to the contracting team.[47]

C. Automated decision-making systems

"Artificial Intelligence, machine learning, automated decision-making systems, and predictive analytics are a series of overlapping terms and refer to a class of technologies that assist or replace the judgment of human decision-makers."[48] (Molnar 2020)

The most complex technologies can replicate high-level human cognition—evaluation, decision-making, and risk assessment—and have the most potential to significantly restructure both work and the relationship between governments and the public. Automated decision-making systems (ADM) can analyze large amounts of data using technologies ranging from simple mathematical analysis to computing that seeks to replicate human intelligence.[49] This broad category of technologies can be used to make predictions that drive resource choices, render decisions based on a set of data, identify the drivers of programmatic outcomes, and provide complex support to customers.

Algorithms are instructions that computers can follow to analyze data and produce a result. Algorithms can use complex and large datasets and generate decisions to be used in anything from recipes to parole hearings. Because algorithms are originally designed by humans, there is concern that human biases can get built into such systems and then rendered invisible, exacerbating patterns of inequity.

Artificial intelligence (AI) seeks to imbue a computer program with the ability to make complex decisions using something close to human intelligence, rather than simply following a pre-scripted program. AI technologies include machine learning, rule-based systems, natural language processing, and speech recognition.[50] AI can help make decisions, use visual and audio and other information to evaluate situations, and understand human language. AI can also add functionality to other technologies—e.g., chatbots and RPAs.[51] Machine learning is a subset of AI in which programs learn from experience, surpassing the intelligence it was provided with in programming.[52]

Predictive analytics is the use of modeling to generate actionable predictions that are used in decision-making; how these predictions are used (i.e., the degree to which their predictions are taken at face value) varies. These kinds of predictive systems are described as "data-driven" decision-making, in which resources are directed based not on workers' judgment but on where the system predicts resources will be most needed or most effective.

Examples of automated decision-making systems used in the public sector:

- Variants of a well-known program called "Rapid Safety Feedback" are used today by child welfare agencies in states including Ohio, Indiana, Maine, Louisiana, Tennessee, Connecticut, and Oklahoma.[53]
- Predictive analytics has been used in child welfare services to target limited resources, drawing on vast amounts of data to predict which children are most at risk (for example, in Pittsburgh, Illinois, and Allegheny County, Pennsylvania).[54]
- Predictive analytics has been used to predict and prevent inmate violence (e.g., by the Indiana Department of Corrections[55])
- Predictive policing relies on algorithms to direct resources to areas assessed to be more likely to have ongoing criminal activity (e.g., as used by the Los Angeles Police Department).[56]
- Risk-based decision-making tools are used by criminal pretrial programs to identify defendants suitable for release before trial (in, e.g., Allegheny County, Pennsylvania and Mesa County, Arizona).[57] Similar tools have been piloted for sentencing, although final discretion remains with judges.[58]
- Louisville, Kentucky, implemented risk-based decision-making using a tool developed by the Laura and John Arnold Foundation and now releases 70% of defendants before trial.[59]
- Algorithms have been used to flag potential cases of cheating in educational settings, using vast amounts of data to identify patterns associated with fraud.[60]
- Artificial intelligence has been used to evaluate and render decisions on disability claims.[61]
- The Department of Veterans Affairs uses machine learning to identify veterans at risk of suicide and reach out to them with additional services.[62]
- Chicago Public Schools piloted a predictive analytical model to identify youth at risk of gun violence who would benefit from a youth violence prevention program.[63]
- Proprietary software that uses algorithms to assess a convicted person's risk of recidivism is used to guide judges' sentencing decisions in Wisconsin.[64]
- Machine learning is used to identify patterns of risk of homelessness and to direct services to high-risk individuals in Los Angeles County.[65]
- The IRS is exploring the use of machine learning for tax enforcement, identifying returns for auditing by learning the factors associated with identified cases of tax fraud.[66]

- Machine learning has been piloted to identify students at risk of not graduating on time in two large Florida school districts. The model produces risk scores that educators can use to prioritize resources, based on the assumption that resource constraints prevent districts from assisting all students.[67]

D. Integrated data systems

Public officials, researchers, and CIOs have been pushing public agencies to integrate the vast amounts of data held by different government programs and put that data to use in program evaluation, fraud assessment, automated decision-making, and streamlined processes.[68] CIOs identify data analytics as a key priority to meet customer expectations for higher performance, guide evidence-based policy decisions and enable greater citizen participation in government.[69] The growing ubiquity of technologies that collect real-time data also generates more information to be fed into other automating systems.[70]

The development of integrated data systems and cloud-based data storage has enabled the expansion of automated decision-making and data analytics to transform many areas of public work. All agencies gather and hold huge amounts of data about their services and the people who use them. Vast amounts of data can be used to measure outputs and outcomes of service delivery and drive program changes and evaluation.[71] For example, in 2015, Los Angeles County, using its IBM Master Services Agreement, set up a data sharing system—Countywide Master Data Management (CWMDM)—that includes over a dozen agencies.[72] Several academic and nonprofit organizations have sprung up to support and promote such initiatives.[73]

Examples of integrated data systems in the public sector:

- Integrated gang databases have been developed in several states to share information about suspected gang members with judges, police, and school officials.[74]
- An integrated data system was developed in San Francisco to promote information sharing and collaboration between programs working with homeless residents.[75]
- Several court systems across the country use such data analytics to facilitate processing of defendants by clerks (e.g., Bexar County, Texas, and several jurisdictions in California).[76]
- Chicago's Department of Family and Support Services was featured in a Microsoft-sponsored case study for its use of a data warehouse that analyzes data on early childhood outcomes to identify opportunities for program improvements.[77]
- Integrated data systems underlie efforts to offer integrated service delivery (for example, through 311 systems), eliminating the burden on citizens to figure out how to access multiple programs, instead requiring that workers (or technical systems) interact with clients about a range of services.[78]

- Integrated data systems (along with other communication technologies) have facilitated the creation of comprehensive virtual call centers, such as that run by the Alaska Department of Health and Human Services—a "modern call center" that replaced the system of calling individual DHSS offices. The call center covers several programs, including Medicaid, SNAP, TANF, and heating assistance. The system used by agents integrates with the DHSS eligibility system, so workers see the information in the database as the call goes through.[79]

E. Electronic monitoring

Electronic monitoring technologies are used throughout the public sector, especially in public safety environments but also in schools, hospitals, and even to monitor public infrastructure:

- Checkpoint verification technologies monitor whether workers are visiting points along their routes, such as electronic visit verification (EVV) used in healthcare settings, and the Postal Service's barcoded Managed Service Points (since replaced by handheld GPS scanners).
- Smart cameras that can sense movement, temperature, and other information are used to monitor patients, patrol buildings, scan airline passengers, and proctor exams.
- Traffic enforcement cameras that can detect red light, speed, and other violations transmit information about incidents to a data center where police officers can review and issue tickets.
- Software that conducts real-time monitoring of client calls evaluates worker's tone, pace, and use of key words and provides real-time performance feedback, which can be used later in employee evaluations.
- Facial recognition technology has been deployed at several federal agencies, schools, hospitals, and other workplaces, recording attendance or flagging suspicious visitors.[80]
- Motion sensors connected to an AI system can alert caregivers to check on elder or home care clients based on movements and other health observations.[81]
- Intelligent infrastructure uses sensors to monitor infrastructure for downtime or repair needs and help make decisions about resource and personnel investments.[82]

Case: Public Safety

Law enforcement has expanded its use of technology significantly over the past several years: video surveillance, facial recognition, body cameras, drones and radar for traffic enforcement, and linked crime databases enabling the use of analytics. Some of these technologies have highlighted and exacerbated longstanding citizen concerns about invasion of privacy, racial bias, and over-policing. Border control systems increasingly manage and surveil migrants using technology, including automated decision-making to move migrants through detention or immigration processing, biometrics to store information about migrants, and surveillance drones that can detect human activity and communicate with border enforcement.[83] Immigration and Customs Enforcement has used a computerized Risk Classification Assessment tool since 2013 to determine processing for arrested migrants.[84] Chicago is using a predictive policing program that estimates the likelihood of a person being either a victim or perpetrator of gun violence and directs both police officers and social workers to their door.[85] A technology called ShotSpotter which uses AI to detect gunshots has been presented as evidence in criminal trials by prosecutors, despite grave concerns about its accuracy and transparency.[86] Las Vegas has piloted using a private communications company to monitor activity in its parks, and sharing that data with police for use in public safety investigations, thereby replacing monitoring by city staff.[87]

Law enforcement's growing reliance on technology to monitor populations and direct policing activity has many concerned that transparency and accountability are being weakened; it is difficult for citizens to get information about how decisions are made, as the formulas are opaque even to law enforcement officials. Much of the data on crime reflects widely proven biases in law enforcement; directing additional resources based on that data feeds directly into a system that is already providing safety for some populations and risk for others. On the other hand, better data gathered by technological monitoring of how law enforcement interacts with the public has produced important evidence for policing reforms.

Other technologies can reduce the interactions between law enforcement and citizens. Automated traffic enforcement (red light cameras and drones) flag potential violations, technicians review the photographs or other data and determine whether a violation has occurred, and the data is then reviewed by a police officer who decides whether to issue a ticket.[88] Automated traffic enforcement would reduce the need for officers to pull over drivers and are often promoted by community advocates as part of a strategy for reducing police bias and civilian injury, which disproportionately affects people of color.[89] For example, in New York City advocates sought to roll back an expansion of public transit police and reallocate funding to the Department of Transportation.[90] However, many local and state governments don't permit or have rolled back the use of traffic cameras because of public backlash.[91] And of course, technological monitoring of drivers raises concerns around due process and privacy if information is shared with law enforcement without subpoenas or is hacked and shared.[92]

The case of law enforcement illustrates that technologies themselves do not increase or reduce accountability and transparency, but they can amplify existing problems if there is not an explicit effort to understand the interaction between technologies, the workers who use them, and the people encountering those workers.

Case: Education

While the COVID-19 pandemic accelerated the adoption of technology in all parts of the public sector, the changes in education were the most dramatic in scale and pace. Overnight, schools from preschool to universities transitioned to remote instruction, in most cases with no preparation or infrastructure. In some parts of the country, remote teaching lasted until the fall of 2021. This transition meant that schools needed new programs for providing online instruction, submitting classwork, administering tests, providing intervention and special education services, and communicating with families. Higher education and even some K-12 districts already had access to computerized learning management systems, but very few had the technology in place to transit instruction, record lessons, equip students with the computers and internet needed to access instruction, and set up digital systems to perform the many other tasks of education: counseling, mental health support, family engagement, special education evaluations, and much more.

More than a year after K-12 students have returned to classrooms, the use of "edtech" to support learning appears to have maintained its significant pandemic-induced growth. The persistence of online education in many higher education venues may last indefinitely. The fiscal pressure on higher education to offer online courses, in particular those that can automate testing and grading, has been mounting for decades as the demand for higher education outpaces the funding, space, and staff available. The economies of scale provided by large online classes online make them a potentially profitable solution to resource shortfalls.

In addition to instruction, schools play an important role in child welfare, by monitoring students for warning signs such as truancy, behavioral issues, and mental health problems. Even before the pandemic, some larger school systems had experimented with using data analytics to identify students at risk for violence, suicide, dropping out, or other risks. As more assignments and classroom management takes place online, through the use of tools like Google classroom/education suite, it creates more opportunities for automating reminders, late notices, parent communication, and other functions. A lot of this is pitched as relieving teacher workload and burnout; in many districts, these technologies can provide services that existing staff lack the time to perform.

In addition to sustaining remote learning systems, there has been a significant expansion in the development and marketing of technologies to perform tutoring and other student supports. These technologies are being pushed in a context of ongoing resource shortages in K12, a looming schools staffing shortage, and national concerns about the pandemic's impact on student achievement. For example:

- Digital tutoring by automated technologies (e.g., chatbots that interact with students while they take quizzes) has been used in many areas of both K-12 and higher education, as well as other government training programs (e.g., military training).[93]
- Online tutoring programs (e.g., TutorMe) have proliferated with the volume of one-time stimulus funding and concerns that tutoring needs can't be met with local staff.[94] Individualized tutoring programs

have been developed using AI/machine learning.[95]

- Instructional technologies such as augmented reality/virtual reality (AR/VR) and digital games are being incorporated into lessons.[96]
- Teachers have used automated grading tools ranging from basic scoring of Scantron exams to algorithmic evaluation of essays and AI grading of math tests.[97]
- Several consultants have published guides to the potential uses of AI in education, including chatbots, natural language processing to evaluate reading proficiency, AI to identify risk factors in student emails, and much more.[98]
- Districts have used algorithms to analyze student engagement with interactive textbooks and flag students at risk for academic failure.[99]
- Higher education institutions have embedded chatbot technology in student administration systems to "nudge" students at risk of not finishing college.[100]
- Schools have used machine learning to compile information from video and audio recordings to be used in teacher evaluations.[101]
- The Florida legislature created the Florida Schools Safety Portal, an integrated data system that flags students presenting warning signs for gun violence, developed in response to the mass shooting at Marjory Stoneman Douglas High School.[102]
- Some technology providers are promising a comprehensive "education-as-a-service" model in which everything from text reminders to facial recognition to customized learning plans to remote tutoring are offered as a single integrated system.[103] Qualcomm's model integrates subscription-based services from several edtech companies, a vision in which technology is embedded in every aspect of the school day.

The boom in educational technologies is the outcome of several factors: an education funding crisis that means schools simply can't keep up with the services students need; ongoing staffing shortages in many areas of education; a mental health crisis that manifests in rising suicide rates and incidents of school violence; and the disruptions of the pandemic on student learning and pressure on districts to get student achievement "back on track." Many districts are trying to roll back their reliance on technology to address concerns about privacy, digital equity, and the fundamental relationship between schools, teachers, and students. The field of "edtech" illustrates how technological reliance can emerge not from a comprehensive assessment of how technology can improve systems but instead as a solution to a dire shortage of other resources (funding and staff), spurred by a temporary crisis that incentivized quick tech investments.

Section Four:
Drivers of Technology Adoption

By digitizing processes and making organizational changes, governments can enhance services, save money, and improve citizens' quality of life.[104] (*Digital by Default* 2016)

Who doesn't want to replace mundane, repetitive tasks with higher-value analytic work, resulting in better accountability, transparency and citizen service?[105] (*March of the Robots* 2018)

A. What drives technological change

Since the 1990s, advocates, researchers, and policy-makers have been touting the potential of technology to transform government: broad ambitions for "Digital Government"/"e-Government" were prevalent during the Clinton Administration.[106] The first digital government frameworks described the potential of still-emerging technologies like machine learning and cloud-based storage to change decision-making, collaboration, public communication, and democracy. The aspirational goals of digital government appear in documents by technology councils and mission statements as early as 2002: "satisfying customer service expectations," "increasing participation in government," and increasing efficiency, effectiveness, and trust.[107] These same ideals have persisted as technology becomes even more complex, with the emergence of artificial intelligence that has indeed transformed how government relates to the public.[108] How have the motivations behind public use of technology evolved over time? How do the motives behind specific technology efforts affect how the work is changed and how success is defined?

This report categorizes motivations into four themes:

1. **Efficiency and cost-reduction**
2. **Performance quality**
3. **Transparency and accountability**
4. **Crisis response**

1. Efficiency and cost reduction

Governments are continually pressed to "do more with less." Revenues per capita—especially in local government—have declined in real terms over several decades as a result of tax-cutting politics, leaving governments struggling to maintain services in an increasingly resource-constrained environment.[109] Technology offers the promise of more efficiently handling everything from determining benefit eligibility to assessing recidivism risk, thereby reducing staffing costs or enabling the same number of staff to handle a growing volume of work. Computer technology has been presented as a possible solution to government fiscal crises since 1977.[110] From the viewpoint of efficiency and cost reduction, being able to digitize behind-the-scenes processes (storage and processing of paperwork, paying bills, and issuing checks, etc.) offers the most immediate productivity gains, especially as the technology becomes more standardized.[111]

Fiscal pressures are not simply the product of economic cycles; they are also created by political decisions. The efficiency imperative can be used to naturalize austerity and mask the fact that we have underfunded many government services. There is a persistent assumption that the private sector is more efficient than the public sector—that competition among private firms generates pressure to reduce costs through innovating, eliminating waste, and using firm inputs more efficiently. Without that market pressure, the narrative goes, governments are not incentivized to use resources efficiently. This narrative manifests in calls for incentivizing or forcing efficiency through reducing government spending, outsourcing or privatizing government functions, or basing funding on productivity metrics.

This narrative is overly simplistic: private employers do not always face significant competitive pressures, and when they do, cost-cutting can manifest in suppressing wages or ignoring regulations rather than innovating to increase productivity. Outsourcing and privatization have not been shown to increase productivity, efficiency, or innovation in the public sector, although they do reliably reduce public employment, and may reduce labor costs not through efficiency but by reducing compensation. Technology companies themselves are not necessarily more efficient either: there are many examples of IT contracts going significantly over budget and failing to realize cost savings. The structure of public contracting itself, and the often inadequate oversight of contractor performance, is also associated with inefficiencies and disincentives to keep costs low.[112]

Making public services more efficient and easier to access has clear social and economic benefits. Reducing the time it takes for people to get needed financial support and allowing workers to serve more people are important goals. But simply automating processes in hopes that it will save money without jeopardizing effectiveness has backfired for agencies before; introducing new technologies in an environment of understaffing and underinvestment is unlikely to increase efficiency in the long run.

2. Performance

There are many ways that expanded technology use can improve performance quality, by increasing the speed, reliability, accuracy, and convenience of public services. Computers don't get tired or make calculation errors; they can sift through large amounts of data with greater accuracy and speed than people, and work around the clock. A computer can check the accuracy of tax forms digitally entered by a taxpayer far faster than a worker reviewing a paper form, and deposit a refund check in the bank within hours, rather than waiting weeks to receive a paper check.

Making it possible for people to obtain services outside traditional office hours minimizes the impact on their own work and family obligations, resulting in real social and economic gains. Many public benefit systems are structured in ways that impose a huge burden on people at their most vulnerable: people without reliable transportation required to make multiple office visits; people without vacation leave required to stand in line to meet a caseworker monthly; benefits processes so cumbersome that studies repeatedly show that only a fraction of eligible families are being served.[113] Digitizing data entry and information processing is likely to reduce errors introduced by manual transcription, and data sharing makes it easier for clients to receive ongoing support from multiple programs. Finally, using technologies to gather and analyze data can enable better evaluation of program outcomes and identify opportunities to improve government services.

Another promised performance improvement is that technology can make government processes less susceptible to bias and fraud. The Governor of Indiana's argument for adopting an automated welfare eligibility system was based on his accusations of "caseworker fraud, inefficiency, abuse, and 'collusion' with clients."[114] A prominent government technology media site frames automation as a way to tackle "fraud, waste, and abuse."[115] It is true that government programs have always grappled with some level of fraud, not typically by individuals by but large-scale criminal endeavors that set up false beneficiaries and take advantage of massive and siloed data systems to make fraudulent claims. For years, governments have experimented with systems that can comb through vast amounts of data and identify patterns indicating potential fraud, work that human analysts don't have the capacity to do. Los Angeles County has used a SAS[116] product for over a decade to detect fraud in Department of Social Services programs, as computers can use algorithms to detect suspicious patterns (such as repeated

funding requests for non-existent childcare programs).[117] Fraud-detecting systems often function at the expense of effectively serving legitimate beneficiaries. A much-touted Michigan fraud detection system had to be abandoned when it flagged a large percentage of applicants as potentially fraudulent.[118] In 2021, Bank of America was fined $225 million by federal agencies for illegitimately freezing hundreds of thousands of legitimate applicants' bank accounts under California's flawed UI fraud detection system.[119]

Automating eligibility determinations for benefits and developing algorithms to prioritize tasks are intended to reduce or replace the role of human decision-making in public services, "rationalizing" decisions and eliminating the biases that human decision-makers may bring to their work. In reality, technologies have been repeatedly shown to replicate the biases of their programmers, and even to generate their own discriminatory outcomes. The assumption that technology inherently improves performance is persistent despite evidence that it often doesn't: replacing human processes with technology-driven ones can deteriorate the quality of service, especially if technologies are developed without an adequate understanding of how workers actually perform their tasks.[120]

3. Transparency and accountability

Technological advances in secure data storage, data sharing, data analytics, and data visualization also have potential to enhance government transparency and accountability. Governments gather vast amounts of data in their day-to-day operations that could be used to provide valuable insight into program outcomes for agencies and policymakers. Integrated data systems and analytics can help governments see which programs are successful, whether programs are serving intended beneficiaries, and whether clients are experiencing long-term improvements in their lives.

While transparency is touted as a benefit of increased technology use, the question of who controls access to data and insights is still highly contested. The vast increase in the amount of data being collected has raised concerns by public citizens and organizations about how this data can be used and what happens if data is inappropriately accessed. The risks posed by increased data have led advocacy groups to seek leverage to force government to disclose what kind of data they're gathering, how it's being used, and how they're preventing misuse.

Some advocates argue that technology use could contribute to a fundamental restructuring of the relationship between governments and their citizens,[121] redistributing power from the state to its citizenry by restructuring information flows and enabling more deliberative democracy, in which the publication of program outcomes and spending leads to greater accountability.[122] Code for America's mission to build accessible government data portals—on public safety and budgets, for example—exemplifies this idea that technology and government accountability are intertwined.

The idea that technology can level the playing field between the state and the public requires, of course, that technology use does not further obscure how resources are being used and how decisions are being made. Accountability and transparency must be intentionally and explicitly built into the ways technology is used.

4. Crises

Public crises—such as recessions, pandemics, or scandals—can also spur increased attention to and funding for technology innovation in government. When public health orders took effect in March 2020, governments across the country had to abruptly close their offices and shift to computerized work, doing in a span of a few months what some agencies had been planning to implement over years.[123] The COVID-19 pandemic rapidly accelerated the pace of replacing manual, paper-based processes with digital systems. In addition to eliminating the need for in-person benefit applications, the pandemic also generated unanticipated experiments of conducting in-person interactions with remote technology, such as remote building inspections and court hearings. Many of those remote services have continued after the expiration of public health orders.

The pandemic also exposed the public sector's aging technological infrastructure. Several state unemployment insurance systems—many reliant on outdated programming languages—nearly collapsed under the weight of unprecedented numbers of claims. In California's unemployment insurance system, the ramifications of an archaic computer system were glaring, as hundreds of thousands of workers didn't get paid for months, spent hours on the phone trying to get help, or had their bank accounts frozen by clumsy and flawed anti-fraud systems.

Crises may also lead to infusions of attention and funding for modernization, as has been the case with COVID-19 stimulus programs. While crises can provide important impetus for fixing things that aren't working, they can also lead to quick fixes. Sudden infusions of funding for technology in the wake of crisis often come in forms not conducive to long-term investment, leading agencies to pursue one-time solutions instead of using technology to reshape processes for greater productivity and service quality. Crises can also lead to a proliferation of tech contracting as agencies struggle to keep up with unprecedented public demand.[124]

Remote work

The COVID-19 pandemic generated flurry of investment in technologies that enable remote work. That shift has shaped expectations in the labor market since then, although it will probably be years before a "post-pandemic" equilibrium is reached. When offices and public buildings were closed in March 2020, public employers quickly implemented technology that would allow work to be performed from anywhere. Services that pre-pandemic had still required in-person office visits and paperwork are now primarily done using electronic documents and

electronic communication. This required not just deploying equipment that workers would need at home—monitors, computer systems, reliable network connections—but also necessitated upgrading of cloud-based services and cybersecurity to enable workers to connect remotely to systems that handle large amounts of confidential data.

Public sector workers and their unions are still negotiating with employers what long-term hybrid and remote work arrangements might look like, including establishing new rules about performance monitoring and productivity expectations. Technology consultants and government associations have been developing models of what a hybrid workplace might look like, as have a handful of government agencies.[125] (The federal government issued a revised telework guide in November 2021 for the first time since 2011.)[126] Offering remote work is also seen by employers as a way to overcome worker burnout and to respond to the tight labor market. Some employers have sought to offer flexible work in exchange for a "results-only" work environment: instead of being expected to work a certain number of hours in the office, workers would be given performance targets to meet or asked to accept a certain degree of monitoring. Monitoring technology and performance analytics can enable

Some of the shifts made during the pandemic shutdown are likely to be permanent. For example, remote court operations are likely to continue long-term in many areas of the justice system. Both civil and criminal justice systems face a volume of work that far exceeds resources: before the pandemic, there were long wait times for hearings, and defendants could spend months in jail awaiting trial.[127] Conducting court proceedings over zoom requires less transition time between cases, makes it easier for attorneys, defendants, and judges to attend from different locations, and enables court systems to process cases faster and reduce some of the injustice and frustration produced by an overwhelmed justice system. This change will affect the need for other workers involved in court proceedings: clerks, court reporters, bailiffs, security guards, and other workers whose positions don't have equivalents in an online courtroom.

The same technology that enables remote work also facilitates "placeless" work—the redistribution of tasks across a large and physically scattered workforce. Once call centers can be staffed by workers in multiple remote locations, workers can be easily deployed as call center staff during surges in customer demand. This has led to employers wanting to expand job descriptions and build greater task flexibility into some jobs to allow workers to be assigned additional tasks.

B. Who drives technological innovation

"The American people expect to interact with government through digital channels such as websites, email, and mobile applications. By building digital services that meet their needs, we can make the delivery of our policy and programs more effective."[128] (U.S. Digital Service, 2022)

Governments have often been drivers of technological change; government policy and procurement can play an important role in innovation by defining how services should be delivered.[129] Elected officials can play a leadership role both in advocating for technology use and in developing regulation and accountability systems for technology, funding technology investments, and issuing mandates for "modernization" or other technology-related goals. Public officials at all levels have campaigned on the potential for technology use to improve government.

1. The federal government

The federal government has for decades made efforts to mandate and incentivize technological advancement of government services. Investments to support technology implementation have waxed and waned; while investments expanded significantly during the pandemic, there had been numerous concerted efforts previously. The Government Paperwork Elimination Act was passed in 1998, spearheaded by then President Clinton.[130] In 2000, testimony on the process of e-Government presented the logic and hopes underlying the introduction of technology into government processes.[131] Successive administrations and Congressional agencies have repeated these imperatives and aspirations.

More recently, the 2017 Congress passed the Modernizing Government Technology Act;, creating the Technology Modernization Fund (TMF), a revolving fund that supports IT modernization and cybersecurity projects.[132] The American Rescue Plan added an additional $1 billion in funding to the TMF, spending intended to be closely monitored for its success in advancing the modernization of the federal government.[133] The Trump Administration's modernization agenda—"Shifting from low-value to high-value work"—centered on robotic process automation (RPA), which is used widely across the federal government.[134] President Trump also established the American Technology Council in 2017 to develop a vision and recommendations for the modernization of federal IT, looking primarily at IT infrastructure.[135]

In 2021 President Biden issued the "Executive Order on Transforming Federal Customer Experience and Service Delivery to Rebuild Trust in Government."[136] The order emphasizes using technology as an equity tool to improve access and customer service; it outlines changes specific

to nearly every area of federal government, including allowing clients to use WIC to shop online, enabling mobile-based Social Security applications, removing requirements for physical paper, and automatically integrating applications to all programs for which citizens may be eligible. The order also outlines "Ongoing Accountability for Federal Service Delivery," focused on assessing the "customer experience" of customer-facing agencies referred to as "High Impact Service Providers" (e.g., Federal Student Aid, Centers for Medicaid and Medicare Services, and the Social Security Administration).[137]

These longstanding efforts illustrate both the persistence of a vision of modernized government and the complexity of technological change, particularly for large branches of government and programs that serve millions of people. The federal government's mandates and emphasis on technology also directly affect state and local entities that receive federal funding.

Unemployment insurance administration has been a particular sore point for federal and state governments.[138] Although UI is a federal program, each state manages its own system for administering benefits. The Great Recession exposed the archaic UI systems' inability to handle an influx of claims; federal legislation was introduced in 2008 to modernize the program (focused on both funding and technology).[139] The COVID-19 pandemic revealed that very little progress had been made since 2008, leading to a Congressional hearing and federal legislation to promote unemployment insurance modernization, including earmarked funds from the American Rescue Plan.[140] Many states' efforts to modernize their UI systems have been plagued by cost overruns, project abandonment, poorly tested systems, and enormous numbers of erroneous benefit denials.[141] UI offers a useful example of both the importance and the challenges of "modernizing" government even when there is funding and motivation to do so.

2. State and local technology departments

Most state and local governments have consolidated IT functions into departments that have a broad innovation and technology-focused mission, led by a Chief Information Officer. These agencies typically play the primary role in identifying ways to incorporate technology in the workplace and pushing those technologies out through smaller units of government, as well as managing data sharing and data security. Chief Information Officers share ideas and resources through various networks, including the National Association of State Chief Information Officers (NASCIO), and through informal networks within states or program areas. Associations of government officials and agencies serve as a convening space for distributing ideas about technology and offer forums for technology companies to pitch their products and services (e.g., at conferences). For example, the NASCIO, the National Governors Association, the National League of Cities, and the U.S. Council of Mayors all hold events and publish papers on the role of technology in government.

Some states, such as California and New York, have created ambitious strategies for technological overhauls of government, such as California Governor Newsom's $40 million

investment in the Office of Data and Innovation.[142] This year, the City of Chicago announced an ambitious IT modernization initiative to lower the burden of receiving services, make services accessible digitally, ensure collaboration across city agencies, and replace outdated IT systems, under the leadership of a Bureau of Innovation and Technology.[143] Some cities and states have also founded tech initiatives—often public-private partnerships—to focus on technology use in particular areas. For example, several New York area transit agencies are part of the NYC Transit Tech Lab, which funds pilot projects and research around automated public transit.[144]

3. Technology companies and consultants

In 2000, the federal government was still a primary driver of IT innovation.[145] While government continues to lead in some areas of technology development (especially in national defense and intelligence), most new technologies adopted in the public sector are developed, marketed, and implemented by private companies.[146] These companies play a significant role in shaping conversations about technology use in the public sector; this include technology providers (cloud services, programing, IT infrastructure, specific technology infrastructure, programming support), and consultant groups (e.g., Ernst & Young, Deloitte, Accenture, McKinsey). Some of these actors are familiar from the private sector (Cisco, AWS, Google, etc.) and have special departments focused on public sector contracting; others are primarily focused on securing government contracts.[147]

Governments often hire consultants to evaluate processes, identify opportunities for efficiencies, and advise on developing the scope of work for a request for qualifications/proposals, and then contract with providers of specific programs. Consultants also present themselves as thought leaders, producing "research" reports that quantify savings or performance improvements and present the outcomes of pilot projects. Consultants have even set up research programs that evaluate the technologies they themselves produce: for example, Blackboard launched the Center for Advanced Learning to study the effectiveness of virtual learning.[148]

Consultants, providers, and government agency associations often appear intermingled in materials for conferences, reports about specific technologies, and news articles about technology trends. In this "govtech" world—reflected most explicitly in the Government Technology website—it can be difficult to differentiate between research, journalism, and marketing.[149] There are some powerful actors in this arena, reflecting the potential boon for companies that public sector contracting can bring. Most recently, Google created a Google Public Sector division in 2022 to focus on bringing Google products to local, state, and federal customers—to help them "accelerate their digital transformations."[150] The importance of these consultants in creating narratives about the capacity of technology to transform and improve government is hard to overstate. Especially given the underdevelopment of internal IT capacity in many agencies, these private actors are not just creating the products themselves but are conceptualizing and arguing for the kinds of products that are needed.

C. Technology constraints

Despite significant momentum for greater use of technology in government, adoption remains uneven, and progress has been plagued by challenges getting projects off the ground and setbacks of project failures. Governments must weigh many concerns as they move to identify and implement new technologies: timely delivery of services, resource constraints, obligations of public transparency, preserving civil liberties, and serving hard-to-reach clients.[151]

- **Legacy IT infrastructure:** The most immediate challenge for many agencies is the cost and complexity of upgrading legacy IT infrastructure. Outdated computers and network systems can prevent agencies from taking advantage of the cloud-based data-sharing necessary to adopt more advanced technologies.

- **Funding:** Most government entities have underinvested in technology and other infrastructure upgrades simply because there aren't enough funds to do so while maintaining services in a declining resource environment. The shifting of many software programs to subscription services rather than a purchasing model has also posed challenges for public entities in budgeting for technology. For very large agencies, the high cost of making significant hardware upgrades can be prohibitive. When large infusions of one-time funding for technology become available, agencies struggle to balance the urgency of spending time-limited funds with the deliberation needed to make effective long-term technology improvements.[152] In addition, the shifting of many software programs to subscription services rather than a purchasing model has also posed challenges for public entities in budgeting for technology.

- **Limited internal IT staff capacity:** Many agencies have also developed insufficient internal IT staff expertise and capacity, which makes them heavily reliant on contractors and consultants. This is not a new problem: two decades ago in 2001 Congress held a hearing on "The Federal Government's Technology Workforce Crisis."[153] IT is one of the most commonly outsourced functions of government, despite plenty of evidence that doing so is more expensive and has significant downsides.[154] Among those downsides is reliance on private contractors, whose incentive is to build in dependency on their proprietary programs and services rather than creating systems that could be handed off to an internal IT team.[155]

- **Uneven digital access:** When considering digitizing services, governments must continue to accommodate clients who lack adequate digital access.[156] Because governments need to continue to serve all clients, new technological systems often must function alongside—rather than in place of—more traditional service structures (including staff, buildings, paperwork, etc.), at least for some significant transition period. This makes it hard to realize cost and efficiency savings.[157] An appreciable percentage of Americans still lack access to reliable internet, especially in rural areas; others may find

it difficult to navigate electronic systems for other reasons. Of course it's also true that digital technologies can make government services more accessible to disadvantaged populations by enabling the use of basic mobile phone technology to request services and eliminating the need for time-consuming in-person visits.[158] Successful and beneficial government modernization will therefore depend on technology investments by other actors—such as community broadband—in order to ensure that technology adoption doesn't create access inequities.

- **Organizational silos:** Public agencies often work in rigid organizational silos that make it challenging to pursue transformations in processing and analysis. Efforts to build integrated data systems often founder on the challenges of simply matching variables and obtaining sharing agreements between agencies; agencies have entrenched ways of interacting with people and offering services which can generate resistance to processes that require integrating with other agencies' programs. And agencies within the same county may be accountable to state and federal funding streams that carry with them specific regulations and ways of doing things.

- **Procurement policies:** Government entities are subject to laws and rules that govern how they select and contract with outside vendors. Procurement offices oversee both bidding and contract management; they also certify contractors in order to enable jurisdictions to contract without competitive bidding. Chief Information Officers (CIOs) have advocated for IT-specific procurement processes because IT contracting is so different from other forms of government purchasing. This is particularly true as IT moves toward "software-as-services"—renewable leases for software and hardware use—instead of one-time purchases to which standard procurement is best suited.[159] In many places, CIOs see standard procurement policies as obstacles to effective technology contracting, which doesn't align with typical ways of measuring effectiveness and presents specific challenges such as data security.[160] Procurement for IT is sometimes managed by a separate office; the federal government has separate regulations specific to contracting for IT.[161]

- **Public values of equity and transparency:** Public entities are obligated to engage with the public about the implications of adopting technology—those implications include the relationship between workers and the public they serve. The public sector should be a model for protecting and managing private information, ensuring that services are universally accessible, and being transparent about the role technology is playing in public decision-making. Although it is necessary and important, engaging in public deliberation about the impacts of new technologies does mean the process of adopting new technologies can be lengthy, sometimes making it harder to use certain types of funding.

- **Cybersecurity concerns:** Cybersecurity dominates the concerns of CIOs. As more data is moved into the cloud and integrated with multiple datasets, a breach could reveal enormous amounts of personal information. Data gathered by governments are protected by many more laws governing confidentiality than data gathered by corporations, so the technological complexity of gathering, storing, and analyzing data is significantly higher than in the private sector. Many state governments are developing strategies for building up their internal cybersecurity capacity to try to address these concerns. Increasing reliance on technology for public services and processes also increases the risk that cybersecurity attacks could effectively cripple vital public services.

None of these constraints will prevent effective technology use by governments. In fact, the deliberation that they bring to the process of technology adoption is likely to increase the ultimate effectiveness of technology projects by forcing agencies to be explicit about weighing the benefits and risks of technologies.

Section Five:
How Technology Impacts Work and Workers

As technology use expands across public sector workplaces, how will the work experience and job security of public sector workers be affected? While much of the focus on technology is how it could replace workers by performing specific tasks, the interaction between workers and technology is very complex. How the relationship between workers and technology affects the day-to-day experience of work—how rewarding, stressful, dangerous, repetitive, mundane, or creative it is—is highly dependent on how employers approach the relationship between workers and technology.

As public employers increase their use of technologies, there are four types of impacts on the workplace:

- **Job losses and gains:** How does technology affect the need for workers in different occupations as tasks are reconfigured or automated by technology? Which occupations are likely to decline, and which to grow? How do those workforce changes affect specific groups of workers?
- **Job complexity:** How does the use of technology change the need for specific skills, and how do changing skills needs affect the demographics and pay structure at a workplace? What happens to workers when technology changes the skills needed for their jobs—either "deskilling" their work or adding new skills requirements?
- **Managerial control:** How does technology affect expectations for productivity and performance? How does technology enable new forms of performance monitoring and evaluation?
- **Outsourcing:** How does technology facilitate the outsourcing of public work to private contractors or increase the reliance of public employers on private contractors to provide core services? What is the impact of outsourcing on public sector workers, both their employment prospects and the nature of their work?

It is important to emphasize that these potential impacts are happening within the context of many decades of declining worker power in the labor market and rising inequality between workers. The labor market is characterized by growing gaps between workers with different levels of formal education, and a decline in real wages for many workers without a college degree.[162] Even absent changes wrought by technology, workers have been steadily losing ground because of declining labor union representation, legislation dismantling worker protections in some states, and the growing market power of certain employers. While forecasting the impacts of technology on specific workers is largely speculative, there is good reason for workers to be apprehensive about how those impacts will play out.

A. Employment impacts

As technology is introduced into a workplace, tasks are transformed and redistributed, and the need for specific skills and occupations may change.[163] How these changes impact individual workers will depend on whether they are provided opportunities to develop new skills and move into new job areas. The labor market context in which changes could take place also affects the magnitude and nature of employment impacts. In late 2022, infusions of one-time funding and an unusually tight labor market have led many public employers to face significant labor shortages. In that context, the practice of adopting technology explicitly to reduce the need for workers may actually increase (in fact many companies are pitching their tech wares as a solution to staffing shortages).

As compared to the private sector, the structure of public sector funding and employment creates a different mechanism through which jobs are eliminated as work needs change. Job reductions often take place through attrition and reclassification rather than direct layoff, both because of stronger contractual rights to rehire and training where public sector unions exist and because of the complexity of eliminating and creating new positions within the public budgeting process. This can mean that technology-induced changes in occupational employment may take longer to appear in employment data.

Observable employment gains or losses that can be confidently attributed to technology use in specific areas of public sector agencies or occupations are limited to a handful of jobs. More commonly, specific tasks, rather than entire jobs, are performed or transformed by technologies.[164] Over time, changes in how tasks are performed—and transference of tasks in response—will create a shift in occupational patterns, skills needs, and distribution of tasks, rather than replacing entire jobs in one step. At very large public employers, this can mean that work moves to a different bargaining unit or even to different agencies.

For decades, computers have been best suited to replace simple, routine, repeated tasks, enabling employers to substitute technology for workers who specialize in these tasks.[165]

In the public sector, this has primarily included occupations in office and administrative services (OAS), which has experienced a dramatic decline in employment since the 1990s.[166] As computers become more widely used across the workplace, the work of preparing and managing documents has moved from secretaries and administrative assistants to lawyers, case workers, and managers. Dictation and scanning software has enabled computers to absorb tasks entirely. At the same time, more universal use of database applications have enabled administrative workers to perform more advanced tasks, such as creating databases and producing data analysis that might have previously been performed by a higher-level analyst.[167] The occupational shifts described in Section 2 reflect these patterns: significant declines in OAS from 2011 to 2019, accompanied by growth in Computer and Mathematical and Business and Financial occupations.

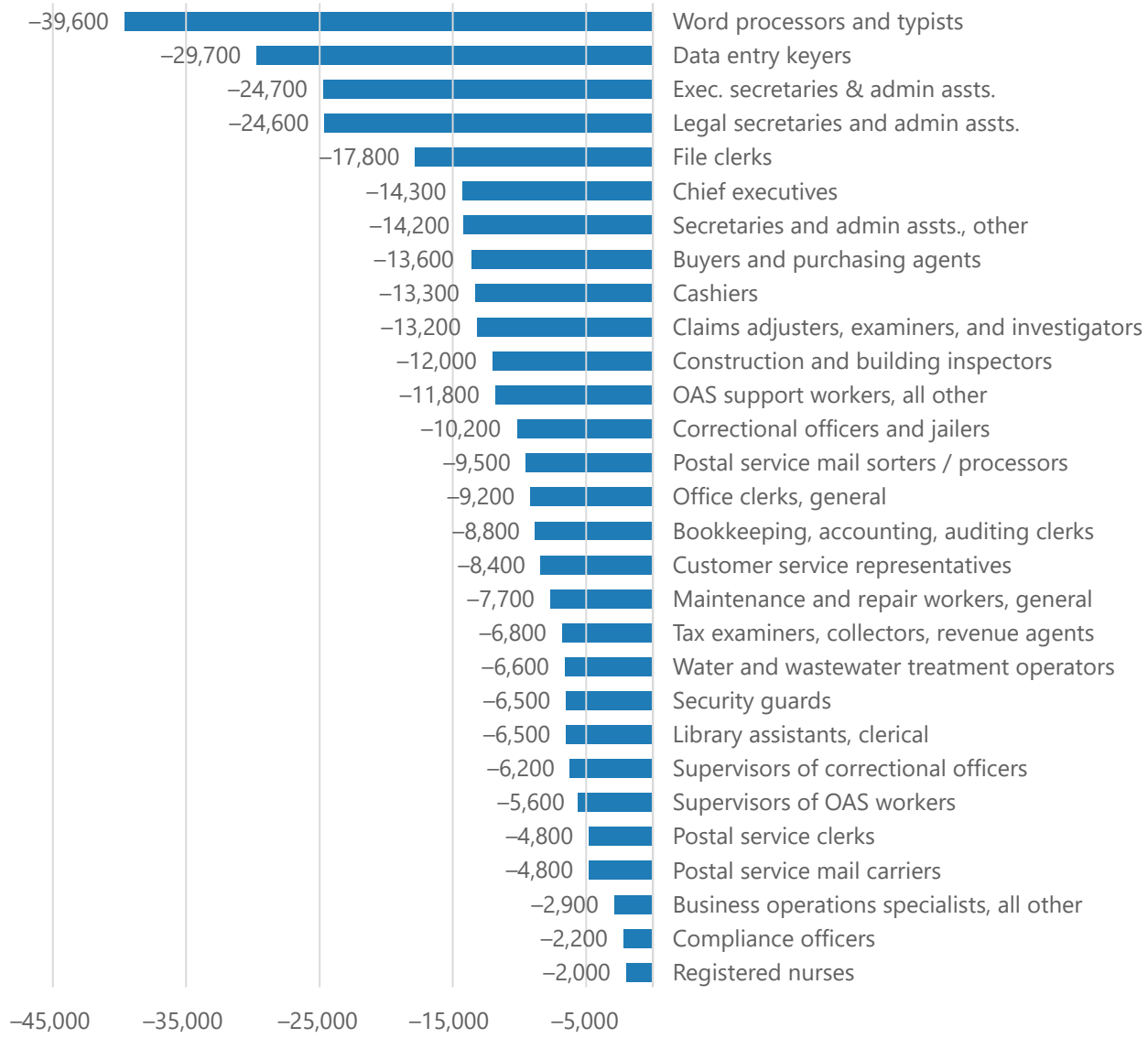
Occupations in OAS with the most significant declines from 2011-19 were Executive Secretaries and Executive Administrative Assistants; Eligibility Interviewers, Government Programs; Postal Service Mail Sorters, Processors, and Processing Machine Operators; Office Clerks; Word Processors and Typists; Bookkeeping, Accounting, and Auditing Clerks; Library Assistants; Receptionists and Information/Record Clerks.

There are also areas of jobs growth fueled by technology. This includes both direct IT work (programming, web development, network maintenance, and IT support) and higher-level business and finance positions, which are associated with the more complex systems enabled by more advanced data gathering and electronic transactions. Computer and mathematical occupations classifications have evolved rapidly over the past decade, making it very difficult to evaluate historical patterns; for example, web developers and data analysts were only classified as specific occupations in 2018. It is also likely that the demand for public sector computer jobs is not reflected in occupational data because so much IT work is outsourced.

The Bureau of Labor Statistics projections for 2021-31 (Figure 7) predict that many of the patterns from the last decade will continue:

- *BLS projected growth occupations:* management analysts, computer occupations, health services managers, software developers, firefighters, patrol officers, computer and information system managers.
- *BLS projected declining occupations:* word processors and typists, data entry keyers, executive and legal secretaries and administrative assistants, file clerks, buyers and purchasing agents, cashiers.

Figure 7. BLS projected declining occupations



Source: BLS National employment projections

Finally, other tasks may be indirectly displaced by technology use. For example, when technological processes reduce the need for physical locations where clients must come to submit benefit applications, there are fewer jobs required to keep those buildings open, clean, and secure. Due to the confluence of technology adoption and some permanency to remote work, the public sector will likely see reduced building usage and accompanying declines in janitorial, landscaping, and security employment.

B. Job complexity

Proponents of technology use—in particular process automation—emphasize its potential to enable more rewarding and productive work. Marketing pitches for process automation suggest that it can free workers from "drudge work" and allow them to focus on more complex and creative work, including meaningful interactions with clients.[168] This can certainly be true in many cases, but how the overall work environment changes will also depend on how any changes in performance expectations are negotiated and implemented, how worker skill development is supported, and whether those complex tasks are instead absorbed by workers in other occupations.

Workers may be understandably skeptical of claims that technology will necessarily improve their jobs. Many are concerned about how technologies might actually "dumb down" their jobs or even eliminate them entirely. Emerging artificial intelligence and machine learning have shown potential to take over the core tasks that workers enter their field to perform: evaluating student work, managing supports for a foster child, providing a network of support for a homeless family, and deciding which social work clients to prioritize. Interviews with workers using AI found they sometimes feel they're "cleaning up" after algorithms that do the job they used to do, but less accurately; they've been transformed from decision-makers to editors and error checkers.[169]

Conversely, algorithmic systems could instead generate important knowledge that enables workers to make more informed decisions, augmenting workers' authority instead of diminishing it. How interaction between algorithmic analysis and human judgment is structured will shape the impact on workers: if the worker is seen as the human "shield" against abuse of algorithms, they may be assigned even *more* responsibility than when they were accountable only for their own decisions. If workers are not given the ability to explain an automated system's decision to their clients—not uncommon when the decision-making rationales are embedded in proprietary algorithms—they will likely feel their job quality has been diminished.[170]

Some workers are happy to have shifted to remote interactions with clients, while others miss the human interaction aspect of work. Moving away from paper files has been a relief for most workers, but transitioning to digital processing and data storage has also enabled the elimination of the assigned-caseworker model, enabling clients to talk with any caseworker in their county. Some workers feel these changes undermine service quality and puts them into interactions with more clients who are frustrated. Overall, reducing human interaction and the use of the assigned-caseworker model can lead workers to feel they are not able to effectively perform their jobs.

As use of these technologies grow, so do the risks—both to the workers and to the public—arising from de-professionalizing some forms of work and handing over essential functions to technological processes.[171] Skills that are aligned with the technological structure of the system itself—to distill family situations into data points and track large amounts of data—may

become more valued than traditional social worker skills—to assemble family narratives through qualitative information, grapple with complexity, and engage in complex decision-making. While these data management skills become more important to jobs affected by automated decision-making systems, many experts think that certain kinds of human decision-making and intelligence cannot be replicated with AI, such as social intelligence (negotiation, persuasion, and care), creative intelligence (generating new ideas), and perception/manipulation (comprehending a chaotic environment).[172]

How these impacts play out will also depend on organizational norms and structures. Some research has found that algorithmization in hierarchical administrative cultures results in more bureaucratic control, while algorithmization in less hierarchical cultures results in more support for professional judgment.[173] Algorithms, in other words, do not impose a model of organization, but can produce different patterns of use depending on workplace hierarchy and other factors.[174]

The division of labor between ADM systems and human decision-making rests on the difficulty of balancing two conflicting purposes: maintaining some element of human discretion to mitigate the possible unintended consequences of algorithmic rules and removing human discretion to prevent bias or mistakes.[175] In situations where judges retained discretion over whether to rely on sentencing algorithms, research has found that they are likely to go along with the algorithms' recommendations even when those recommendations differ from the decisions they would have made in similar cases.[176] Workers are caught in the middle of these significant questions—often feeling both that their power to make decisions has been reduced and that the consequences of bad decisions still fall on them.

C. Managerial control

As technology use expands in the workplace, workers may experience automation as intensification: caseloads or performance metrics are increased, and new elements of work are added. For example, social work caseloads have increased significantly over the past decade, both because of increasing numbers of clients and stagnant staffing levels. Digitization and automation have enabled social workers to manage some elements of the job in much less time, but have also led to increased complexity. The ability to easily find information about a client's interaction with other public agencies helps workers serve clients better, but it also adds to the depth of assistance they are expected to provide. And many new digital systems developed don't work as promised, which may take agencies years to admit; meanwhile workers struggle to explain why they can't keep up with their growing caseloads.

Many technologies enable real-time and detailed monitoring of worker performance, including coaching workers while they provide services, commenting on their tone with clients, and reminding them how long they have been talking with a client.[177] These functions are marketed as positive outcomes, but workers can experience them as interfering with their ability to focus

on what they're doing. Case workers, for example, feel that these systems can make it harder for them to provide individualized assistance and fail to recognize how complicated it is to provide services, especially now that programs are more integrated through data systems and there is more information to document and respond to. In this way, technology can create additional stress and set productivity expectations that are hard to meet without compromising the quality of services.

Concerns about employer electronic monitoring have grown with the proliferation of remote work. For example, the inspector general's office of the Social Security Administration told employees it would discipline remote workers for productivity declines, measured using computer logs and telephone records.[178] In many cases, this kind of monitoring is done without workers' knowledge, and relies on obtainable data such as keystrokes or data transfer rates, which may be poor proxies of actual productivity. In the private sector, such technologies are widespread and used to make determinations about everything from scheduling to task assignment to promotion and pay raises.[179]

The same algorithmic processes that are adopted to make decisions and analyze data about public services can also be put to work evaluating and supervising workers. Technologies that monitor worker performance may also concentrate decision-making among a smaller group of managers, distancing workers from their supervisors once regular interaction is not the basis for supervision and evaluation.[180] Instead of being accountable to a supervisor who they interact with regularly, and who can see them engaging in the many dimensions of work, workers may effectively be supervised by an algorithm, just as their clients are.[181]

D. Outsourcing

Outsourcing and privatization in the public sector has accelerated since the 1990s, for many reasons (although it is much less prevalent in states that provide public sector workers with strong bargaining rights).[182] Although privatization and contracting out are often promoted as ways to increase efficiency and lower costs, they often lead to higher costs and reduces both employee productivity and service quality.[183] One argument made for IT outsourcing is that public sector agencies cannot meet the pay levels of private sector technology jobs; contracting IT services gives public agencies access to a pool of skilled labor they can't hire directly. For most IT services, the contractors performing the work are paid more than similarly situated IT workers in the contracting agency.[184]

While most of the focus on technology and outsourcing has concerned the outsourcing of IT itself, technology also facilitates the effective outsourcing of other areas of work. Technology implemented and monitored by private contractors takes over tasks currently performed by government workers; even if those workers are absorbed in other areas, it's important to

consider that work as having been outsourced. (In some cases, workers are being required to work with private contractors to feed information into the development of chatbots capable of performing their jobs.) The work of maintaining those chatbots may also be part of the private contract, effectively outsourcing the full array of functions of a government responsibility.

Contracting out, particularly for services like IT that are integral to a government's ability of function and fulfill its mission, diminishes the public sector's ability to perform and oversee such services;[185] expertise is externalized and institutional knowledge is not available to the agency, unless they continue to contract with the same vendors.[186] If the public sector is to fully realize the benefits of technological transformations, building internal technology capacity is vital.

Section Six:
The Path Forward

[D]isruptive technological innovation, by definition, will leave in its wake profound societal changes that, in turn, will force a reassessment of the role of the State and a renegotiation of the social contract.[187] (Leitner et al. 2019)

Technology use is inherently neither problematic or beneficial: automation can free workers from tedious paperwork and increase productivity, benefiting both workers and society. Or advanced technologies can be used to exert greater control over both workers and clients, driving costs down not by increasing productivity but by reshaping labor relations.[188]

Technology's impact on workers and the public will depend on how its implementation is negotiated among stakeholders. There are many opportunities for technology to enhance the ability of public sector workers to serve their clients better, handle growing workloads, and engage in more rewarding work. But there are also ominous possibilities: deteriorating job satisfaction, reduced civil liberties, and growing reliance on private technology providers to the detriment of the public sector's mission.

Some concluding concerns are listed here, followed by a discussion of three strategies for addressing them:

- Digitizing paper processes is often approached as a straightforward process, but many projects have foundered even in the early stages of automation.[189] Government processes can be inordinately complex and burdensome, reflecting the (often needlessly) elaborate criteria of the policies themselves; trying to feed these steps into a computerized process can lead to project failure or poor service quality. Digitizing and automating work processes requires a more complex project of overhauling the underlying processes themselves, incorporating the institutional knowledge workers have developed about how to actually help clients.[190] Digitization can also fail because it doesn't take into account the ability of humans to home in on what's important in a case file, using the kind of judgment and skill that computers have yet to replicate.

- Technologies that replace or supplement human decision-making have raised significant concerns about how they might impact privacy, transparency, equity, and due process. Many people are skeptical about promises of advanced technologies' impartiality and effectiveness. Algorithms have been pitched as a way to eliminate the role of human bias in decision-making, but they can also replicate the biases of their programmers or the underlying data used to program them (or even begin to generate their own biases).[191] There are many examples of automated decision-making systems reproducing and deepening existing structural inequalities, while users of such systems ignore evidence that the systems are producing faulty outcomes because they have been convinced that automation produces superior results to human decision-making.[192]

- Many workers share the public's concern about removing human judgment from decision-making processes, particularly when someone's fundamental rights are at stake. Research on the use of sentencing algorithms found that even though judges retain ultimate discretion, the algorithms alter their decision-making in sometimes pernicious and unexpected ways.[193] Humans may overestimate the accuracy of technical decision-making systems, overriding their own judgment in favor of outcomes they are skeptical of, simply because they have been told that technologies are more reliable and unbiased. This means that humans are not necessarily effective safeguards against the poor outcomes of algorithmic tools.

- Governments don't always have sufficient resources to responsibly introduce technologies—especially potentially controversial technologies such as ADM. This includes developing and funding internal expertise so that the complex issues raised by ADM technologies can be internally managed without relying on outsiders.[194]

- New technologies should be integrated with existing accountability policies, but existing laws and policies are insufficient to manage many of these technologies. Furthermore, laws and policies created to manage these technologies need to be regularly reviewed and updated as technology evolves and the consequences become more clear. Some policymakers and advocates have pushed for moratoria on certain technologies—such as facial recognition software in schools—until a sufficient regulatory system can be introduced.[195]

- All of the elements of good contracting practice are important for making sure technology adoption is done responsibly. But two obstacles can make it difficult: vendors keeping elements of the technology proprietary, and the limited internal IT expertise needed to evaluate the terms of contracts. While all types of government contracts can go over budget and fail to realize promised benefits, the complexity of IT contracting has led to many notorious examples of over budget projects that were ultimately abandoned or had to be redone. Indiana sought nearly half a billion dollars in damages when IBM's modernization of its child welfare system failed.[196]

In order to realize the potential of technology to contribute to the public good, governments need to be explicit about the expectations and risks of new technology projects, increase internal technical capacity, and develop technology-specific approaches to transparency and accountability. Over and over, stakeholders and researchers have emphasized the importance of involving both workers and clients in the development of technology, ongoing feedback and adjustment, and evaluation of its outcomes.

Transparency

Transparency about how technology is being used is important for clients, workers, and the general public. When governments develop or purchase technologies to interact with the public (such as chatbots) or direct decisions and resources, transparency about the structure of a program and how it's performing is crucial to maintaining accountability and public trust. Advocates have created clear guidelines for more open contracting around complex technologies, so that the public and workers can understand how technology is being used.[197]

Meaningful transparency—"explainability"— is an important factor in public acceptance of technologies like AI and ADMs.[198] When governments are required to make available information about how technology is used, both the public and workers are empowered to ask questions about what impact technology will have on public services and the public good. Meaningful transparency doesn't mean just revealing the code and mechanisms of these new systems; instead, there must be transparency about the entire process—both the technical and human elements. The public and workers should be informed at each stage of the technology adoption process—commissioning, building models, developing technical specifications, setting the relationship between humans and the technology, and specifying mechanisms for evaluation, disclosure, and revisions.[199]

In addition to basic explainability of how the technology itself functions, governments should be able to answer questions about the impacts of technology: How does the new technology align with the mission of the organization? How will the technology change the way workers do their jobs? How will it change the ability of clients to access goods or services, and to reach a human worker if their needs are not being met? What data is being gathered and how it will be used? How will client data be used, and how will it be kept private?

Accountability

Providing clear answers to such questions is also necessary to ensure that governments are held accountable to citizens, and that technologies are evaluated in relation to both public values and the promised improvements. Public agencies are subject to rules intended to ensure that programs and processes meet important public goals including integrity, ethics, equity, and universal accessibility. Any technology implementation strategy should outline how new systems or processes will comply with these goals. Governments should be able to identify what aspects of public service the new technology is intended to improve and how the agency will assess whether a new technology has fulfilled anticipated improvements in service quality, efficiency, productivity, or other objectives. Governments should also have a clear process for gathering and analyzing feedback and correcting course if necessary.

Accountability systems should begin from the foundational expectations for public goods. One analysis of chatbot technology uses the idea of "public service values" to evaluate whether technologies are working appropriately.[200] The framework includes several values in the context of technology: adaptability, user orientation, professionalism, effectiveness, efficiency, fairness, legitimacy, acceptability, openness, accountability, social license, privacy, trust in government, and collaborative intelligence. The extent to which technologies like chatbots can emulate the fairness and openness available in personal interactions is still evolving. As technologies increasingly replace human interaction, agencies need to ensure that the system continues to demonstrate the full range of public service values expected of a human agent.[201]

Accountability frameworks may also use risk analysis to evaluate whether the potential impacts of a new technology will jeopardize the fundamental rights people expect to have when interacting with the government. In the case of automated decision-making systems, a risk analysis must consider the potential harm caused by the autonomy granted to technologies themselves and whether the systems have sufficient safeguards: To what degree do human employees retain the knowledge and ability to overrule and critique system outcomes?[202] Do the decision-making parameters built into the system align with the expertise that would be used by skilled human workers?

Accountability mechanisms could be spelled out in policies governing the procurement of technology services, or as standalone policies governing the use of technology in the public sector. Several jurisdictions have already explored policies that require both accountability and transparency when governments adopt specific types of technologies. For example, a bill in Washington State would establish "guidelines for government procurement and use of automated decision systems in order to protect consumers, improve transparency, and create more market predictability."[203] The World Economic Forum has outlined key components of an AI procurement program that could address concerns about transparency, accountability, public input, and technological opacity.[204]

Involving workers

Most of the legislative efforts to put in safeguards around government use of advanced technologies have focused on addressing concerns about bias and clients' privacy; few of them mention workers.[205] Centering workers in accountability strategies is important for two reasons: First, the success of new technologies will depend on having workers who understand and are bought into new systems. Second, workers are in the best position to document and explain how such systems will affect clients.[206] Workers can help identify potential pitfalls and important safeguards in the launching of new technologies, based on their experience helping clients navigate existing systems.[207] Workers—along with clients—are vital partners in identifying opportunities for technology to help government better serve more people in an era of growing needs and shrinking resources.

In worksites with strong union contracts, workers may be entitled to negotiate the impacts of new technologies. Collective bargaining agreements typically require that employers must "meet and confer" (i.e., negotiate within the terms of a contract) with workers over the impacts of new technologies: how they are phased in, how they are used to evaluate workers, what happens to tasks or jobs that are replaced by technology. A contract could require that new technologies not displace workers, or that the impacts be bargained. This will depend on the state's specific labor laws and the terms of collective bargaining agreements.[208] Strengthening public sector unions, which serves multiple purposes including reducing racial and gender wage gaps,[209] could also serve to maximize the benefits of public sector technology use. Without such rights, workers may find themselves struggling to learn new technical systems while their non-technical expertise is simultaneously devalued.[210] Employment and labor laws that protect workers from exploitation can increase the likelihood that employers will invest in technologies that enhance productivity instead of facilitating the suppression of worker autonomy and skill.[211]

Worker training should be centered in discussions of public sector technology; researchers have found that employers' approach to training affects the uptake of technology and its impacts on jobs.[212] Building the training institutions necessary for developing important new technical skills to sufficiently support public sector technology use will take years, but it's a project the public sector could choose to undertake.[213] A focus on skills development could help address the stagnation of wages and growing inequality that is sometimes associated with expanded technology use in the workplace.[214] Consultants are seeing this opening and are already marketing programs for technology skill development.

Ideally both workers and clients should be in the room when employers are explaining problems or needs to a vendor. Analyses of the many failed UI modernization efforts have led to recommendations for centering workers through modernization committees that bring both workers and customers into the design process.[215]

Ensuring that technology brings productivity returns requires attention to the human contribution and interaction between workers and technologies.[216] Development and implementation of new technology uses needs to focus not just on the technology itself but on the "human-technology" interface: how algorithms or ADM results are used by human workers at the end of the process.[217] Too often, the ways that technologies will change how workers function—how they interact with clients, what skills they are using, what decisions they are making—are left out of technology planning. There are many examples of expensive technology projects that have failed because they were effectively unusable by workers.

Conclusion

Getting technology right in the public sector is a high stakes challenge. Many government processes determine fundamental quality of life issues: liberty versus incarceration, essential financial assistance, public safety, and custody of children. Governments also have access to enormous amounts of data; anything that puts citizen privacy at risk, or utilizes personal data in ways that promote distrust in government services, threatens the relationship between the public and its government. Cybersecurity threats and manipulation of data analysis to achieve political goals also pose challenges to legitimacy and confidence in government.

The relationship between the public sector and citizens rests on a foundational social compact: that the government will serve all people equitably, be available in times of crisis, and enable citizens to hold their government accountable to democratic decision-making. Used wisely, technology holds tremendous promise for strengthening the ability of governments to serve its citizens. Public sector workers are important stakeholders for ensuring that promise is fulfilled.

Endnotes

1 See e.g., Kevin C. Desouza, Gregory S. Dawson, and Daniel Chenok, "Designing, Developing, and Deploying Artificial Intelligence Systems: Lessons from and for the Public Sector," *Business Horizons* 63, no. 2 (March 2020): 206, https://doi.org/10.1016/j.bushor.2019.11.004.

2 Adam Seth Litwin, "Technological Change in Health Care Delivery" (UC Berkeley Center for Labor Research and Education and Working Partnerships USA, June 2020), https://laborcenter.berkeley.edu/technological-change-in-health-care-delivery/.

3 US Census Bureau, "2017 Census of Governments: Organization," Census.gov, 2017, https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html.

4 Congressional Research Service, "Federal Workforce Statistics Sources: OPM and OMB," June 28, 2022, https://sgp.fas.org/crs/misc/R43590.pdf.

5 Department of Defense, "About," U.S. Department of Defense, 2022, https://www.defense.gov/About/.

6 In 22 states, Walmart is the largest employer.

7 The List, "Top Public Sector Employers in Los Angeles," August 31, 2020, https://www.cbjonline.com/a2labj/lists/2020-PubSec.pdf; California State University, "CSU Workforce, Fall 2021," 2022, https://www.calstate.edu:443/csu-system/faculty-staff/employee-profile/csu-workforce.

8 All numbers here from 2011, 2019, and 2021 Bureau of Labor Statistics OEWS data.

9 Monthly employment data suggest that local education employment is recovering, as state budgets performed much better than expected and as federal stimulus money bolsters local education hiring, but those changes won't be reflected until the May 2022 data are released sometime in early 2023.

10 Katherine Schaeffer, "America's Public School Teachers Are Far Less Racially and Ethnically Diverse than Their Students," *Pew Research Center* (blog), December 10, 2021, https://www.pewresearch.org/fact-tank/2021/12/10/americas-public-school-teachers-are-far-less-racially-and-ethnically-diverse-than-their-students/.

11 Partnership for Public Service, "A Revealing Look at Racial Diversity in the Federal Government," *Fed Figures* (blog), July 14, 2020, https://ourpublicservice.org/blog/a-revealing-look-at-racial-diversity-in-the-federal-government/.

12 U.S. Census Bureau, "American Community Survey 1-Year Estimates Public Use Microdata Sample," 2019, https://data.census.gov/mdat/#/search?ds=ACSPUMS1Y2019&cv=RAC1P&rv=SOCP&nv=HISP%2801%29,COW%283,4,5%29&wt=PWGTP.

13 Alicia H Munnell et al., "Comparing Compensation: State-Local Versus Private Sector Workers," *Center for Retirement Research*, no. 20 (September 2011): 19.

14 Sylvia Allegretto, "The Teacher Pay Penalty Has Hit a New High: Trends in Teacher Wages and Compensation through 2021" (Economic Policy Institute, August 16, 2022), https://www.epi.org/publication/teacher-pay-penalty-2022/.

15 Mike Maciag, "Government Wage Growth Lags Private Sector by Largest Margin on Record," February 7, 2022, https://pew.org/3B5mwPd.

16 Monique Morrissey and Jennifer Sherer, "Unions Can Reduce the Public-Sector Pay Gap" (Economic Policy Institute, March 14, 2022), https://www.epi.org/publication/public-sector-pay-gap-co-va/.

17 Michael Madowitz, Anne Price, and Christian E. Weller, "Public Work Provides Economic Security for Black Families and Communities" (Center for American Progress, October 23, 2020), https://www.americanprogress.org/issues/economy/reports/2020/10/23/492209/public-work-provides-economic-security-black-families-communities/.

18 U.S. Census Bureau, "American Community Survey 1-Year Estimates Public Use Microdata Sample."

19 Madowitz, Price, and Weller, "Public Work Provides Economic Security for Black Families and Communities."

20 Bureau of Labor Statistics, "News Release: Union Members—2021," January 20, 2022, https://www.bls.gov/news.release/pdf/union2.pdf.

21 Daniel DiSalvo, "By the Numbers: Public Unions' Money and Members Since Janus v. AFSCME," April 2022, https://media4.manhattan-institute.org/sites/default/files/disalvo-public-unions-money-members-since-janus-v-afscme.pdf; Rebecca Rainey and Ian Kullgren, "1 Year After Janus, Unions Are Flush," *POLITICO*, May 17, 2019, https://www.politico.com/story/2019/05/17/janus-unions-employment-1447266; Ian Kullgren and Aaron Kessler, "Unions Fend Off Membership Exodus in 2 Years Since Janus Ruling," *Bloomberg Law*, June 26, 2020, https://news.bloomberglaw.com/daily-labor-report/unions-fend-off-membership-exodus-in-2-years-since-janus-ruling.

22 Milla Sanes and John Schmitt, "Regulation of Public Sector Collective Bargaining in the States," March 2014, 68.

23 Morrissey and Sherer, "Unions Can Reduce the Public-Sector Pay Gap."

24 Morrissey and Sherer.

25 Andrew B. Whitford et al., "The Adoption of Robotics by Government Agencies: Evidence from Crime Labs," *Public Administration Review* 80, no. 6 (2020): 976–88, https://doi.org/10.1111/puar.13301.

26 Thor Benson, "Self-Driving Buses to Appear on Public Roads for the First Time," *Inverse*, February 1, 2020, https://www.inverse.com/innovation/americas-first-self-driving-buses-are-coming-to-a-town-in-florida.

27 Jaagup Ainsalu et al., "State of the Art of Automated Buses," *Sustainability* 10, no. 9 (September 2018): 3118, https://doi.org/10.3390/su10093118; Kostas Mouratidis and Victoria Cobeña Serrano, "Autonomous Buses: Intentions to Use, Passenger Experiences, and Suggestions for Improvement," *Transportation Research Part F: Traffic Psychology and Behaviour* 76 (January 1, 2021): 321–35, https://doi.org/10.1016/j.trf.2020.12.007.

28 talkdesk, "4 Steps to Contact Center Digital Transformation for the Public Sector," 2021.

29 USDA, "Robotic Process Automation," 2022, https://www.usda.gov/rpa.

30 Innovation Committee, Chief Information Officers Council, "Robotic Process Automation in Federal Agencies," 2019, https://www.cio.gov/assets/resources/robotics-process-automation-whitepaper.pdf; Darrell M. West, "How Robotic Process and Intelligent Automation Are Altering Government Performance," *Brookings* (blog), November 15, 2021, https://www.brookings.edu/research/how-robotic-process-and-intelligent-automation-are-altering-government-performance/.

31 Oracle, "What Is a Chatbot?," 2022, https://www.oracle.com/chatbots/what-is-a-chatbot/.

32 City of Mesa, "Smart Government," 2022, https://www.mesaaz.gov/government/smart-city/smart-priorities/smart-government.

33 State of Ohio, "State of Ohio - Transforming Delivery of Health & Human Services through Robotics Process Automation," 2019, https://www.nascio.org/wp-content/uploads/2020/09/NASCIO-Awards-2019_State-of-OH-Bots.pdf.

34 Terry Ng, "Transform Your Teaching with a Chatbot," *California Teachers Association* (blog), August 13, 2021, https://www.cta.org/educator/posts/transform-teaching-with-chatbot.

35 Jack Corrigan, "IRS Turns to Automation Amid Shrinking Workforce," *Nextgov.Com*, April 8, 2019, https://www.nextgov.com/emerging-tech/2019/04/irs-turns-automation-amid-shrinking-workforce/156161/.

36 Stephanie Kanowitz, "IRS Deploys Bots to Streamline Procurement Processes," *GCN*, January 29, 2021, https://gcn.com/emerging-tech/2021/01/irs-deploys-bots-to-streamline-procurement-processes/315896/.

37 USDA, "Robotic Process Automation"; Patience Wait, "USDA's Bot Program Saves More Than 150,000 Hours Per Year," *Nextgov*, November 12, 2021, https://www.nextgov.com/emerging-tech/2021/11/usdas-bot-program-saves-more-150000-hours-year/186811/.

38 Digital.gov, "Federal RPA Use Case," 2022, https://digital.gov/pdf/federal-rpa-use-case-inventory-compliant.pdf.

39 Emily Nonko, "California's Streamlined SNAP App Pivots to Meet COVID-19 Demand," April 1, 2020, https://nextcity.org/urbanist-news/californias-streamlined-snap-app-pivots-to-meet-covid-19-demand.

40 Matt Langan, "Robotic Process Automation (RPA) at U.S. Citizenship and Immigration Services," *Government Technology Insider* (blog), June 17, 2021, https://governmenttechnology-insider.com/robotic-process-automation-rpa-at-u-s-citizenship-and-immigration-services/.

41 U.S. Citizenship and Immigration Services, "Meet Emma, Our Virtual Assistant | USCIS," 2018, https://www.uscis.gov/tools/meet-emma-our-virtual-assistant.

42 UIPath, "Processing SNAP Applications as Demand Ramps Up," 2022, https://www.uipath.com/resources/covid-automations/processing-snap-applications-as-demand-ramps-up.

43 Code for America, "Automatic Record Clearance," 2021, https://codeforamerica.org/programs/criminal-justice/automatic-record-clearance/.

44 Joseph Serna, "San Francisco Will Remove More than 9,300 Marijuana-Related Crimes from People's Records - Los Angeles Times," *Los Angeles Times*, February 25, 2019, https://www.latimes.com/local/lanow/la-me-ln-san-francisco-marijuana-expunged-crimes-code-20190225-story.html.

45 Julia Edinger, "Can Artificial Intelligence Help With 911 Staff Shortages?," *GovTech*, February 23, 2022, https://www.govtech.com/gov-experience/can-artificial-intelligence-help-with-911-staff-shortages.

46 Tajha Chappellet-Lanier, "How NASA's Shared Services Center Is Using Process Robotics," *FedScoop*, August 11, 2017, https://www.fedscoop.com/nasa-nssc-process-robotics/.

47 Patrick Thibodeau, "Trump 2020 Budget Calls for More RPA, Better CX," *SearchCIO*, March 12, 2019, https://www.techtarget.com/searchcio/news/252459328/Trump-2020-budget-calls-for-more-RPA-better-CX.

48 Petra Molnar, "Technological Testing Grounds: Migration Management Experiments and Reflections from the Ground Up," November 2020, 11, https://edri.org/wp-content/uploads/2020/11/Technological-Testing-Grounds.pdf.

49 See Rashida Richardson, "Defining and Demystifying Automated Decision Systems," *Maryland Law Review* 81, no. 3 (January 1, 2022): 785 for an explanation of algorithm versus AI and ADM.

50 William D. Eggers and Peter Viechnicki, "How Much Time and Money Can AI Save Government?" (Deloitte, April 2017), https://www2.deloitte.com/us/en/insights/focus/cognitive-technologies/artificial-intelligence-government-analysis.html.

51 See e.g., Desouza, Dawson, and Chenok, "Designing, Developing, and Deploying Artificial Intelligence Systems."

52 Eggers and Viechnicki, "How Much Time and Money Can AI Save Government?"

53 Emnet Almedom, Emnet Almedom, and Nandita Sampath, "Algorithms and Child Welfare: The Disparate Impact of Family Surveillance in Risk Assessment Technologies," *Berkeley Public Policy Journal*, February 2, 2021, https://bppj.berkeley.edu/2021/02/02/algorithms-and-child-welfare-the-disparate-impact-of-family-surveillance-in-risk-assessment-technologies/.

54 Casey Family Programs, "Predictive Analytics: Applications for Child Welfare," January 2015, https://www.sauerff.org/application/files/7015/4352/1686/Predictive_Analytics_Applications_for_Child_Welfare.pdf.

55 Julia Edinger, "Indiana Corrections Uses Software to Reduce Prison Assaults," *GovTech*, August 30, 2021, https://www.govtech.com/public-safety/indiana-corrections-uses-software-to-reduce-prison-assaults.

56 Eva Ruth Moravec, "Do Algorithms Have a Place in Policing?," *The Atlantic*, September 5, 2019, https://www.theatlantic.com/politics/archive/2019/09/do-algorithms-have-place-policing/596851/.

57 Stephen Goldsmith and Jane Wiseman, "Using Data Analytics to Curb the Billions We're Wasting in Our Jails," *GovTech*, June 23, 2016, https://www.govtech.com/data/Using-Data-Analytics-to-Curb-the-Billions-Were-Wasting-in-Our-Jails.html.

58 Time Simonite, "Algorithms Were Supposed to Fix the Bail System. They Haven't," *WIRED*, February 19, 2020, https://www.wired.com/story/algorithms-supposed-fix-bail-system-they-havent/.

59 Arnold Ventures, "Bail Reform," 2021, https://www.arnoldventures.org/work/release-decision-making.

60 Kashmir Hill, "Accused of Cheating by an Algorithm, and a Professor She Had Never Met," *The New York Times*, May 27, 2022, sec. Technology, https://www.nytimes.com/2022/05/27/technology/college-students-cheating-software-honorlock.html.

61 Jason A. Newfield, "What Happens When Your Claims Adjuster Is AI (Artificial Intelligence) Bot?," *Disability Lawyers | Frankel & Newfield* (blog), March 23, 2021, https://www.frankelnewfield.com/blog/what-happens-when-your-claims-adjuster-is-ai-artificial-intelligence-bot.shtml.

62 Benedict Carey, "Can an Algorithm Prevent Suicide?," *The New York Times*, November 23, 2020, sec. Health, https://www.nytimes.com/2020/11/23/health/artificial-intelligence-veterans-suicide.html.

63 Dana Chandler, Steven D. Levitt, and John A. List, "Predicting and Preventing Shootings among At-Risk Youth," *American Economic Review* 101, no. 3 (May 2011): 288–92, https://doi.org/10.1257/aer.101.3.288.

64 Adam Liptak, "Sent to Prison by a Software Program's Secret Algorithms," *The New York Times*, May 1, 2017, sec. U.S., https://www.nytimes.com/2017/05/01/us/politics/sent-to-prison-by-a-software-programs-secret-algorithms.html.

65 Emily Alpert Reyes, "Preventing Homelessness with Help from a Computer Model," *Los Angeles Times*, June 12, 2022, https://www.latimes.com/california/story/2022-06-12/homeless-prevention-unit.

66 Janet Holtzblatt and Alex Engler, "Machine Learning and Tax Enforcement" (Tax Policy Center, June 22, 2022), https://www.urban.org/sites/default/files/2022-06/Machine%20Learning%20and%20Tax%20Enforcement.pdf.

67 Himabindu Lakkaraju et al., "A Machine Learning Framework to Identify Students at Risk of Adverse Academic Outcomes" (KDD '15: The 21st ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, Sydney NSW Australia: ACM, 2015), 1909–18, https://doi.org/10.1145/2783258.2788620.

68 NASCIO, "Making the Case for Insight Enabling Analytics," September 2021, https://www.nascio.org/wp-content/uploads/2021/09/NASCIO_InsightEnablingAnalytics_Sep2021.pdf.

69 Yu-Che Chen and Michael J. Ahn, eds., *Routledge Handbook on Information Technology in Government* (New York: Routledge, 2017), https://doi.org/10.4324/9781315683645.

70 Ruth Puttick, Lisa Mae Fiedler, and Jennifer Park, "Diffusion of Data-Driven Practices: How the Opinion Leading U.S. Cities Are Advancing the Use of Data in Local Government," *State and Local Government Review* 54, no. 1 (March 1, 2022): 52–67, https://doi.org/10.1177/0160323X221088017.

71 Roberta Fasiello, William C. Rivenbark, and Carmine Bianchi, "Exploring the Shift from Output Measures to Outcome Measures of Service Delivery: Insights from Municipal Research," *Public Performance & Management Review* 45, no. 2 (March 4, 2022): 428–47, https://doi.org/10.1080/15309576.2021.1988648.

72 Matt Williams, "L.A. County, IBM to Develop Data Sharing Portal for Child Welfare Investigations," *GovTech*, May 24, 2017, https://www.govtech.com/data/LA-County-IBM-to-Develop-Data-Sharing-Portal-for-Child-Welfare-Investigations.html; Erika M Kitzmiller, "IDS Case Study: Los Angeles County," January 2014.

73 Puttick, Fiedler, and Park, "Diffusion of Data-Driven Practices."

74 Richardson, "Defining and Demystifying Automated Decision Systems."

75 Jessica Mulholland, "Single Platform Data System Serves All San Francisco Area Homelessness Outreach Professionals," *GovTech*, June 8, 2017, https://www.govtech.com/health/Single-Platform-Data-System-Serves-All-San-Francisco-Area-Homelessness-Outreach-Professionals.html.

76 Blaine Corren, "Courts Using Data to Improve Services," *California Courts Newsroom*, June 15, 2022, https://newsroom.courts.ca.gov/news/courts-using-data-improve-services; Jessica Renee Napier, "Data Analytics Helps Bexar County, Texas, Reduce Inmate Population, Save Millions," *GovTech*, August 3, 2016, https://www.govtech.com/data/Data-Analytics-Helps-Bexar-County-Texas-Reduce-Inmate-Population-Save-Millions.html.

77 Hameed Ahsan, "Transforming Data with Platform-as-a-Service" (Government Technology, 2022).

78 Sandford Borins et al., *Digital State at the Leading Edge*, *Digital State at the Leading Edge* (University of Toronto Press, 2016), https://doi.org/10.3138/9781442685468.

79 eRepublic, "Virtual Call Center Streamlines Public Assistance for Alaskans," A Government Technology Case Study, 2022, https://media.erepublic.com/document/GT22_CASE_STUDY_Genesys_Alaska_V.pdf.

80 Claire Galligan et al., "Cameras in the Classroom: Facial Recognition Technology in Schools" (University of Michigan, August 25, 2020), https://stppstage.fordschool.umich.edu/sites/stpp/files/2021-07/cameras_in_the_classroom_full_report.pdf.

81 Zoë Corbyn, "The Future of Elder Care Is Here – and It's Artificial Intelligence," June 3, 2021, https://www.theguardian.com/us-news/2021/jun/03/elder-care-artificial-intelligence-software.

82 See Stephen Goldsmith, Betsy Gardner, and Jill Jamieson, "Toward a Smarter Future: Building Back Better with Intelligent Civil Infrastructure -- Smart Sensors and Self-Monitoring Civil Works" (Cambridge Mass.: Ash Center for Democratic Governance and Innovation, Harvard Kennedy School, September 2021), https://ash.harvard.edu/publications/toward-smarter-future-building-back-better-intelligent-civil-infrastructure-smart.

83 See e.g., Molnar, "Technological Testing Grounds: Migration Management Experiments and Reflections from the Ground Up."

84 Daniel Oberhaus, "ICE Modified Its 'Risk Assessment' Software So It Automatically Recommends Detention," *Vice*, June 26, 2018, https://www.vice.com/en/article/evk3kw/ice-modified-its-risk-assessment-software-so-it-automatically-recommends-detention.

85 Matt Stroud, "An Automated Policing Program Got This Man Shot Twice," *The Verge*, May 24, 2021, https://www.theverge.com/c/22444020/heat-listed-csk-entry.

86 Garance Burke et al., "How AI-Powered Tech Landed Man in Jail with Scant Evidence," *AP News*, March 5, 2022, https://apnews.com/article/artificial-intelligence-algorithm-technology-police-crime-7e3345485aa668c97606d4b54f9b6220?utm_source=Stanford+HAI&utm_campaign=1b78e2c689-Mailchimp_HAI_Newsletter_September+2021_1&utm_medium=email&utm_term=0_aaf04f4a4b-1b78e2c689-63637067.

87 Skip Descant, "Las Vegas Uses Smart Network to Monitor Park Activity," *GovTech*, October 11, 2021, https://www.govtech.com/fs/las-vegas-uses-smart-network-to-monitor-park-activity.

88 See e.g., Dovid Coplon, "Red Light Camera and Other Automated Enforcement," Text, SFMTA (San Francisco Municipal Transportation Agency, September 20, 2017), https://www.sfmta.com/getting-around/drive-park/red-light-camera-and-other-automated-enforcement.

89 Justin Fox, "One Tool to Cut Racism in Policing: Traffic Cameras," *Bloomberg*, July 10, 2020, https://www.bloomberg.com/opinion/articles/2020-07-10/red-light-and-speed-cameras-could-cut-down-on-police-stops; Megan Cassidy and Susie Neilson, "S.F. May Limit When Police Can Pull over Drivers to Fight Racial Profiling. Will It Make the City Less Safe?," *San Francisco Chronicle*, October 7, 2022, sec. Crime, https://www.sfchronicle.com/crime/article/SF-police-traffic-stops-17492666.php.

90 Kristin Toussaint, "Cameras and Smart Design Could Make Safer Streets than Police," *Fast Company*, June 29, 2020, https://www.fastcompany.com/90520217/instead-police-randomly-enforcing-traffic-laws-cameras-and-smart-design-could-make-safer-streets; Transportation Alternatives, "The Case for Self-Enforcing Streets," June 2020, https://static1.squarespace.com/static/5cab9d9b65a707a9b36f4b6c/t/5eec1235fe73d720da412589/1592529462229/CaseForSelfEnforcingStreets.pdf.

91 Fox, "One Tool to Cut Racism in Policing: Traffic Cameras."

92 Ángel Díaz and Rachel Levinson-Waldman, "Automatic License Plate Readers: Legal Status and Policy Recommendations for Law Enforcement Use" (Brennan Center for Justice, September 10, 2020), https://www.brennancenter.org/our-work/research-reports/automatic-license-plate-readers-legal-status-and-policy-recommendations.

93 J. D. Fletcher, "The Value of Digital Tutoring and Accelerated Expertise for Military Veterans," *Educational Technology Research and Development* 65, no. 3 (June 1, 2017): 679–98, https://doi.org/10.1007/s11423-016-9504-z.

94 Brandon Paykamian, "Online Tutoring Platform TutorMe Gains Popularity in K-12," *GovTech*, February 2, 2022, https://www.govtech.com/education/k-12/online-tutoring-platform-tutorme-gains-popularity-in-k-12.

95 Gillian Diebold and Chelsea Han, "How AI Can Improve K-12 Education in the United States" (Center for Data Innovation, April 2022).

96 Sigmund Tobias, J. Dexter Fletcher, and Fei Chen, "Digital Games as Educational Technology: Promise and Challenges in the Use of Games to Teach," *Educational Technology* 55, no. 5 (2015): 3–12.

97 Brandon Paykamian, "WPI Researchers Developing AI to Provide Homework Feedback," *GovTech*, August 9, 2021, https://www.govtech.com/education/higher-ed/wpi-researchers-developing-ai-to-provide-homework-feedback; Cade Metz, "Can A.I. Grade Your Next Test?," *The New York Times*, July 20, 2021, sec. Technology, https://www.nytimes.com/2021/07/20/technology/ai-education-neural-networks.html.

98 Diebold and Han, "How AI Can Improve K-12 Education in the United States."

99 Gökhan Akçapınar et al., "Developing an Early-Warning System for Spotting at-Risk Students by Using EBook Interaction Logs," *Smart Learning Environments* 6, no. 1 (May 10, 2019): 4, https://doi.org/10.1186/s40561-019-0083-4.

100 Katharine Meyer et al., "Let's Chat: Chatbot Nudging for Improved Course Performance," *EdWorkingPapers.Com* (Annenberg Institute at Brown University, April 21, 2022), https://www.edworkingpapers.com/ai22-564.

101 Richardson, "Defining and Demystifying Automated Decision Systems."

102 Ora Tanner, "Parents and Students Deserve Answers on the State's Massive 'Safety Portal' Database," *Tampa Bay Times*, August 15, 2019, https://www.tampabay.com/opinion/2019/08/15/parents-and-students-deserve-answers-on-the-states-massive-safety-portal-data-base-column/.

103 Winnie Ma Bekmanis, "Qualcomm Education-as-a-Service: Transforming the Digital and Hybrid Classroom and Campus Experience," December 5, 2021, https://www.qualcomm.com/news/onq/2021/12/qualcomm-education-service-transforming-digital-and-hybrid-classroom-and-campus.

104 Bjarne Corydon, Vidhya Ganesan, and Martin Lundqvist, "Digital by Default: A Guide to Transforming Government" (McKinsey Center for Government, November 2016).

105 Jeffrey C. Steinhoff, Andrew C. Lewis, and Kirke E. Everson, "March of the Robots," *Journal of Government Financial Management*, Spring 2018.

106 Sharon Dawes, Peter Bloniarz, and Kristine L. Kelly, "Some Assembly Required: Building a Digital Government for the 21st Century" (Albany N.Y.: Center for Technology in Government, 1999).

107 National Research Council, *Information Technology Research, Innovation, and E-Government* (Washington, D.C: National Academy Press, 2002), 3. and McKinsey 2016 (p. 3)

108 Whitford et al., "The Adoption of Robotics by Government Agencies."

109 Sara Hinkley, "Public Sector Impacts of the Great Recession and COVID-19" (UC Berkeley Labor Center, October 21, 2020), https://laborcenter.berkeley.edu/public-sector-impacts-great-recession-and-covid-19/.

110 James N. Danziger, "Computer Technology and the Urban Fiscal Crisis," *Urban Systems* 2, no. 2 (January 1, 1977): 105–19, https://doi.org/10.1016/0147-8001(77)90009-2.

111 Corydon, Ganesan, and Lundqvist, "Digital by Default: A Guide to Transforming Government," p.5.

112 Donald Cohen and Allen Mikaelian, *The Privatization of Everything: How the Plunder of Public Goods Transformed America and How We Can Fight Back* (New York: The New Press, 2021).

113 Sonal Ambegaokar, Zoë Neuberger, and Dorothy Robsenbaum, "Opportunities to Streamline Enrollment Across Public Benefit Programs" (Center on Budget and Policy Priorities, November 2, 2017), https://www.cbpp.org/research/poverty-and-inequality/opportunities-to-streamline-enrollment-across-public-benefit; Amy Finkelstein and Matthew J Notowidigdo, "Take-Up and Targeting: Experimental Evidence from SNAP," *The Quarterly Journal of Economics* 134, no. 3 (August 1, 2019): 1505–56, https://doi.org/10.1093/qje/qjz013; Kelly M. Purtell, Elizabeth T. Gershoff, and J. Lawrence Aber, "Low Income Families' Utilization of the Federal 'Safety Net': Individual and State-Level Predictors of TANF and Food Stamp Receipt," *Children and Youth Services Review* 34, no. 4 (April 1, 2012): 713–24, https://doi.org/10.1016/j.childyouth.2011.12.016.

114 Virginia Eubanks, "A Child Abuse Prediction Model Fails Poor Families," *Wired*, January 15, 2018, https://www.wired.com/story/excerpt-from-automating-inequality/.

115 Nextgov, "Working Smarter Not Harder: Automation Tackles Fraud, Waste, and Abuse," June 14, 2021, https://www.nextgov.com/feature/working-smarter-not-harder/.

116 SAS Institute Inc., "Uncovering Social Service Fraud Saves Millions, Reinforces Public Trust," 2022, https://www.sas.com/en_us/customers/la-county-dpss.html.

117 Brian Heaton, "Child-Care Fraud Detected in Los Angeles County Using Data Analytics," *Governing*, May 17, 2012, https://www.governing.com/archive/gt-child-care-fraud-detected-in-los-angeles-county-using-analytics.html; Miriam Jones, "Los Angeles County Uses Analytics to Stop Child-Care Fraud," *GovTech*, May 16, 2012, https://www.govtech.com/health/Los-Angeles-County-Uses-Analytics-to-Stop-Child-Care-Fraud.html.

118 Hana Schank et al., *Power to the Public: The Promise of Public Interest Technology* (Princeton: Princeton University Press, 2021), https://muse.jhu.edu/book/81957.

119 Consumer Financial Protection Bureau, "Federal Regulators Fine Bank of America $225 Million Over Botched Disbursement of State Unemployment Benefits at Height of Pandemic," July 14, 2022, https://www.consumerfinance.gov/about-us/newsroom/federal-regulators-fine-bank-of-america-225-million-over-botched-disbursement-of-state-unemployment-benefits-at-height-of-pandemic/.

120 See Schank et al., *Power to the Public*, for several examples.

121 See e.g., Frank K. Y. Chan et al., "Service Design and Citizen Satisfaction with E-Government Services: A Multidimensional Perspective," *Public Administration Review* 81, no. 5 (2021): 874–94, https://doi.org/10.1111/puar.13308.

122 Viktor Mayer-Schönberger and David Lazer, *Governance and Information Technology from Electronic Government to Information Government* (Cambridge, MA: MIT Press, 2007).

123 Alana Semuels, "Millions of Americans Have Lost Jobs in the Pandemic — And Robots and AI Are Replacing Them Faster Than Ever," *Time*, August 6, 2020, https://time.com/5876604/machines-jobs-coronavirus/.

124 Lauren Hepler, "Amid California's Unemployment Crisis, a Tech Gold Rush," *CalMatters*, April 5, 2021, http://calmatters.org/economy/2021/04/california-unemployment-crisis-contracts/.

125 Adobe Government Forum, "Preparing State and Local Government for the Future of Work," https://adobegovforum.govexec.com/session/preparing-state-and-local-government-for-the-future-of-work/.

126 United States Office of Personnel Management, "2021 Guide to Telework and Remote Work in the Federal Government" (Washington D.C., November 2021).

127 Daniel Stewart, "The Court Is Now in (Virtual) Session: How Remote Services Are Transforming the Judicial System," *Route Fifty*, March 30, 2021, https://www.route-fifty.com/public-safety/2021/03/remote-services-are-transforming-judicial-system/173029/.

128 U.S. Digital Service, "The Digital Services Playbook," 2022, https://playbook.cio.gov/.

129 See e.g., Robert Dalpé, "Effects of Government Procurement on Industrial Innovation," *Technology in Society* 16, no. 1 (January 1, 1994): 65–83, https://doi.org/10.1016/0160-791X(94)90021-3.

130 U.S. Congress, "Government Paperwork Elimination Act" (1998), https://www.cio.gov/handbook/it-laws/gpea/.

131 General Accounting Office and David L. McClure, "Electronic Government Opportunities and Challenges Facing the FirstGov Web Gateway" (Washington D.C., October 2, 2000), https://www.govinfo.gov/content/pkg/GAOREPORTS-GAO-01-87T/pdf/GAOREPORTS-GAO-01-87T.pdf.

132 Will Hurd, "Modernizing Government Technology Act of 2017," H.R. 2227 § (2017); Mick Mulvaney, "Implementation of the Modernizing Government Technology Act" (Office of Management and Budget, February 27, 2018).

133 Government Accountability Office, "Technology Modernization Fund: Implementation of Recommendations Can Improve Fee Collection and Proposal Cost Estimates" (Washington D.C., December 2021), https://www.gao.gov/assets/gao-22-105117.pdf; The Technology Modernization Fund, "American Rescue Plan: Guidelines on the American Rescue Plan Funding," 2022, https://tmf.cio.gov/arp/.

134 General Services Administration, "Organizational Transformation: Low-Value to High-Value Services," 2018, https://www.gsa.gov/cdnstatic/CAPGoal6GSACFOCaseStudyFINAL_rev.pdf; General Services Administration, "Shifting from Low-Value to High-Value Work," January 2021, https://www.performance.gov/CAP/low-value-to-high-value-work/.

135 American Technology Council, "Report to the President on IT Modernization," 2017, https://www.cio.gov/assets/resources/Report-to-the-President-on-IT-Modernization-Final.pdf.

136 President Biden, "Executive Order on Transforming Federal Customer Experience and Service Delivery to Rebuild Trust in Government," December 13, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/13/executive-order-on-transforming-federal-customer-experience-and-service-delivery-to-rebuild-trust-in-government/.

137 This mission of modernization and service improvement is also carried forward by legislative committees and specific federal agencies. The House Committee on Government Oversight & Reform, Subcommittee on Government Operations has held hearings on the technology workforce, artificial intelligence, and the modernization of veterans' records. Other federal agencies play a central role in the adoption and regulation of technology in government: the General Services Administration, Office of Management and Budget (which includes the Office of E-Government and Information Technology), Office of Personnel Management, and the National Artificial Intelligence Advisory Committee (NAIAC), under the Department of Commerce. The Office of Science and Technology Policy has a task force on the use of AI.

138 Sarah Chaney, "Amazon, Google Help States as Coronavirus Boosts Unemployment Claims," *Wall Street Journal*, May 12, 2020, sec. Politics, https://www.wsj.com/articles/amazon-google-help-states-as-coronavirus-boosts-unemployment-claims-11589275801.

139 Julia Simon-Mishel et al., "Centering Workers—How to Modernize Unemployment Insurance Technology," September 17, 2020.

140 "From Disrepair to Transformation: How to Revive Unemployment Insurance Information Technology and Infrastructure" (Washington D.C., July 15, 2020), https://www.nelp.org/publication/from-disrepair-to-transformation-how-to-revive-unemployment-insurance-information-technology-infrastructure/; Natalie Alms, "States Need to Invest in Their Unemployment Systems, Labor Secretary Says," *Route Fifty*, June 22, 2022, https://www.route-fifty.com/health-human-services/2022/06/states-need-invest-unemployment-systems-labor-secretary-tells-congress/368473/; U.S. Congress, "Unemployment Insurance Technology Modernization Act of 2021," S. 490 § (2021), https://www.congress.gov/bill/117th-congress/senate-bill/490/text?q=%7B%22search%22%3A%5B%22actionCode%3A%5C%2210000%5C%22%22%5D%7D&r=62&s=1.

141 Simon-Mishel et al., "Centering Workers—How to Modernize Unemployment Insurance Technology."

142 Elizabeth Castillo, "It's Been a Mess for Decades. Can Gov. Newsom Fix the State's Technology?," *CalMatters*, June 20, 2019, http://calmatters.org/economy/2019/06/newsom-digital-innovation-budget-technology/.

143 Mayor's Press Office, "Mayor Lightfoot Announces a New, Coordinated Approach to Technology," Press Release, June 23, 2022, https://www.chicago.gov/content/city/en/depts/mayor/press_room/press_releases/2022/june/CoordinatedApproachToTechnology.html.

144 Partnership for New York City, "Transit Tech Lab," Transit Innovation Partnership, 2022, https://transitinnovation.org/lab.

145 National Research Council, *Information Technology Research, Innovation, and E-Government*.

146 In some cases, this has included enabling commercial actors to offer government services directly (for example, private companies like TurboTax can file customers' taxes directly with the IRS).

147 For more on outsourcing see Rachel Augustine Potter, "Macro Outsourcing: Evaluating Government Reliance on the Private Sector," *The Journal of Politics* 84, no. 2 (April 2022), https://www-journals-uchicago-edu.libproxy.berkeley.edu/doi/full/10.1086/716295.

148 Blackboard Inc., "Blackboard Launches Center for Advancing Learning" (Reston, VA, July 20, 2021), https://www.prnewswire.com/news-releases/blackboard-launches-center-for-advancing-learning-301337637.html.

149 eRepublic, "Government Technology State & Local Articles," GovTech, 2022, https://www.govtech.com/.

150 Thomas Kurlan, "Announcing Google Public Sector," *Google Cloud Blog* (blog), June 28, 2022, https://cloud.google.com/blog/topics/public-sector/announcing-google-public-sector/.

151 Whitford et al., "The Adoption of Robotics by Government Agencies."

152 Julie Pattison-Gordon, "How States, Localities Are Looking to Spend Federal IT Funds," *GovTech*, March 7, 2022, https://www.govtech.com/computing/how-states-localities-are-looking-to-spend-federal-it-funds.

153 "Public Service for the 21st Century: Innovative Solutions to the Federal Government's Technology Workforce Crisis" (Washington, D.C., July 31, 2001).

154 SEIU Local 1000, "Information Technology Outsourcing Is the State's $2.5 Billion Addiction," July 2017, https://www.seiu1000.org/notification/information-technology-outsourcing-states-25-billion-addiction.

155 Schank et al., *Power to the Public*.

156 General Accounting Office, "Broadband: National Strategy Needed to Guide Federal Efforts to Reduce Digital Divide," May 2022, https://www.gao.gov/assets/gao-22-104611.pdf?utm_source=sendgrid&utm_medium=email&utm_campaign=Newsletters.

157 Darrell M. West, *Digital Government: Technology and Public Sector Performance* (Princeton: Princeton University Press, 2011), https://muse.jhu.edu/book/30013.

158 Corey Kewei Xu and Tian Tang, "Closing the Gap or Widening the Divide: The Impacts of Technology-Enabled Coproduction on Equity in Public Service Delivery," *Public Administration Review* 80, no. 6 (2020): 962–75, https://doi.org/10.1111/puar.13222.

159 NASCIO, "State CIO as Broker: A New Model," 2018, https://www.nascio.org/wp-content/uploads/2019/11/NASCIO_StateCIOasBrokerModel.pdf.

160 Cassandra Kirsch, "Navigating the Challenges of IT Procurement," July 2014, 2.

161 National Association of State Procurement Officials, "2018 Survey of State Procurement Practices," 2018, https://www.naspo.org/wp-content/uploads/2019/12/2018-FINAL-Survey-Report_6-14-18.pdf; National Association of State Procurement Officials, "2020 Survey of State Procurement Practices," *NASPO* (blog), 2020, https://www.naspo.org/research-innovation/publications/survey-state-procurement-practices/.

162 David Autor, David A. Mindell, and Elisabeth B. Reynolds, "The Work of the Future: Building Better Jobs in an Age of Intelligent Machines" (The MIT Press, November 17, 2020), https://doi.org/10.7551/mitpress/14109.001.0001.

163 Abigail Gilbert et al., "Case for Importance: Understanding the Impacts of Technology Adoption on 'Good Work'" (Institute for the Future of Work, May 2022).

164 Eggers and Viechnicki, "How Much Time and Money Can AI Save Government?"

165 Marcus Dillender and Eliza Forsythe, "Computerization of White Collar Jobs," Working Paper, Working Paper Series (National Bureau of Economic Research, March 2022), https://doi.org/10.3386/w29866.

166 Dillender and Forsythe, 7.

167 Dillender and Forsythe, "Computerization of White Collar Jobs."

168 Daniel Castro, "How Artificial Intelligence Will Usher in the Next Stage of E-Government," *GovTech*, December 2016, https://www.govtech.com/opinion/How-Artificial-Intelligence-Will-Usher-in-the-Next-Stage-of-E-Government.html.

169 PAI Staff, "What Workers Say About Workplace AI: In Conversation With PAI's Stephanie Bell," *Partnership on AI* (blog), May 26, 2022, https://partnershiponai.org/what-workers-say-about-workplace-ai/.

170 Andrea Bernstein, "Can an Algorithm Predict Child Abuse? LA County Child Welfare Officials Are Trying to Find Out," *KPCC - NPR News for Southern California - 89.3 FM*, January 13, 2015, https://www.kpcc.org/2015-01-13/can-an-algorithm-predict-child-abuse-la-county-chi.

171 Lester Parrott and Iolo Madoc-Jones, "Reclaiming Information and Communication Technologies for Empowering Social Work Practice," *Journal of Social Work* 8, no. 2 (April 1, 2008): 181–97, https://doi.org/10.1177/1468017307084739.

172 Eggers and Viechnicki, "How Much Time and Money Can AI Save Government?," 12.

173 Albert Meijer, Lukas Lorenz, and Martijn Wessels, "Algorithmization of Bureaucratic Organizations: Using a Practice Lens to Study How Context Shapes Predictive Policing Systems," *Public Administration Review* 81, no. 5 (2021): 837–46, https://doi.org/10.1111/puar.13391.

174 Richardson, "Defining and Demystifying Automated Decision Systems," 802–3.

175 Devansh Saxena et al., "A Human-Centered Review of the Algorithms Used within the U.S. Child Welfare System" (arXiv, March 7, 2020), http://arxiv.org/abs/2003.03541.

176 Emily Keddell, "Algorithmic Justice in Child Protection: Statistical Fairness, Social Justice and the Implications for Practice," *Social Sciences* 8, no. 10 (October 8, 2019): 281, https://doi.org/10.3390/socsci8100281.

177 See e.g., Aiha Nguyen, "The Constant Boss: Work Under Digital Surveillance" (Data & Society, May 2021), https://datasociety.net/wp-content/uploads/2021/05/The_Constant_Boss.pdf.

178 Eric Katz, "Agency Threatens Discipline After Monitoring Employee Computer Logs and Alleging Telework Non-Productivity," *Government Executive*, September 9, 2021, https://www.govexec.com/workforce/2021/09/agency-threatens-discipline-after-monitoring-employee-computer-logs-and-alleging-telework-non-productivity/185236/.

179 Lewis Silkin, "Algorithms in the Workplace – the Rise of Algorithmic Management — Future of Work Hub," *Futureofworkhub* (blog), July 26, 2021, https://www.futureofworkhub.info/comment/2021/7/26/algorithms-in-the-workplace-the-rise-of-algorithmic-management-hcd4f.; Medwell, "When the Algorithm Is Your Boss," *Tribune*, January 30, 2022, https://tribunemag.co.uk/2022/01/amazon-algorithm-human-resource-management-tech-worker-surveillance.

180 See e.g., Parrott and Madoc-Jones, "Reclaiming Information and Communication Technologies for Empowering Social Work Practice."

181 Karen Levy and Solon Barocas, "Privacy at the Margins| Refractive Surveillance: Monitoring Customers to Manage Workers," *International Journal of Communication* 12, no. 0 (March 1, 2018): 23.

182 Potter, "Macro Outsourcing: Evaluating Government Reliance on the Private Sector"; See e.g., Cohen and Mikaelian, *The Privatization of Everything*.

183 W.E. Upjohn Institute, "Public Sector," Outsourcing: Impacts on the U.S. Workforce, 2020, https://www.upjohn.org/major-initiatives/outsourcing-impacts-us-workforce/research/public-sector.

184 For wage comparison in California see SEIU Local 1000, "The State's $2.5 Billion Addiction," July 2017, https://www.seiu1000.org/notification/information-technology-outsourcing-states-25-billion-addiction.

185 Patrick Thibodeau, "West Virginia's IT Workers Fight State Outsourcing," *Computerworld*, September 1, 2010, https://www.computerworld.com/article/2515312/west-virginia-s-it-workers-fight-state-outsourcing.html.

186 See e.g., Brian Darrow and SEIU Local 1000, "Evaluation of Outsourcing in the Public Sector," 2005, for examples, https://www.inthepublicinterest.org/wp-content/uploads/Evaluation_of_Outsourcing_in_the_Public_Sector.pdf.

187 Christine Leitner and Christian M. Stiefmueller, "Disruptive Technologies and the Public Sector: The Changing Dynamics of Governance," in *Public Service Excellence in the 21st Century*, ed. Alikhan Baimenov and Panos Liverakos (Singapore: Springer, 2019), 261, https://doi.org/10.1007/978-981-13-3215-9_8.

188 Brishen Rogers, "The Law and Political Economy of Workplace Technological Change," *Harvard Civil Rights - Civil Liberties Law Review* 55, no. 2 (Summer 2020), https://harvardcrcl.org/vol-55-no-2-summer-2020/.

189 Schank et al., *Power to the Public*.

190 Schank et al.

191 Julia Angwin et al., "Machine Bias: There's Software Used across the Country to Predict Future Criminals. And It's Biased against Blacks.," *ProPublica*, May 23, 2016, https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing.

192 See e.g., Richardson, "Defining and Demystifying Automated Decision Systems."

193 Andrew Van Dam, "Algorithms Were Supposed to Make Virginia Judges Fairer. What Happened Was Far More Complicated.," *Washington Post*, November 19, 2019, https://www.washingtonpost.com/business/2019/11/19/algorithms-were-supposed-make-virginia-judges-more-fair-what-actually-happened-was-far-more-complicated/.

194 Automated Decision Systems Task Force, "New York City Automated Decision Systems Task Force Report" (New York, N.Y., November 2019), https://www1.nyc.gov/site/adstaskforce/index.page.

195 Government Accountability Office and Candace N. Wright, "Facial Recognition Technology: Federal Agencies' Use and Related Privacy Protections" (Washington D.C., June 29, 2022), https://www.gao.gov/assets/gao-22-106100.pdf.

196 Miriam Jones, "Nobody Wins in Indiana vs. IBM Lawsuit, Judge Says," *GovTech*, July 19, 2012, https://www.govtech.com/health/Nobody-Wins-in-Indiana-vs-IBM-Lawsuit-Judge-Says.html.

197 Center for Technology Innovation at Brookings, "Operationalizing Responsible AI," https://www.brookings.edu/events/operationalizing-responsible-ai/.

198 Stephan Grimmelikhuijsen, "Explaining Why the Computer Says No: Algorithmic Transparency Affects the Perceived Trustworthiness of Automated Decision-Making," *Public Administration Review* n/a, no. n/a (February 9, 2022), https://doi.org/10.1111/puar.13483.

199 Jennifer Cobbe, Michelle Seng Ah Lee, and Jatinder Singh, "Reviewable Automated Decision-Making: A Framework for Accountable Algorithmic Systems," in *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency*, FAccT '21 (New York, NY, USA: Association for Computing Machinery, 2021), 598–609, https://doi.org/10.1145/3442188.3445921.

200 Tendai Makasi et al., "Chatbot-Mediated Public Service Delivery: A Public Service Value-Based Framework," *First Monday*, November 5, 2020, https://doi.org/10.5210/fm.v25i12.10598.

201 Makasi et al., 15.

202 Michele Loi et al., "Automated Decision-Making Systems in the Public Sector: An Impact Assessment Tool for Public Authorities" (Algorithm Watch, June 2021).

203 Washington State Legislature, "An Act Relating to Establishing Guidelines for Government Procurement and Use of Automated Decision Systems in Order to Protect Consumers, Improve Transparency, and Create More Market Predictability.," Pub. L. No. SB 5116 (2021), https://app.leg.wa.gov/billsummary?BillNumber=5116&Year=2021&Initiative=false#-billhistorytitle.

204 World Economic Forum, "Guidelines for AI Procurement," September 2019, https://www3.weforum.org/docs/WEF_Guidelines_for_AI_Procurement.pdf.

205 See e.g., Edward Markey et al., "Letters to Federal Agencies on Clearview AI," February 9, 2022, https://pressley.house.gov/sites/pressley.house.gov/files/Letters%20to%20Federal%20Agencies%20on%20Clearview%20AI.pdf.

206 New York City Council, "The New York City Council - File #: Int 1696-2017," Pub. L. No. 2018/049 (2018), https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3137815&GUID=437A6A6D-62E1-47E2-9C42-%20461253F9C6D0.

207 Gilbert et al., "Case for Importance: Understanding the Impacts of Technology Adoption on 'Good Work.'"

208 Lisa Kresge, "Union Collective Bargaining Agreement Strategies in Response to Technology" (UC Berkeley Labor Center, November 2020), https://laborcenter.berkeley.edu/wp-content/uploads/2022/01/Working-Paper-Union-Collective-Bargaining-Agreement-Strategies-in-Response-to-Technology-v2.pdf.

209 Morrissey and Sherer, "Unions Can Reduce the Public-Sector Pay Gap"; Malkie Wall and David Madland, "11 Things State and Local Governments Can Do to Build Worker Power," February 9, 2021, https://www.americanprogress.org/article/11-things-state-local-governments-can-build-worker-power/.

210 Rogers, "The Law and Political Economy of Workplace Technological Change," 536.

211 Rogers, "The Law and Political Economy of Workplace Technological Change."

212 Enzo Falco et al., "User Acceptance of Technology: Statistical Analysis of Training's Impact on Local Government Employees' Perceived Usefulness and Perceived Ease-of-Use," *International Journal of Electronic Government Research (IJEGR)* 16, no. 3 (July 1, 2020): 85–104, https://doi.org/10.4018/IJEGR.2020070105.

213 OECD, "The OECD Framework for Digital Talent and Skills in the Public Sector," OECD Working Papers on Public Governance, vol. 45, OECD Working Papers on Public Governance, April 22, 2021, https://doi.org/10.1787/4e7c3f58-en.

214 James Bessen, "Toil and Technology: Innovative Technology Is Displacing Workers to New Jobs Rather than Replacing Them Entirely," *Finance & Development* 0052, no. 001 (February 27, 2015): 18, https://doi.org/10.5089/9781498351942.022.A007.

215 Simon-Mishel et al., "Centering Workers—How to Modernize Unemployment Insurance Technology."

216 Gilbert et al., "Case for Importance: Understanding the Impacts of Technology Adoption on 'Good Work.'"

217 Madalina Busuioc, "Accountable Artificial Intelligence: Holding Algorithms to Account," *Public Administration Review* 81, no. 5 (2021): 825–36, https://doi.org/10.1111/puar.13293.

Institute for Research on Labor and Employment
University of California, Berkeley
2521 Channing Way
Berkeley, CA 94720-5555
(510) 642-0323
laborcenter.berkeley.edu

UC Berkeley Center for Labor Research and Education

The Center for Labor Research and Education (Labor Center) is a public service project of the UC Berkeley Institute for Research on Labor and Employment that links academic resources with working people. Since 1964, the Labor Center has produced research, trainings, and curricula that deepen understanding of employment conditions and develop diverse new generations of leaders.