

**EVOLVING WORKFORCE DYNAMICS AND THE
CHALLENGES FOR DEFENSE ACQUISITION AND
DEFENSE INDUSTRIAL BASE**

HEARING

BEFORE THE

**COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE**

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EVOLVING WORKFORCE DYNAMICS AND THE CHALLENGES FOR DEFENSE ACQUISITION AND DEFENSE INDUSTRIAL BASE

WEDNESDAY FEBRUARY 28, 2024

UNITED STATES SENATE,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

The Committee met, pursuant to notice, at 9:31 a.m., in room 216, Hart Senate Office Building, Senator Jack Reed (Chairman of the Committee) presiding.

Committee Members present: Senators Reed, Shaheen, Blumenthal, Hirono, Kaine, King, Warren, Peters, Rosen, Kelly, Wicker, Fischer, Ernst, Sullivan, Scott, Tuberville, Mullin, Budd, and Schmitt.

OPENING STATEMENT OF SENATOR JACK REED

Chairman REED. Good morning. The Committee meets today to receive testimony on evolving workforce dynamics and challenges for defense acquisition and defense industrial base personnel.

This Committee has spent several years examining the various challenges for our defense acquisition system. We have worked to identify supply chain problems, to pinpoint shortages in critical materials, and to improve investments in long lead items for our weapons systems.

However, there is nothing more important for our defense acquisition strategy than our workforce, the men and women of the Defense Acquisition Corps, and the personnel in the defense industrial base whom they helped to guide and oversee. We cannot solve our acquisition problems without an adequate supply of skilled and trained workers.

This challenge is spread through many sectors of our defense industrial base and in many geographic areas. From my own Rhode Island perspective, I often see the workforce challenges facing the submarine industrial base and the textile industry.

These sectors each have their own unique hiring challenges, but those are further exacerbated by widespread competition for talent among Federal agencies, between the Federal Government and the private sector, and even between the defense industrial base and the rest of the commercial sector.

During today's hearings, we will take a step back to better understand the broader dynamics at play and consider how the Department of Defense (DOD) can or should adapt its hiring and retention processes to try to address these challenges. Until we thor-

oughly identify and understand the changes happening in the broader workforce, we will not be able to properly meet them.

Many of the defense workforce strains are related to demographic changes as more Millennial and Generation Z workers enter the workforce, and many of our baby boomers, who have been the backbone of the defense workforce for decades, begin to exit in greater numbers.

The younger generations have different demands and expectations of their employers than previous generations, especially in the post-COVID landscape. I am concerned that the Department has not fully recognized this evolution and has not fully adapted its talent management practices as a result.

The sources of these labor challenges are diverse. Two-thirds of Americans who lost their full time job during the pandemic say they are only somewhat active, or not very active at all, in searching for a new job.

About half are not willing to take jobs that do not offer the opportunity for remote work, and we know that younger Americans are prioritizing their personal growth over searching for a job, with many saying that they are more focused on acquiring new skills, education, or training before reentering the job market.

To discuss these issues and help us better understand how the Department of Defense can adapt its hiring and retention policies, I would like to welcome our distinguished panel of witnesses. Mr. Johnny Taylor is the President and CEO of the Society for Human Resources Management (SHRM).

Mr. Taylor's career spans more than 20 years as a lawyer, human resources (HR) executive, and CEO in both the profit and not for profit sector. He is a global leader on the future of employment, workplace culture, and leadership. Dr. Simon Johnson is the Ronald A. Kurtz Professor of Entrepreneurship at the MIT Sloan School of Management.

He is the co-author of the book, *Jumpstarting America, How Breakthrough Science Can Revive Economic Growth and the American Dream*. Dr. Johnson was previously a senior fellow at the Peterson Institute for International Economics, a member of the Congressional Budget Office's Panel of Economic Advisers, and a member of the Financial Research Advisory Committee of the U.S. Treasury Office of Financial Research.

Dr. Julie Lockwood is the Director of Business Modernization at the Institute for Defense Analysis, or IDA. An economist with expertise in labor, health, and computational economics, Dr. Lockwood built and led the Human Capital Group within IDA, a team of researchers that used data analytics, machine learning, and applied econometrics to address Department of Defense personnel and readiness issues.

We are grateful to have such an accomplished panel of experts with us to discuss this important issue. Thank you again to our witnesses, and we certainly look forward to your testimony. Let me now recognize Ranking Member Wicker.

OPENING STATEMENT OF SENATOR ROGER WICKER

Senator WICKER. Thank you, Mr. Chairman. The Department of Defense employs more than 700,000 civilians who is sure that our

military personnel are capable of performing their mission. Their mission is to deter and win wars to protect our national security.

For this reason, the Armed Services Committee takes a special interest in ensuring that the Department of Defense has every tool necessary to build a civilian workforce that is capable, innovative, and dedicated to keeping our country safe. The basic principles of building an effective workforce are simple.

The Department of Defense needs to be able to hire the best people quickly and pay them what they are worth. But if an employee does not meet expectations, the Department needs to be able to dismiss that employee and find someone better. Unfortunately, the laws and regulations governing the Department of Defense workforce are anything but simple and efficient.

Hiring takes too long even when Congress provides accelerated direct hiring authority. Pay is often inadequate, especially in trade provisions such as welders and electricians who maintain the Navy's nuclear powered submarines and carriers.

The Department also does not pay competitive salaries for jobs that require extensive formal education, and everyone knows how hard it is to terminate an underperforming employee. Those who have spent any length of time in the Pentagon have a story of an underperforming colleague who was shuffled around to various offices to get him out of the way.

Similarly, most know a truly exceptional performer who left the Department of Defense in search of better rewards for her hard work. The status quo is unacceptable, and the evidence is everywhere we look.

Our public shipyards struggle to attract skilled trade workers. The Navy is hemorrhaging the civilian mariners, whose work ensures the delivery of critical supplies around the world to the rest of the fleet. We cannot hire or retain enough doctors or nurses to staff our military hospitals.

Cyber professionals leave the Department of Defense in droves to join other Government agencies or the private sector. I could go on. The unique mission of the Department of Defense demands that Congress provides it exceptional authorities to allow the Department to build the civilian workforce needed to support our warfighters.

The system that governs every other Federal agency is inadequate for our national defense workforce. Numerous bipartisan commissions and our military's senior leaders agree. I hope we can use this year's National Defense Authorization Act to provide legislative tools to achieve the basic principles of an effective civilian workforce.

I would ask the witnesses to help us understand the weaknesses of the Department's current human resource system. But more importantly, I hope the witnesses can tell us what we can do to make the Department of Defense a more competitive employer. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Wicker. Mr. Taylor, please begin.

**STATEMENT OF JOHNNY C. TAYLOR, JR., PRESIDENT AND
CHIEF EXECUTIVE OFFICER, SOCIETY FOR HUMAN RE-
SOURCE MANAGEMENT**

[Technical problems.]

Mr. WICKER.—the state of the workforce. Thank you. SHRM empowers people and workplaces by advancing human resources practices and maximizing human potential. We are 75 years old this year, and we have been the trusted authority on all things work, workers, and the workplace.

Our nearly 340,000 H.R. professionals across the globe represent nearly 362 million workers and their families in 180 countries. A few weeks ago, SHRM released its state of the workplace report, which focused on the challenges employers faced in 2023 and the critical issues we expect that they will face in 2024 and beyond. The report looks at four key areas which impact the workplace.

First, balancing inflation and talent challenges. Yes, we want to pay our people more, but somehow the consumer is pushing back increasingly on paying more for services and goods. Trading and evolving workforce. Indeed, both Chairman Reed and Ranking Member Wicker spoke to the challenges of for the first time we have five generations in the workplace at once and they have significantly different needs.

Third, we looked at realizing the full potential of artificial intelligence (AI). Quite the debate these days, and I will spend more time in my introductory comments addressing that, and then we are struggling with engaging workers.

So, it is just not enough to have the bodies there, but to engage them is yet a significant challenge. I would like to talk for just a minute about key findings from our report. One is inflation was the top concern for organizations in 2023, and not just general inflation, but indeed wage inflation.

Seventy-three percent of H.R. professionals indicated that this is their current number one concern. We want the talent, we want to pay them, but we have got to figure out how to do so. Second, labor shortages.

They were the number two issue in 2023. We have already somewhere between 8, 9, 10, 11 million open jobs at any given time, and that has created a major concern for organizations. More than two-thirds of employers have said we simply can't find enough people.

There are labor shortages, and then we do need to reduce the cost and increase efficiencies. I will talk a little bit more about how that has directly led to adoption of AI and other technologies.

Nearly 9 in 10 workers believe fair compensation from current employees, including the Government, the Department of Defense, for example, should be the top priority for organizations in 2024, yet only 27 percent of H.R. executives say this is their top priority. So, a major disconnect.

A quarter of H.R. Departments are currently using artificial intelligence applications for specific purposes, such as recruiting talent, employee training, and development. So, in 2024, we expect that number will significantly be increased.

Finally, improving people managers, that is, the people leaders understanding of their roles and developing more of their what we call soft skills, their not so soft power skills such as empathy.

Top organizational priorities for 2024 are all about not just getting the talent but retaining the talent. What our data tells us overwhelmingly is that 60 percent or more of employees leave not the employer, but their manager, their people manager, and thus the challenge for us.

So, let's talk about the labor shortages that we are all seeing and are specifically impacting the Department of Defense. H.R. Departments are being compelled to strategize to solve for the labor shortages with a market that does not want to respond in traditional ways. A key focus in the past was increase salary and that will help you attract talent. Well, what we know about the younger generation is that doesn't necessarily work.

Our data will tell us that employees will say they will actually leave an employer for less money, to go make less money if they get to work for a more empathetic leader. This is the reality of Generation Z and Millennials, and something we have to take into consideration at the Department of Defense.

The Department of Defense can greatly benefit by retraining and retaining officers and enlisted personnel who leave the military and are having difficulty finding work in the private sector. This is a significant conversation in the private sector world, I can tell you, is how do we create opportunities?

How do we translate the experiences of people who have come from the military and from the Department of Defense into private sector jobs? But that creates an opportunity for the DOD, because, in fact, you might consider keeping those people. But returning alone is not enough.

We need to train them and train these employees to be more adaptable, because in today's rapidly changing world, adaptability is paramount, and SHRM research indicates that over 31 percent of organizations are modifying the recruitment strategies, including enhancing social media presence, advertising, and employee referrals.

So, in summary, got a lot more to tell you, but SHRM's testimony today underscores several pivotal areas where organizations can concentrate their efforts to attract, retain, and empower the workforce.

Very quickly, adopt skills based hiring, invest in retention, leverage apprenticeship programs, modernize talent management processes. This is, Mr. Wicker, Senator Wicker, a real challenge for the Government, and we need to invest in people managers, upskill and reskill the workforce, create a culture of learning.

The employees want this. They don't want to take the job and know the job for 30 years and then retire. Create AI responsibly. It is not enough to just enable the technology, but to do so responsibly, and then to focus on human and machine collaboration. At SHRM, we speak a lot about AI plus HR (human resources) will equal the new ROI.

So, it is not a sum zero game for employees. We have got to embrace this technology and we think there are huge opportunities for the Department of Defense. Thank you.

[The prepared statement of Mr. Johnny C. Taylor follows:]



Written Testimony of Johnny C. Taylor, Jr.
President & CEO
SHRM

Submitted to the
Senate Armed Services Committee

Evolving Workforce Dynamics and the Challenges for Defense Acquisition and Defense Industrial Base Personnel

Wednesday, February 28, 2024

Introduction

Chairman Jack Reed, Ranking Member Roger Wicker, and Senate Armed Services Committee members thank you for the opportunity to testify on the state of the workforce.

SHRM empowers people and workplaces by advancing HR practices and maximizing human potential. For 75 years, we have been the trusted authority on all things work, workers, and the workplace. Our nearly 340,000 HR professionals and executive members touch the lives of over 362 million workers and their families in 180 countries.

A few weeks ago, SHRM released its [2023-2024 State of the Workplace Report](#), focusing on the challenges employers and workers faced in 2023 and the key issues they foresee confronting them in the future. The report looks at four existing critical issues and future challenges in the workplace:

1. Balancing inflation and talent challenges.
2. Training an evolving workforce.
3. Realizing the full potential of Artificial Intelligence.
4. Struggles with engaging workers.

Key Trends and Challenges

The 2023-2024 SHRM *State of the Workplace* report highlights several key findings:

- **Inflation:** Inflation was the top concern for organizations in 2023, with 73 percent of HR professionals indicating it as a current concern. Organizations expect inflation to remain a

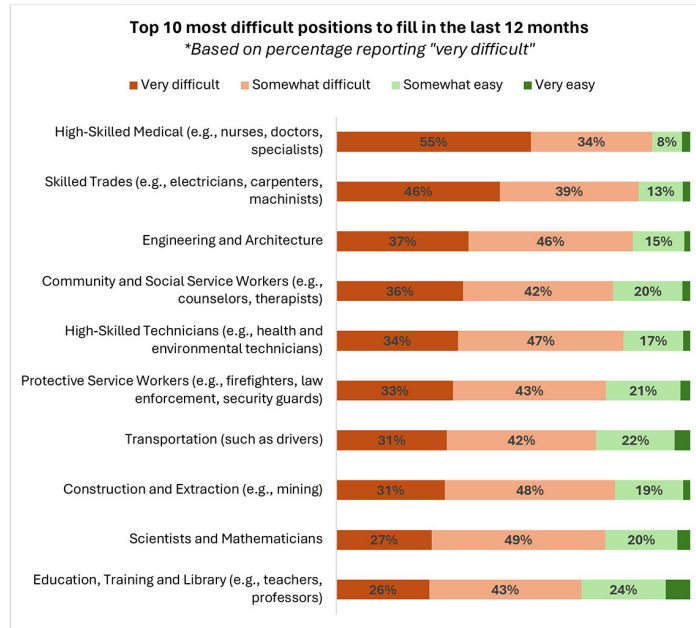
challenge in 2024, impacting hourly/nonexempt employees (82 percent of HR professionals identified this concern), salaried/exempt employees (69 percent), and customers/consumers (67 percent).

- **Labor Shortages:** Labor shortages were another major issue in 2023, with 65 percent of organizations expressing concern.
- **Cost Reduction and Efficiency:** Reducing costs and increasing efficiencies is a top priority for organizations in 2024, cited by 68 percent of HR professionals. However, only 31 percent of HR professionals say their organizations were extremely or very effective at finding ways to reduce costs and increase efficiencies in 2023.
- **Compensation:** Nearly 9 in 10 U.S. workers (87 percent) believe fair compensation for current employees should be the top priority for organizations in 2024. Yet only 27 percent of HR executives say they factor inflation into annual pay raises.
- **Artificial Intelligence (AI):** A quarter of HR departments currently use AI applications for specific purposes such as recruitment and employee training and development. Plans for 2024 reveal steady AI adoption in more organizations.
- **People Management:** Improving people managers' understanding of their roles and developing their soft skills (such as empathy) are top plans for 2024 (both selected by 76 percent of HR professionals). Organizations can build better managers by developing skills in coaching and mentoring, effective communication, performance management, conflict resolution, and strategic thinking.

Recruitment Challenges

- Seventy-seven percent of organizations report difficulty recruiting for full-time regular positions in the last 12 months. While this is a decrease from 91 percent in 2022, recruiting difficulties remain of deep concern.
- Forty-seven percent of HR professionals say it has been somewhat (39.1 percent) or much more difficult (8 percent) for their organization to recruit for full-time regular positions compared to one year ago.
- The top three reasons for recruitment challenges are a low number of applicants (60 percent), competition from other employers (55 percent), and an increase in "ghosting" (46 percent).

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 2024 Talent Trends, SHRM Research, 2024.
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The Changing Face of Leadership, People + Strategy Journal Summer 2023 Issue, SHRM Research, 2023.
Perspectives on Effective People Management, EN: Insights Forum, SHRM Research, 2023.
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An Unanticipated Retirement Wave Is Happening Right Now in the U.S., SHRM.org, 2024.



Retention Challenges

- Nearly half (49 percent) of organizations have had difficulty retaining full-time regular employees in the last 12 months.
- The top five reasons for retention challenges are salaries/pay not competitive for the market (56 percent), employees' personal reasons (54 percent), poor people managers/leaders (50 percent), limited advancement opportunities (49 percent), and the inability to offer flexible work arrangements, such as remote work (44 percent).
- For organizations **not** experiencing retention challenges, the top reasons are a positive workplace culture (70 percent), competitive benefits packages (68 percent), positive work-life

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integration/balance (61 percent), salaries/pay that is competitive for the market (58 percent), and good people managers/leaders (54 percent).

Skills Availability

- 1 in 4 (26 percent) HR professionals report that some of the full-time regular positions hired by their organization in the last 12 months have required new skills to fulfill new job duties.
- 3 in 4 report that it has been somewhat (62 percent) or very difficult (14 percent) to find qualified individuals for these positions that require new skills.
- The top three reasons organizations require new skills are the growth of the organization (55 percent), changing technology (51 percent), and developing or offering new products/services (41 percent).
- Among HR professionals whose organizations hired full-time regular positions in the last 12 months that required new skills, 44 percent say these positions required new workplace soft skills (e.g., problem-solving, interpersonal skills, communication, teamwork).

Modernization: Navigating the Changing Landscape

SHRM is a longstanding pioneer in predicting workplace trends and equipping organizations for perpetually evolving work environments. In 2024, HR departments are implementing several strategies to enhance recruitment:

- They are expanding their search to more diverse and underutilized talent pools, including people with disabilities and formerly incarcerated individuals (62 percent).
- Utilizing pre-employment tests or assessments to identify qualified candidates (35 percent).
- Relaxing education/degree requirements (28 percent).

However, due to ongoing labor shortages, HR departments are being compelled to strategize about workforce management more effectively. A key focus is on supporting the existing workforce before recruiting new talent.

Organizations must evolve beyond traditional hiring practices, which often emphasize qualifications and experience, and adopt skills-based hiring principles. This approach broadens the talent pool, uncovering overlooked talent, such as veterans, military spouses, and caregivers, by prioritizing skills acquired through various experiences, certifications, competency assessments, or nontraditional learning platforms.

In today's rapidly changing world, adaptability is paramount. SHRM research indicates that over 31 percent of organizations are modifying their recruitment strategies, including enhancing social media presence, advertising, and employee referrals. Approximately 20 percent are adopting new HR technologies or upskilling their HR professionals to improve recruitment and hiring processes in this new

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environment. HR executives rank strategic thinking and adaptability among their top five most effective behaviors sought in their talent.

A commitment to communicating potential career paths and development opportunities is an incredibly effective retention strategy. Opportunities for growth within the workplace are a prominent factor in employees' overall mental well-being, and they directly affect decisions to remain with a current employer rather than look elsewhere. According to HR Professionals surveyed in the *State of the Workplace*, the top three priorities for organizations in 2024 are maintaining employee morale and engagement (81 percent), retaining top talent (78 percent), and finding and recruiting talent with the necessary skills (70 percent). Workers outside of HR had two additional top priorities:

1. Providing fair compensation for current employees. *
2. Maintaining employee morale and engagement.
3. Providing good health care coverage. *
4. Retaining top talent.
5. Finding and recruiting talent with the necessary skills.

In 2024, organizations must include these targeted initiatives to address talent needs strategically:

1. **Training and development for people managers remains vital.** HR managers say that people managers are essential to their organization's overall success (92 percent) and accomplishing their organization's strategic objectives (82 percent).
2. **Upskilling/reskilling current employees is a high priority.** Upskilling or reskilling the current workforce is a top priority for 53 percent of organizations.
3. **Succession planning and mentoring receive attention.** For 49 percent of organizations, succession planning is a top priority.

Investing in employee knowledge development also reduces skills gaps and increases productivity. Leadership development, performance management, mentorship and coaching, and continuous learning opportunities are good strategies to bolster employee development. Employers should also look at career pathing programs that clearly outline the different career paths available in the organization and the skills and experience required at each level. Employees must also be encouraged and given opportunities to move between different roles and departments to develop a dynamic skill set. This approach is particularly effective in bolstering retention efforts. Additionally, providing employees access to career development websites, skills assessments, and job shadowing opportunities can help them explore different pathways and discover hidden strengths and interests.

It's also vital to leverage and reinforce existing strengths to attract and retain workers. Organizations must be innovative to prepare for and respond to potential economic pressures. A good starting point is benefits packages. SHRM research shows that 60 percent of HR professionals believe providing affordable and comprehensive healthcare coverage is the most effective incentive, and 35 percent plan to enhance leave and flexibility policies – cost-effective ways to increase employee engagement. However, there's room for improvement. In 2023, employee mental health was a primary concern for HR professionals. Yet only 35

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percent felt their organizations effectively supported employees in this regard, suggesting a communications gap regarding existing resources and needs.

Creating and maintaining a positive workplace culture, civility, and an inclusive work environment is another solution to current organizational challenges. A respectful and inclusive work environment is crucial for employee morale and engagement. Fifty-eight percent of HR professionals said their organizations were effective or very effective in ensuring a civil and respectful workplace in 2023. U.S. workers also noted civility as an area of high organizational effectiveness. On the other hand, while 90 percent of HR professionals report having had mostly positive interactions with co-workers, only 67 percent of U.S. workers said the same.

Interestingly, 94 percent of working American civilians have considered Google as a potential employer, while only 46 percent have considered the Department of Defense (DOD). The primary reason cited was a lack of knowledge about the DOD's culture or employer brand. Most civilian workers in the DOD choose to work there because they get to do innovative things and care about the mission of securing the Nation. However, these key factors are rarely promoted as part of the DOD civilian workforce's mission. Given that the DOD employs more than 900,000 civilian roles, this represents a missed opportunity to enhance its civilian employment brand and talent.

In recent years, the DOD has taken positive steps to address these challenges, build a stronger partnership with the Office of Personnel Management, leverage data-driven methods to develop an enterprise-wide set of cultural guiding principles, and modernize talent management processes.

Striking a Balance: Employee Needs and Organizational Mission and Values

A well-defined culture rooted in shared values and guiding principles is the cornerstone of healthy employee engagement, retention, and mission success. Leadership is key, and HR managers must comprehend their roles and responsibilities. According to SHRM's "Changing the Face of Leadership" report, employees rank accountability, transparency, mentorship, inspiration, and empathy as the top five leadership behaviors they wish to see in their organization's leaders. Exceptional leaders are characterized by inspiration, innovation, empowerment, empathy, and advocacy. Notably, over 45 percent of employees have higher expectations of their organizational leaders now than they did seven years ago.

To effectively balance the needs of employees across an organization with diverse sectors and occupations, it's crucial for HR leaders to understand the different segments of their workforce. Creating personas is a strategic approach to identifying these segments and accounting for the unique needs and challenges pertinent to each. Clear and open communication is a must to achieve this. Leaders are expected to articulate the organization's goals and challenges while empowering employees to express their needs or concerns. Implementing collaborative solutions such as internal task forces, workshops, educational opportunities, or employee-led initiatives can be effective tools to address trends that emerge. Maintaining a balance between equitable treatment and tailoring for employee segments is an ongoing process that necessitates continuous evaluation, adaptation, and communication. Investing in employees is essential as engaged employees contribute to higher productivity, innovation, and loyalty.

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Investing in effective people managers is a critical aspect of any organizational success. HR managers affirm that people managers are integral to their organization's overall success (92 percent) and in achieving their organization's strategic objectives (82 percent). Insights from SHRM's "Perspectives on Effective People Management" suggest that effective people managers significantly influence overall performance, well-being (mental health, stress, exhaustion), professional development, and commitment to the organization. Organizations can cultivate better managers by developing skills in coaching and mentoring, effective communication, performance management, conflict resolution, and strategic thinking. Inadequate investment in enhancing people manager effectiveness is a missed opportunity. HR executives who report their organizations make adequate investments in manager development are significantly more likely to say their people managers are effective (88 percent) than those who say their organization makes inadequate investments in this area (63 percent).

Artificial Intelligence (AI) is another critical area that supports HR-related functions. Organizations are leveraging AI for talent acquisition to streamline the recruitment process, generate job descriptions, review, and screen resumes, communicate with applicants, and identify the best talent. These technologies assist hiring managers in analyzing candidates, enhancing the quality of candidate pools and hires, and reducing the time it takes to fill positions.

Apprenticeships

Apprenticeships are valuable tools for developing a skilled workforce and closing the skills gap. These programs help employers build programs that tap into diverse talent pipelines, such as veterans, military spouses, caregivers, and individuals without four-year degrees.

- Among organizations that currently provide work in conjunction with a registered or a customized (i.e., non-registered) apprenticeship program, **nearly half (48 percent)** plan to expand their use of apprenticeship programs over the next five years.
 - In contrast, among those organizations that do **not** currently provide work in conjunction with an apprenticeship program, **only 9 percent** plan to start an apprenticeship program over the next five years.
- Among HR professionals whose organizations provide work in conjunction with a registered or a customized (i.e., non-registered) apprenticeship program, **over 3 in 4** say these programs have been somewhat (54 percent) or very (24 percent) effective at addressing their organization's talent shortages.
- The top four reasons why organizations **don't** provide work in conjunction with apprenticeship programs include:
 - Staffing limitations (37 percent)
 - An unclear return on investment (34 percent)
 - Time constraints (27 percent)
 - They wouldn't know where to start (22 percent)

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HR Technology Advancements

The excitement over generative AI in the workplace is palpable. As companies rush to implement generative AI capabilities, understanding the technology's potential to deliver value will help shape critical decisions. Businesses must maximize ROI, stay competitive in a digital landscape, and manage workforce transformations amidst the greatest technology shift of this generation. To realize the most value from generative AI, people across the spectrum of work – from applicants to employees to managers – leaders need to understand how to:

Manage disruption and empower innovation. Work is where markets, people, and disruptive technologies intersect with the intelligence of humans at the heart of the workplace. As generative AI becomes more integrated into our daily lives, we will learn how to unlock potential, spark innovation, and discern our unique human qualities from AI.

Augment the power of people to drive the world forward. To flourish in the AI era, we must rethink work, workers, and workplaces—reimagining a world of work where the intelligence and ingenuity of people are augmented, not replaced.

Engender a culture of change and invest in human catalysts. Studies show human catalysts are key to successful AI integrations. Organizations must invest in their people to empower the mindsets, skill sets, and toolsets to drive thriving, responsible workplace transitions.

SHRM's research shows that private-sector employers are already embracing the possibilities of AI in the workplace. **One in four** organizations already use AI to support HR-related activities; however, **nearly two in three** only began using it for this purpose within the past year. The top three areas where organizations are using AI to support HR-related activities include recruitment, interviewing and hiring (64 percent), learning and development (43 percent), and performance management (**25 percent**).

SHRM's 2024 *Talent Trends* survey found most HR professionals are optimistic about the potential for AI to benefit their organization. **Three in four** agree that advancements in AI will increase the importance of HI in the workplace over the next five years. Over **60 percent** are optimistic about the potential for the effective use of AI, and **56 percent** are optimistic about its potential to improve collaboration in their organization.

The use of AI in the workforce development process is more efficient and profitable than traditional methods. For example, 36 percent of those surveyed said it allows them to make more data-driven decisions related to their learning and development offerings, and 33 percent said it has reduced the costs associated with learning and development activities.

While embracing generative AI is a business imperative, it's essential to approach its adoption responsibly. Addressing ethical considerations, ensuring transparency, and providing proper training are crucial aspects of a successful AI integration strategy. Critically, AI is helping employers avoid biases during the hiring process. When technological developments eclipse the speed of government, SHRM is not standing pat waiting for legislation or guidance – we lead the way in shaping best practices that fit

2023-2024 *State of the Workplace*, SHRM Research, 2024.
2024 *Talent Trends*, SHRM Research, 2024.
Defense Business Board – Talent Management, Culture & Diversity Subcommittee, *Building A Civilian Pipeline*, 2023.
The Changing Face of Leadership, People + Strategy Journal Summer 2023 Issue, SHRM Research, 2023.
Perspectives on Effective People Management, EN: Insights Forum, SHRM Research, 2023.
Artificial Intelligence in HR, 2024 *Talent Trends*, SHRM Research, 2024.
CHRO Business Outlook: Optimism on the Rise Amid Challenging Conditions, SHRM Research, 2023.
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within existing legal frameworks and support appropriate application in the world of work. HR is working with policymakers to establish guardrails and standards to protect individuals and employers.

We see a future where the synergy of artificial intelligence and human intelligence paves the way for a workforce that is not only efficient but truly empowered. **When combined with human intelligence (HI), this synergy has the capacity to transform organizations while maximizing human potential. AI + HI = ROI.**

The role of the CHRO (Chief Human Resource Officer) and HR teams has never been more critical. As automation and AI augmentation become more prevalent, HR must focus on reskilling and upskilling initiatives to ensure that employees have the skills necessary to thrive in a technology-driven workplace and ensure continuous learning.

The Future of Work

Labor shortages are forecast to persist for years. According to the World Bank, the number of people of working age in the US will decline by over 3 percent over the next decade. The Bureau of Labor Statistics (BLS) estimates our Labor Participation Rate will drop to 60.4 percent in 2030. A recent Federal Reserve Bank of St. Louis report found that “[t]he U.S. has about 2.7 million more retirees than predicted,” an 80 percent increase from six months ago.

People are retiring faster than new workers are entering the workforce to replace them. The aging of the Baby Boomers would have been felt even more acutely by now, except that people are working longer than they once did. Today, 41 percent of Americans expect to work past age 65, a Bain & Company study found. Thirty years ago, just 12 percent did.

With not enough new workers to replace those leaving, employers are increasingly cognizant of the need to look at retaining and attracting older workers. By 2030, roughly 40 percent of adults aged 65 to 69 are expected to still be in the workforce, according to the BLS. That’s up from 33 percent in 2020. This means there will be more older employees at workplaces soon, and their specific needs should be on employers’ minds.

One of the most effective and least-utilized solutions to close labor gaps is reaching untapped talent pools: those workers who may not be in the standard consideration set when businesses seek talent due to perceived barriers related to one or more demographic characteristics. These previously untapped talent pools include veterans, military spouses and caregivers, workers over 60, disabled workers, those with a criminal record, and non-student unemployed youth. For employers to remain competitive, bringing untapped talent to the forefront of recruitment and hiring will be paramount.

Our modern, skills-based economy demands new strategies and approaches to meet hiring and retention needs. SHRM and its members see firsthand the challenge of filling jobs in today’s labor market, which is why we have been leading the way in providing resources on using skills-based hiring and skill credentials to acquire top talent. To that end, HR departments are evolving to adapt skills-based hiring practices. To level set, let’s first answer what skills-based hiring is and why it is essential today. Skills-

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based hiring goes beyond education and experience requirements to focus on the skills match between candidates and roles.

Such practices can offer instant economic opportunities for millions of job seekers, help relieve talent shortages, increase diversity, and strengthen internal mobility in the workplace. Skills-based hiring becomes a talent acquisition solution for the skills gap and a talent shortage, especially today, as the United States is facing a talent shortage expected to persist for years. Furthermore, 82 percent of HR executives and 80 percent of HR professionals agree that labor shortages are the second most significant external challenge facing workplaces. Skills-based hiring is about ensuring that people have a chance to showcase their skills and qualifications. This can be as simple as employers looking at skills listed on a resume, or it can consist of more formal skills assessments. Skills-based hiring can be achieved by hiring entities that recognize skilled credentials and proper use of skills assessments. The SHRM Foundation, the 501(c)(3) nonprofit affiliate of SHRM, has prioritized educating employers about using skill credentials in talent acquisition through the SHRM Foundation's Skilled Credentials at Work Initiative.

Businesses miss talented people every day because their gifts, aptitudes, and skills are more challenging to identify than a degree on a resume. Skills-based hiring recognizes the abilities of all workers, regardless of where these skills are obtained. SHRM and the SHRM Foundation are committed to educating HR leaders and people managers about skills-based hiring to ensure that all learning paths are granted weight in assessing whether a person can thrive in a job. SHRM looks forward to partnering with Congress to increase knowledge, reduce barriers, and support work, workers, and workplaces transitioning toward a skills-based hiring and retention mindset.

Conclusion/Recommendations

Again, thank you to the Senate Armed Services Committee for the opportunity to share SHRM's thought leadership and insights on the critical issues facing the American workforce. As we navigate the rapidly changing landscape, addressing talent shortages, fostering a positive workplace culture, and leveraging emerging technologies are the keys to building a future of work. The evolving workplace landscape presents many challenges and opportunities, and the private and public sectors, including the Department of Defense (DOD), are no exception. SHRM's testimony underscores several pivotal areas where organizations can concentrate efforts to attract, retain, and empower the workforce:

Talent Acquisition and Retention

- **Adopt skills-based hiring:** Prioritize the skills and qualifications necessary for the role, irrespective of traditional education and experience prerequisites. This approach unveils untapped talent pools such as veterans, military spouses, and older workers.
- **Invest in retention:** Place employee engagement at the forefront and address concerns like compensation, work-life balance, and career development opportunities.
- **Leverage apprenticeship programs:** Broaden existing programs and contemplate partnering with other organizations to establish new ones, particularly for in-demand skills.

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- **Modernize talent management processes:** Employ data-driven strategies and harness technology to enhance efficiency and effectiveness.

Employee Development and Empowerment

- **Invest in people managers:** Offer training and development opportunities to equip managers with the skills to coach, mentor, and support their teams effectively.
- **Upskill and reskill the workforce:** Provide continuous learning opportunities to ensure employees possess the skills and knowledge needed to excel in the evolving workplace.
- **Create a culture of learning:** Foster a growth mindset and provide employees with the resources and support needed to advance their careers.
- **Embrace AI responsibly:** Utilize AI tools for recruitment, learning, and other HR functions while ensuring ethical considerations and transparency.
- **Focus on human-machine collaboration:** Acknowledge the value of human intelligence and synergize it with AI to enhance performance and innovation.

Additional Considerations

- **Support skills-based hiring policies:** Advocate for policies facilitating access to skilled workers from diverse backgrounds.
- **Partner with SHRM:** Collaborate with SHRM to leverage resources, best practices, and expertise in navigating the changing workplace landscape.

Implementing these recommendations will help employers construct a robust and resilient workforce equipped to confront the challenges of today and the future. It's imperative to remember that attracting and retaining talent is a continuous process that necessitates ongoing evaluation, adaptation, and investment. By prioritizing the needs of its employees and embracing innovative approaches, private and public sector employers can ensure a competitive and thriving workforce. This commitment to the workforce will enhance operational effectiveness and contribute to competitiveness and the need to meet global challenges.

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Chairman REED. Thank you, Mr. Taylor. Dr. Johnson, please.

STATEMENT OF SIMON H. JOHNSON, RONALD A. KURTZ 1954 PROFESSOR OF ENTREPRENEURSHIP, MASSACHUSETTS IN- STITUTE OF TECHNOLOGY SLOAN SCHOOL OF MANAGE- MENT

Dr. JOHNSON. Thank you, Senator. I would like to make three points. The first is about a term I fear you are going to hear in-

creasingly, which is stranded expertise. It is a term being used in the tech sector to refer to the impact of AI in particular.

But of course, it is not a new problem. We have been facing issues with expert people, people who spent a lot of time acquiring education and training, losing opportunities and being left behind. These have been a problem since at least the wave of automation. We have experienced that in the 1980s.

The shock of Chinese imports from the early 2000, exacerbated this. In the age of AI, I think we are going to be seeing much more of this, and of course, it is overlaid, Senator Reed, with some of the issues we have talked about in terms of the demographics. I would also highlight the shift of innovation away from the historical dispersion of the United States toward the East and West Coast.

Of course, from a broader social, economic point of view, this is a problem. But my second point is that this is actually an opportunity for the Department of Defense and a way to think about responding to the problems both you, Senator Reed and Senator Wicker already flagged. Because the key point is that innovation and technology develops and is maintained in particular geographies, around hubs, and we used to have a lot of hubs that were very dynamic in the United States.

Now we have fewer, but that can be addressed. The analysis we did suggests there is over 100 urban areas in 36 states where 80 million Americans live that are ripe for stepping up to become fantastic places for exactly the kind of problems that you are trying to solve and address on this Committee.

So, there is potentially available labor. So, there are already skills. There is no doubt some retraining needed and some repositioning. Of course, one of the problems with apprenticeship programs in the United States, one of the reasons the private sector doesn't, frankly speaking, love them is they are afraid that if once you train a worker, that worker leaves and goes to work for a competitor.

But if the goal is to strengthen the defense industrial base and if people are sticking, because we have all become less mobile, modern Americans are much less mobile than our predecessors. Then if you are training people in a particular area to work on submarines, for example, or to acquire welding skills and electrical skills that are relevant to the submarine business, and they leave to a related enterprise in that area, you have not weakened the defense industrial base. You have actually strengthened and deepened its ties in that community. You have also, of course, got a reserve workforce that can be pulled in if you need to increase those activities. For broader understanding, Rhode Island, Senator Reed, you got some terrific hub based developments.

But as we are seeing this all around the country and the CHIPS and Science Act, which was passed on a bipartisan basis, I think included affirmation of the importance of this as a general policy approach, but also something I would say that the DOD can take on board.

Including, however, in that approach, Senator Reed would be addressing one of the key points you made, which is labor force participation. So, it is not enough to have the opportunities, people have to want to come to work, and that is partly about compensa-

tion. It is partly about can they access childcare? It is partly about how long does it take to commute to work.

There is a package that should be looked at of this hub level, and I commend that to this Committee into the DOD for further investigation, the way it overlays with your existing activities and priorities around the country.

The third issue is, I think, with stating out loud, which is China, and I think that that is on the back of all our minds, or maybe the front, Senator, when we think about the potential threats here.

China is of course, not just threatening but actually investing very heavily in further research and development, trying to move innovation, trying to own the future of jobs across a lot of civilian, but also, I think, military activities. The best way to respond to that would be three fold.

First of all, invest more in science for the United States. Second, figure out how to commercialize and bring more of those activities to market because if you have got a strong civilian economy supporting innovation, that is going to help you on the military side also. Obviously there is a huge amount of spillovers and interaction there. Again, I would recommend a hub based approach for that.

The third approach, the third piece would be to develop a line of work for artificial intelligence that is pro-worker. What do I mean by pro-worker? I mean within the framework Mr. Taylor suggesting, AI is certainly arriving, but is this AI is going to displace manual workers and displace workers with less education, or does it enhance their productivity and enhance their opportunities? I think it could actually go both ways.

There is a lot of opportunity, a lot of issues around health care, a lot of issues around education, a lot of issues around manufacturing that are not the top priority for AI oriented investments in innovation in the private sector. There more to more about social media and digital advertising, to be frank.

So, focusing on those activities, and I think both Senator Reed and Senator Wicker alluded to this, changing how we think about manual work and thinking—changing the value we place on manual skills—I think that is something we have lost in this country over the past 40 or so years. It is something we were very strong at during WWII.

That was the basis of being able to scale up that economy and move it toward wartime production. To the extent we have outsourced those jobs to other places and created fragile supply chains, we should look at AI as an opportunity to motivate people and to bring technology to bear that enhances the effectiveness of that part of the workforce. Thank you.

[The prepared statement of Dr. Simon H. Johnson follows:]

February 26, 2024

Simon Johnson, Ronald A. Kurtz (1954) Professor of Entrepreneurship at MIT Sloan School of Management, and faculty co-director, MIT Shaping the Future of Work Initiative.¹

Testimony prepared for the Senate Armed Services Committee hearing on evolving workforce dynamics and the challenges for defense acquisition and defense industrial base personnel, Wednesday, February 28, 2024, 9:30am.

A. Summary and Recommendations

- 1) The U.S. has serious long-standing issues related to what people in the tech industry call “stranded expertise.” This term refers to people who have skills and experience that previously earned a high wage in productive activities, but which the market now does not highly value. With the rapid deployment of AI technology, we should expect this issue to become even more salient.
- 2) However, while the modern phenomenon of stranded expertise is associated with major economic and social problems, it also presents opportunities for the Defense Department, both for the defense industrial base in general and its human resources strategy in particular. Specifically, the DoD can and should think about strengthening its suppliers around the country by applying the following principles.
 - a. Identifying geographies where the tech sector is not otherwise booming and where there is sufficient housing (or willingness to build it) to accommodate the current and future workforce.
 - b. Seeking out cities and regions where potential hubs of interrelated expertise already exist and can be further strengthened (e.g., through apprenticeship programs which help specific suppliers while generating positive spillovers for related activities, and knowledge sharing programs that can be coordinated by universities and applied research institutes).
 - c. Focusing on developing expertise that is undervalued by the private sector, including skilled manual work and the tacit knowledge needed for modern manufacturing at scale.
 - d. Buying in on software, which is the main focus of private sector innovation, but also building next generation hardware with long development cycles and high capital costs.
 - e. Establishing incentives for the development of “pro-worker AI” – i.e., encouraging the development of artificial intelligence-based tools that are complementary to (boosting the productivity and effectiveness of) workers without a four-year college degree.
 - f. Scanning for up-and-coming technologies that have the potential to transform the organization of any economy, including (but not limited to) how it produces weapons and military equipment. Boosting productivity while sharing prosperity creates the soundest possible foundation for national defense. We should also aim to build and maintain a lead in all sectors and activities with fast-changing technology frontiers. This could happen, for example, in the

¹ This testimony draws on *Jump-Starting America* (co-authored with Jonathan Gruber) and *Power and Progress* (co-authored with Daron Acemoglu), as well as ongoing projects at the MIT Shaping the Future of Work Initiative (co-led with Daron Acemoglu and David Autor), including “Can We Have Pro-Worker AI? Choosing a Path of Machines in Service of Minds” (<https://shapingwork.mit.edu/wp-content/uploads/2023/09/Pro-Worker-AI-Policy-Memo.pdf>), and as part of the Industrial Strategy Seminar, co-organized with Brian Deese and Liz Reynolds. However, all views expressed here are personal and do not represent the views of any other person or organization.

context of a “Chips and Science Act 2.0” that included support for biomanufacturing, critical minerals, clean energy, additive manufacturing, quantum computing, and other cutting-edge technologies.

3) The U.S. private sector does some things very well. For example, we lead the world in software-centric projects that thrive based on venture capital finance, and our largest tech companies dominate the strategically important AI sector.²

4) However, in recent decades, the private sector has chosen to outsource a large part of its supply chains to other countries, without deeply considering the geopolitical risks that this creates. We have also lost a lot of the skills needed to design and build physical goods, both in normal times and when there is an emergency that requires rapid scale-up. If international trade is also disrupted, directly or indirectly, by a serious crisis, that makes the problem even worse.

5) Long-term, it makes sense for the DoD to think about how to support places and people that can remain world class at manufacturing while also offering the potential for rapid scale-up when needed.

6) In this context, apprenticeships are particularly appealing. The private sector underinvests in apprentices, because employers are concerned that workers will leave for better opportunities once trained. However, this should be much less of a concern to the DoD because everyone who completes an apprenticeship in the defense industrial base becomes a resource for that base.

7) In the U.S. today, we have deep and underutilized geographic pockets of technology-related expertise. The impact of AI should be tracked carefully, as it may create more such pockets. Matching available and relatively immobile skilled labor with current DoD requirements should not be difficult, and including workforce training into such a program makes even more sense when people are disinclined to move.

8) Predicting exactly what technology skills the DoD will need in the future, even in the near future, is much more daunting. In the post-1945 period (in line with the “Endless Frontier” program) and in particular under the National Defense Education Act of 1958 (part of the policy reaction to Sputnik and the perceived engineering gap with the Soviet Union), the federal government successfully expanded access to higher education and specifically pulled more young people into what we now call STEM.

9) What we need now is to redouble our efforts in science, including more funding for basic research and more support for commercialization. This should be combined with complementary workforce development for people without a college degree. Undervaluing and underinvesting in manual skills has, for too long, undermined the strength of our defense industrial base.

10) The path of technology is never inevitable. It is and can be shaped by national policy, including how we think about and invest in the defense industrial base. A top priority now should be to encourage the development of AI-based tools that increase the effectiveness of workers without a college degree.

The remainder of this testimony is structured as follows.

- Section B: More details on what happened to jobs in the U.S. over recent decades, as well as lessons from relevant military-technology history.

² However, there are serious concerns that the digital ad-based model of social media damages young people, encourages extremism, and undermines our national capacity to sustain a full-range of innovation. AI-technologies may make all of these problems more severe. See *Power and Progress*, Chapters 10 and 11, for a thorough explanation of these points.

- Section C: Evidence on innovation and productivity growth in an economy where inter-regional mobility has become limited.
- Section D: Explanation of the potential workforce problems created by current and next generation AI, particularly if this focuses heavily on automation.
- Section E: Suggestions on how to respond to the business/competitive and national security threats posed by China.
- Section F: The national security benefits of funding science above currently appropriated levels.

B. Some Relevant History

When automation replaces people with machines, the obvious question is: what happens to the skilled workers who previously had those tasks? Historically, there have been episodes when the U.S. private sector created a large number of new tasks requiring expertise, and workers were able to benefit from these new opportunities (e.g., in the early 1900s and again after the 1940s) through employment at high relatively wages.

However, after the 1970s, the destruction of jobs through automation has outpaced the creation of new tasks for human experts, with this effect concentrated on blue-collar and white-collar tasks that had a significant routine element. Consequently, people previously in the middle of the wage distribution, particularly those who did not go to a four-year college, lost good jobs, and found themselves forced to compete in the low-skill (and low-wage) part of the labor market.

The most obvious manifestation of this issue is at the regional level. Over the past 40 years, innovation has become disproportionately concentrated in relatively few parts of the United States. Rigidities in local housing markets limited construction in cities that would otherwise have increased housing stock. Increased housing prices deter workers from moving to these new opportunities. The shock of cheap Chinese imports in the early 2000s accelerated the decline of manufacturing in some parts of the country.

The acceleration of Artificial Intelligence (AI) threatens to create even more stranded expertise as whole job categories may be wiped out. We have seen similar disruptions in U.S. labor markets previously, but the impact from this new challenge may be closer to that of the “China Shock” in the early 2000s than the arrival of automated telephone exchanges.³ We are not creating enough new tasks requiring expertise, and many people will have difficulty converting their expertise into different sectors and jobs if their current positions are eliminated.

³ Manual telephone exchanges employed a lot of young women. These jobs were eliminated with the arrival of automated exchanges. At the same time, however, women were able to find more and better opportunities across the economy. In contrast, the surge of imports from China after 2000s had major negative effects on employment in US manufacturing, and many communities and people have still not recovered (and perhaps never will recover fully, at least on our current technology path).

These developments pose major challenges for the U.S. macroeconomy, including our ability to sustain high wages, to boost productivity growth, and to maintain or continue the “compression” in wage inequality that occurred after the onset of the COVID-19 pandemic.⁴

At the same time, experience over the past century suggests that a robust defense industrial base needs three elements.

- a. Actual and potential capacity to meet predictable needs.
- b. The ability to pull in additional resources and scale up fast.
- c. Access to the greatest possible innovative depth.

The formative moment of the modern U.S. industrial base is instructive. In 1940, the U.S. was not prepared for war, either in terms of its stock of cutting-edge technology or its ability to scale up production of weapons, equipment, and other goods needed by the military. There was limited political support for anything that looked like intervention in (what was then regarded as just) another “European war”.

In late August 1940, Sir Henry Tizard arrived in Washington, DC, as head of an expert team bearing information about some of Britain’s most important technological discoveries. The Battle of Britain raged through the summer and fall of 1940, with the German Luftwaffe first crippling critical airfields and then switching to the Blitz bombing of civilian areas, including London, Coventry, Birmingham, and other major cities. In this moment of great national desperation, Tizard and a few others persuaded Churchill’s government to put aside all conventional notions of secrecy, with the goal of receiving greater material assistance from the United States.

Of all Tizard’s offerings, without question the most immediately consequential was a small mechanical device, about the size of a hockey puck: the resonant cavity magnetron. This simple and even elegant piece of equipment created the possibility—with a lot of additional work—of smaller, more powerful, and more accurate radar sets.

To the great credit of the U.S., the wartime scientific organization under Vannevar Bush immediately recognized the potential of this technology, created the Radiation Lab at MIT (bringing together physicists from around the country), and brought this technology to fruition and into scale production by early 1941 – in time to play a decisive role in the Battle of the Atlantic (where plane-based radar was used to spot German submarines).⁵ The success of this

⁴ As documented by MIT colleague David Autor and coauthors, “The labor market tightness following the height of the COVID-19 pandemic led to an unexpected compression in the US wage distribution that reflects, in part, an increase in labor market competition. Rapid relative wage growth at the bottom of the distribution reduced the college wage premium and counteracted nearly 40% of the four-decade increase in aggregate 90-10 log wage inequality.” (<https://shapingwork.mit.edu/research/the-unexpected-compression-competition-at-work-in-the-low-wage-labor-market/>)

⁵ Experience at Pearl Harbor on December 7, 1941, should remind us that there is no necessary or automatic link from technology development to effective application in the defense sphere. Just after 7am on that morning, two radar operators reported a large number of unidentified aircraft heading towards Oahu. The officer to whom they reported told them to “Forget it.” The official congressional report determined, “The real reason, however, that the information developed by the radar was of no avail was the failure of the commanding general to order an alert commensurate with the warning he had been given

effort, as well as the Manhattan Project and other technology development and scale-up efforts, was the basis for Bush's 1945 *Endless Frontier* report. This provided a framework for post-war federal government efforts to support the development of breakthrough science, with both civilian and military applications. This effort received a further major impetus after the Soviet Union launched Sputnik, the first artificial satellite, in October 1957.

The story of military aviation development in the 1920s and 1930s is also instructive, although in part because of its cautionary elements. In 1923, France had the largest and most modern airforce in the world. By the late 1930s, however, all of this equipment was completely antiquated (or already out of service).

The French were not short of planes in May 1940. Instead, they lacked (a) modern fighter planes, capable of intercepting German bombers and defeating German fighters; (b) any kind of modern air defense system integrating human observers (and preferably radar); and (c) the strategy and tactics to use air defense effectively against a Luftwaffe that had been built and trained to practice close air support.⁶

Of course, 1940 was a long time ago, and the weapons of war continue to change fast. The more general lesson from history is that stockpiles are never enough. For robust national defense, we need strong national innovation across a wide range of technologies, most of which must presumably be rooted in the non-military economy. Of course, finding or imagining military and defense applications is entirely appropriate and a good idea.

The most important goal is to build a coherent vision for how technology is developed and applied to national defense. A key component of this vision must be the skills required at all levels of the future workforce.

C. Innovation, Productivity Growth, and Regional Issues⁷

In the decades that followed World War II, the U.S. led the world in innovation, creating entirely new sectors such as jet aircraft, life-saving drugs and vaccines, microelectronics, satellites, and

by the "War Department that hostilities were possible at any moment" (pp.141-142, Investigation of the Pearl Harbor Attack, Joint Committee on the Investigation of the Pearl Harbor Attack, Congress of the United States, July 20, 1946.)

⁶ The key breakthrough by German armored forces across the Meuse at Sedan was made possible by intense support from dive bombers, acting in place of towed artillery. The Germans then shifted focus to disrupt French communications, particularly the railway system, making it very hard (or perhaps impossible) to bring up reinforcements quickly. Within a few days, German forces had reached the sea, cutting the supply lines of over 300,000 Allied troops. The British Expeditionary Force and some French troops were evacuated from Dunkirk, and France surrendered within a few weeks.

⁷ This section is an updated version of a series of policy memos co-authored with Jonathan Gruber, 2019–2024. For more details, see our book, *Jump-Starting America*. The data to identify "Top Technology Hub Candidates" are freely available on this website, <https://www.jump-startingamerica.com/>, which allows users to examine the effects of adjusting the criteria and changing the weightings used in our baseline assessment (e.g., housing prices, college graduates, working population).

digital computers. Widespread innovation boosted productivity. Household income increased faster than ever before, while inequality declined.

Since the 1970s, however, U.S. productivity growth has slowed – reflected in falling total GDP growth from 4 percent in the post-war years, to under 3 percent from the mid-1970s, and to under 2 percent since 2000. The CBO projects growth (in real potential GDP) over the next decade of only 1.9-2.2 percent.⁸

Moreover, well-paying jobs in the U.S. are now concentrated disproportionately in a small number of superstar cities. People in the rest of the country increasingly – and correctly – feel that they are being left behind. Cities and states attempt to compensate by offering large tax breaks and other subsidies to big companies, but this just enriches corporations while starving local services.

The long-term slowdown in U.S. productivity growth has multiple causes, but in part is due to congestion, restrictive zoning, and high housing prices in existing innovation mega-hubs (Seattle, San Francisco Bay Area, Los Angeles, Boston, New York City, and Washington DC). Other large U.S. cities have strengths but have not broken through as magnets for venture capital and tech business creation. Meanwhile, small towns are losing their working age populations as workers age or move away (“brain drain”).

At the same time, Asian and European countries are building their own scientific infrastructure, including technical facilities and – most importantly – expertise. The US faces a new wave of global challenges to its technological leadership and ability to sustain good jobs. (More on this in the context of thinking about potential threats from China in Section E below).

What went wrong? Policymakers forgot one of the most important lessons of the post-1945 period. Modern private enterprise is most effective when the government provides strong underlying support for science and for the commercialization of inventions.

Firms are interested in innovation only to the extent that it improves their own bottom line – and not if creating new ideas and products leads to benefits for someone else. But spillovers from discovery are incredibly important, creating both the basic scientific knowledge and the more applied ideas that help determine how fast our economy can grow. Government involvement can fill this strategic gap by enabling scientific discoveries that, while crucial for long-run progress, may not always have immediately apparent benefits to “the bottom line.”

⁸ “In CBO’s projections, real potential GDP grows at an average rate of 2.2 percent a year from 2024 to 2028— slightly higher than the average rate since the business cycle peak in 2007—and then grows at an average rate of 1.9 percent a year from 2029 to 2034.” A large part of this growth is due to expected increase in the labor force. “The productivity of the potential labor force (which equals real potential GDP divided by the size of the potential labor force) is projected to grow by an average of 1.2 percent a year from 2024 to 2028 and 1.5 percent a year from 2029 to 2034.” See p.54 in “The Budget and Economic Outlook, 2024-2034,” Congressional Budget Office, February 2024.
<https://www.cbo.gov/publication/59946>

The innovation that led to rapid growth after World War II was the direct result of a fruitful partnership between the private sector, federal government, and universities that allowed us to generate and benefit from these spillovers as a country. Almost every major innovation in this era relied on federal government support, provided by both Democratic and Republican administrations. Public spending on research and development peaked at nearly 2% of our entire economy in 1964.

Public support for R&D in recent years amounts to no more than 0.7 percent of GDP (and we are now under 0.6 percent of GDP). This is equivalent to spending at least \$250 billion per year LESS than we did during the post-war boom. Lower public investment in science has contributed to the slowdown in productivity growth.

Across almost every dimension of technology today, America faces the imminent prospect of falling behind other nations. Around the world, including in China, government-supported research initiatives are helping to create the technologies of tomorrow, along with the associated well-paid jobs. Our competitors have studied post-1945 American history carefully – and are applying the lessons. We are at risk of falling behind and losing even more good jobs.

When Amazon announced its intention to build a HQ2 somewhere in North America, 238 cities submitted bids with generous tax incentives, infrastructure improvements, real estate deals, and other inducements. Yet the winners were two of the most economically successful places in recent decades: New York City, and Northern Virginia/Washington DC. The private sector, left to its own devices, will not close the income and opportunity gaps in America.

In contrast, placed appropriately, geographically concentrated federal investments can be truly transformative: attracting companies and helping to generate more local private sector employment. We need to jump-start the American growth engine in a way that benefits the entire country, not just a few large cities. Specifically:

1. Expand federal funding for basic science, as well as for the technology development that creates jobs through commercialization. Every incremental investment by the federal government of \$100 billion per year in this scientific infrastructure creates four million good new jobs in the near term – while boosting growth and helping to strengthen the middle class.
2. Share the benefits much more broadly across the country. In *Jump-Starting America*, Jonathan Gruber and I identified 102 urban communities that are plausible next generation tech hubs, all with large populations, highly educated workforces, and a low cost of living. These communities are home to over 80 million Americans in 36 states, across all regions of the country. For example, there are: seven potential new hub locations each in Florida, Michigan and Ohio; six each in Alabama and Indiana; five each in New York, Pennsylvania, Tennessee, and Texas; four in Georgia; and three each in Iowa, South Carolina, and Wisconsin.⁹
3. Create a rolling national competition for municipalities to become new technology hubs. Areas would bid to show that they can become an effective home for technology development. Potential hubs should also aim to increase the supply of skilled workers by: making higher education more affordable; providing appropriate practical and technical training, including for

⁹ See this website link for a map and list of the relevant Metropolitan Statistical Areas: <https://www.jump-startingamerica.com/policy-summary>.

people who begin with just a high school-level education; and linking to locally available employment opportunities that pay good wages.

4. Ensure that the benefits of technology-led growth accrue to all Americans by creating a cash Innovation Dividend. The capital appreciation (and higher rents) on government-owned real estate in new hubs would flow to all Americans through a flat annual payment – just as the Alaska Permanent Fund redistributes oil royalty revenue.

D. The Likely Workforce Impact of AI¹⁰

The world is currently flooded with optimistic forecasts regarding the growth implications of AI. Goldman Sachs, for example, claims that “AI adoption could boost productivity growth by 1.5 percentage points per year over a 10-year period” and raise global GDP by 7 percent – that’s \$7 trillion of additional output, as they calculate it. People close to the industry have even more excited estimates, including a supposed 10 percent chance of an “explosive growth” scenario, with global output rising more than 30 percent per year, which would be unprecedented by almost an order of magnitude.

All this techno-optimism draws on a set of deep-rooted beliefs in modern economics: innovation drives productivity growth, and productivity growth is ultimately good for workers. In this long-established conventional wisdom, technological change—including various forms of automation—always has the net effect of raising wages and generating more opportunity, creating an engine that pulls everyone along and leads directly to shared prosperity.

Such optimism is at odds with the historical record and seems particularly inappropriate for the current path of “just let AI happen,” because this is focused primarily on automation (replacing people). The macroeconomic and human impacts will be much better if we first recognize that there is no singular, inevitable path of development for this (or any) new technology. Armed with that understanding, we can then address the right question: Assuming that the goal is to improve economic outcomes for more people in a sustainable manner, what policies would help put AI development on the right path, with much more focus on enhancing what *all* workers can do?

Is There a Productivity Bandwagon?

Optimism regarding shared benefits from technological progress is founded on a simple and powerful idea: the “productivity bandwagon.” This idea maintains that new machines and production methods that boost productivity will also produce higher wages. As technology progresses, the bandwagon will pull along everybody, not just entrepreneurs and owners of capital.

The theory behind the productivity bandwagon is straightforward: when businesses become more productive from new technology, they want to expand their output. For this, they need more workers, so they get busy with hiring. And when many firms attempt to do so at the same time, they collectively bid up wages.

¹⁰ This section is based on “Rebalancing AI,” by Daron Acemoglu and Simon Johnson, *Finance & Development*, International Monetary Fund, December 2023.
<https://www.imf.org/en/Publications/fandd/issues/2023/12/Rebalancing-AI-Acemoglu-Johnson>

This is sometimes what happens. For example, throughout most of the twentieth century, innovations like electrical machinery and more-efficient factories boosted productivity in US industries like car manufacturing, and real wages increased in tandem. Remarkably, from the end of World War II to the mid-1970s, the wages of high school graduates and college graduates in the US and other industrial countries grew at roughly the same rate.

Unfortunately, what subsequently occurred is not consistent with the notion of an unstoppable bandwagon. How productivity benefits are shared depends on how technology changes and on the rules, norms, and expectations that govern how management treats workers. To understand this, consider the two steps that link productivity growth to higher wages.

- First, productivity growth increases the demand for workers as businesses attempt to boost profits by expanding output and hiring more people.
- Second, the demand for more workers increases the wages employers need to offer to attract and retain employees.

The Machinery Question

Contrary to popular belief, productivity growth need not translate into higher demand for workers. The standard definition of productivity is average output per worker—total output divided by total employment. The hope is that as output per worker grows, so will the willingness of businesses to hire people.

But employers are not incentivized to increase hiring based on average output per worker. Rather, what matters to companies is *marginal productivity*—the additional contribution that one more worker brings by increasing production or by serving more customers. The notion of marginal productivity is distinct from output or revenue per worker; output per worker may increase while marginal productivity remains constant or even declines.

Many new technologies, like industrial robots, expand the set of tasks performed by machines and algorithms, displacing workers who used to do these tasks. Automation raises average productivity but does not increase, and in fact may reduce, worker marginal productivity. Over the past four decades, automation has raised productivity and multiplied corporate profits, but has not created shared prosperity in industrial countries.

Replacing workers with machines is not the only way to improve economic efficiency—and history has proven this, as I describe in my recent book *Power and Progress* (co-authored with Daron Acemoglu). Rather than automating work, some innovations boost how much individuals contribute to production. For example, new software tools that aid car mechanics and enable greater precision can increase worker marginal productivity. This is completely different from installing industrial robots with the goal of replacing people.

Where Are the New Tasks?

Even more important for raising worker marginal productivity is the creation of new tasks. When new machines create new uses for human labor, this expands workers' contributions to production

and increases their marginal productivity. There was plenty of automation in car manufacturing during the momentous industry reorganization led by Henry Ford starting in the 1910s. But mass-production methods and assembly lines simultaneously introduced a range of new design, technical, machine-operation, and clerical tasks, boosting the industry's demand for workers.

New tasks were vital, not just in early US car manufacturing, but also in the growth of employment and wages over the last two centuries. And many of the fastest-expanding occupations in the last few decades—MRI radiologists, network engineers, computer-assisted machine operators, software programmers, IT security personnel, and data analysts—did not exist eighty years ago. Even people in occupations that have been around for quite a while, such as bank tellers, professors, and accountants, now work on many relatively new tasks using computers and modern communication devices. In almost all these cases, new tasks were introduced because of technological advances and have been a major driver of employment growth. These new tasks have also been integral to productivity growth—they have helped launch new products and enabled a more efficient production process.

Automation Also Rises

Automation in an industry can also boost employment—in that sector or in the economy broadly—if it substantially increases productivity. In this case, new jobs may come either from nonautomated tasks in the same industry or from the expansion of activities in related industries. In the first half of the twentieth century, the rapid increase in car manufacturing stimulated massive expansion of the oil, steel, and chemical industries (think gasoline, car bodies, and tires). Vehicle output at mass scale also revolutionized the possibilities for transportation, enabling the rise of new retail, entertainment, and service activities.

The productivity bandwagon is not activated, however, when the productivity gains from automation are small—what we call “so-so automation.” For example, self-checkout kiosks in grocery stores bring limited productivity benefits because they merely shift the work of scanning items from employees to customers. When stores introduce self-checkout kiosks, fewer cashiers are employed, but there is no major productivity boost to stimulate the creation of new jobs elsewhere. Groceries do not become much cheaper, there is no expansion in food production, and shoppers do not live differently.

Even nontrivial productivity gains from automation can be offset when they are not accompanied by new tasks. For example, in the industrial heartland of the American Midwest, the rapid adoption of industrial robots has contributed to mass layoffs in the manufacturing sector and ultimately prolonged regional decline.

The situation is similarly troubling for workers when new technologies focus on surveillance. Increased monitoring of workers may lead to some small improvements in productivity, but its main function is to extract more effort from workers.

All this underscores perhaps the most important aspect of technology: *choice*. There are often myriad ways of using our collective knowledge to improve production and even more ways to

direct innovation. Will we invent and implement digital tools for surveillance? For automation? Or to empower workers by creating new productive tasks?

When the productivity bandwagon is weak and there are no self-correcting mechanisms to ensure shared benefits, these choices become more consequential—and the few tech leaders who make them become more powerful, both economically and politically.

The Human Complementary Path

New technology may complement workers by enabling them to work more efficiently, perform higher quality work, or accomplish new tasks. For example, even as mechanization gradually pushed more than half of the US labor force out of agriculture, a range of new blue-collar and clerical tasks in factories and newly emerging service industries generated significant demand for skilled labor between (roughly) the years 1870 and 1970. This work was not only better paid but also less dangerous and less physically exhausting.

This virtuous combination—automation of traditional work alongside creation of new tasks—proceeded in relative balance for much of the twentieth century. But sometime after approximately 1970, this balance was lost. While automation has maintained its pace or even accelerated over the ensuing five decades due to computerization, the offsetting force of new task creation has slowed, particularly for workers without four-year college degrees. As a result, these workers are increasingly found in low-paid services such as cleaning, security, food service, recreation, and entertainment. These jobs are socially valuable, but they require little specialized education, training, or expertise, and hence pay poorly.

The critical question we face in the new era of AI is whether this technology will primarily accelerate the existing trend of automation without the offsetting force of good job creation—particularly for non-college workers—or whether it will instead enable the introduction of new labor-complementary tasks for workers with diverse skillsets and a wide range of educational backgrounds.

It is inevitable that AI systems will be used for some automation. A major barrier to automation of many service and production tasks has been that they require flexibility, judgment, and common sense—things that are notably absent from pre-AI forms of automation. Artificial intelligence, especially generative AI, can potentially master such tasks. It is unclear how much this type of automation will contribute to aggregate productivity growth while these technologies are immature, but they could contribute to sizable productivity gains as costs fall and reliability improves.

The dominant intellectual paradigm in today’s digital tech sector—among both business leaders and academic researchers—also favors the automation path. A major focus of AI research is to attain human parity in a vast range of cognitive tasks and, more generally, to achieve “artificial general intelligence” that fully mimics and then surpasses capabilities of the human mind. This intellectual focus encourages automation rather than the development of human-complementary technologies.

However, there is a case for qualified optimism: AI offers an opportunity to complement worker skill and expertise, if we direct its development accordingly.

Human productivity is often hampered by lack of specific knowledge or expertise, which could be readily supplemented by next-generation technology. AI tools could assist in such cases by boosting human expertise, supporting workers in unfamiliar situations, providing on-the-spot training, and improving all forms of information translation. AI holds great potential for training and retraining expert workers, such as educators, medical personnel, software developers, and other workers with modern “crafts” (such as electricians and plumbers). AI could also create new demands for human expertise and judgment in overseeing these processes, communicating with customers, and enabling more sophisticated services that leverage these tools.

Redirecting technological change is not easy, but it can be done. Specifically, there are five steps that can help put AI development onto a human-complementary, rather than human-displacing, path. Governments everywhere should consider these steps, but the impact will be strongest in places where the technology is under active development—particularly in the U.S.

What Can Be Done?

Reform business models: The dominant developers of AI easily expropriate consumer data without compensation, and their reliance on digital advertising incentivizes grabbing consumers’ attention through whatever means possible. To force this business model to change, we need to establish clear ownership rights for all consumers over their data, and to tax digital ads. Enabling a more diverse range of business models is likely essential for the development of AI technology that is helpful to all humans.

Tax system: The current tax code places a heavier burden on firms that hire labor than on those that invest in algorithms to automate work, and the same is true in many other countries. Policymakers should aim to create a more symmetric tax structure, equalizing marginal tax rates for hiring (and training) labor and for investing in equipment/software. This would shift incentives toward human-complementary technological choices by reducing the bias of the tax code toward physical capital over human capital.

Labor voice: The direction of AI will have profound consequences for all workers. Creating an institutional framework through which workers have a voice in its development would be constructive—and there is an important role for civil society in pressing for this to happen. At the same time, government policy should restrict deployment of untested (or insufficiently tested) AI for applications that could put workers at risk, for example in high-stakes personnel decision-making tasks (including hiring and termination) or in workplace monitoring and surveillance. Health and safety rules need to be updated accordingly. The same policies are relevant for other countries to consider.

Funding for more human-complementary research: Additional support for the research and development of human-complementary AI technologies could have significant impact. With this field in its infancy, the US federal government should foster competition and investment in technology that pairs AI tools with human expertise, aiming to improve work in vital social sectors

like education and healthcare. Other countries could pursue research efforts, either by themselves or (more efficaciously) by working together on shared problems. Once enough progress has been made, governments can encourage further investment by advising on whether purported human-complementary technology is appropriate to adopt in publicly funded education and healthcare programs.

AI expertise within government: AI will touch every area of government investment, regulation, and oversight, including (but not limited to): transportation, energy production, labor conditions, healthcare, education, environmental protection, public safety, and military capabilities. Developing a consultative AI division within government that can support the many agencies and regulators tackling these challenges will support more timely, effective decision-making.

The Potential Impact on the Macroeconomy

AI could increase global GDP in the next five years, although not as substantially as the enthusiasts claim. It might even modestly raise GDP growth in the medium-term. However, on our current trajectory, the first-order impact is likely to be increased inequality within industrial countries. Middle-income countries and many lower-income countries also have much to fear from the existing path. A new capital-intensive technology is arriving and will soon be applied in offices and factories everywhere. There is no guarantee that, on its current path, AI will generate more jobs than it destroys.

If we can redirect AI onto a more human-complementary path, while using it to address pressing social problems, all parts of the planet can benefit. But if the “just-automate” approach prevails, shared prosperity will become even harder to achieve.

E. A Better Response to China¹¹

China’s strategy for economic growth is no secret. In the short-term, the authorities endeavor to keep the Renminbi exchange rate at a level that is consistent with robust manufacturing exports, while over the longer run they build the financial capital, physical infrastructure, and – most important – human expertise necessary to become more innovative.

Such a strategy has compelling antecedents, with versions finding remarkable success over the past 70 years in Asia (Japan, Taiwan, Singapore, and South Korea) and in Europe (Germany but also France, Austria, Sweden, Finland and others). If a country can advance its innovative capacity sufficiently, it can create a lot of good jobs at the forefront of designing and building what comes next.

The economic success of perceived rivals has led to trade friction with the United States in the past, including for Germany in the early 1970s and Japan in the 1980s, but the challenge from China is viewed as more existential for three main reasons. First, China’s economy is already

¹¹ This section is an updated version of “To Counter China, Out-Invent It,” by Jonathan Gruber and Simon Johnson, *Foreign Affairs*, September 12, 2019. <https://www.foreignaffairs.com/articles/china/2019-09-12/counter-china-out-invent-it>

big (more than half the size of the U.S.) and could easily become the largest in the world. Second, China has acquired a reputation for not always playing by existing trade and exchange rate rules, with significant negative implications for employment in the United States. Third, China is clearly projecting its influence around the world, sharing technology and potentially creating its own international sub-system.

The real China issue is not an undervalued exchange rate (that was the problem 15-20 years ago), or weak protection for intellectual property (to encourage domestic innovation, China is already moving toward stronger protections), or even the much-discussed U.S.-China trade deficit (a completely misleading guide to sensible economic policy.) The main threat from China is both much more serious and considerably easier for the U.S. to address than any of the current headline concerns – it is their increasingly effective government-led investments in Research and Development (R&D). China's commitment to this area seems likely to make it the global innovation leader of the near future – displacing the U.S. from a position it has held for 70 years. Quite apart from the direct national security consequences of no longer leading the way, such a shift would reduce the number of good jobs in the U.S. that flow from new breakthrough industries.

Some changes in Chinese policy could help, but there is actually no reason to force or persuade China to do anything different. What the U.S. needs to do is change its own policy drastically to favor innovation and spread opportunity more broadly around the country.

The Real Threat from China

Chinese higher education was decimated as a result of the Cultural Revolution from 1966-1976, but during the 1990s and 2000s the country took a major step forward in science and engineering. From 1990 to 2010, Chinese enrollment in higher education rose eightfold, rising from 6 percent to 17 percent of total world higher educational enrollment. Over the same time period, the number of college graduates rose from 300,000 to nearly 3 million per year. In 2017, 7 million students graduated from Chinese universities. (The US equivalent number is around 3 million new graduates).

The quality of scientific education in China can be debated, but the numbers are not in question. In 1990, China graduated only one-twentieth as many science and engineering Ph.Ds. as the U.S., whereas by 2010 China (28,000 Ph.Ds.) had surpassed the U.S. (24,500). Chinese universities remain of a lower quality than their U.S. counterparts, but the gap is closing. In 2003, China had only 10 universities ranked in the top 500 in the world; today they have 45. (This assessment is run by a Chinese group, which sees 8 out of the top 10 universities as American.)

More scientists and more engineers add up, over time, to more innovation – when combined with adequate funding. Total worldwide spending on Research and Development currently runs around \$2 trillion per year (latest data are for 2015). About a quarter of this spending is by the US, down from a 37 percent share in 2000. Up from \$33 billion (roughly the same as France; one-tenth of the US level) in 2000, China now ranks second, with \$408.8 billion – 21 percent of world R&D spending.

Technology is Power – and Jobs

Why should we care which country makes new discoveries? Ultimately, technological development benefits the world as a whole as ideas spread. A look back at American history, however, shows that technological leadership matters for both national security and the kind of jobs that are created in a country.

In 1938, on the eve of World War II, US federal and state governments spent a combined 0.076 percent of national income on scientific research, a miniscule amount. By 1944, the US government was spending nearly 0.5 percent of national income on science – a sevenfold increase that was used to fund the creation of radar systems, the development of penicillin, and the invention of the atomic bomb. The effects of this unprecedented surge were simply incredible and, for America's enemies, ultimately devastating.

The lesson for peacetime (and the Cold War) was straightforward: use public resources to create new science and encourage the private sector to bring applications of these ideas to market. From 1940 to 1964, federal funding for research and development increased twentyfold. At its peak in the mid-1960s, this spending amount was around 2 percent of annual gross domestic product.

The result was modern pharmaceuticals, microelectronics, digital computers, jet aircraft, satellites, GPS, the internet, and much more. The number of university places for studying science, engineering, and all their applications greatly increased. The United States became, without question, the best country in the world to study, develop, and commercialize new technology.

Median family income in the United States doubled from 1947 through 1970. This increase in prosperity was shared throughout the country, with growth not only on the coasts but in the industrial Midwest and the newly dynamic South. Not all of this shared growth was due to the new prominence of Research and Development, but public investment in new sectors and activities played a catalytic role. New ideas based on government-funded R&D, both through universities and private sector contracts, were the basis for the growth of some of our most iconic companies and best employers – companies like IBM, AT&T, and Xerox.

From the late 1960s, the U.S. government commitment to Research and Development declined, but in the early 1980s the U.S. still spent 1.2 percent of GDP on publicly funded science. Total R&D spending, including private sector efforts, amounted to 2.3% of GDP. Few other countries came even close.

This situation changed dramatically over the next twenty-five years, as U.S. public sector R&D slipped below 0.7% of GDP. Today, nine countries spend a higher share of GDP on public support for Research and Development. Seven countries now spend a higher share of their GDP on total R&D (public plus private) than does the U.S. China, the rising challenger, currently spends less than the U.S. currently (2.07 percent vs. 2.74 percent, for total R&D as a share of GDP) but plans to change that in the coming years.

The private sector in the U.S. continues to innovate, but mostly in the kind of software projects favored by modern venture capitalists. Outside of life sciences, the private sector does not spend much on fundamental breakthroughs – new knowledge is great for an economy but seldom pays off for the investors who fund the work.

Corporations have moved away from basic research, with a 60 percent decline in publications by corporate scientists in recent decades. In the critical area of clean energy, for example, the type of long-term innovative investments that lead to future jobs are not the current priority of US companies and financiers – the amount of capital involved is too large and the time horizon for returns is regarded as too long.

Other promising industries of the future, such as synthetic biology and hydrogen power, were hatched in the U.S. but now seem likely to develop further in China and elsewhere – based on where governments are providing more support for basic research and the translation of new science into production.

At the same time, many local US innovation ecosystems – which used to be vibrant creators of good factory jobs – have fallen into disrepair. In their analysis of what they call “[The China Trade Shock](#)”, David Autor, David Dorn, and Gordon Hanson identified a form of hollowing out of the middle class created by relatively cheap (and not high tech) Chinese imports in the early 2000s. In any important set of geographies, across the industrial Midwest and in smaller towns, low-cost Chinese imports wiped out existing employers or induced firms to move jobs to lower labor cost locations.

American consumers were able to buy less expensive goods but American workers, in some geographies, lost out rather badly. The U.S. economy has proved good ultimately at generating replacement jobs, but most of these do not pay high wages or provide the same level of benefits. Now China is poised to move further up the technology ladder, into more sophisticated products – this is the point of all that scientific investment. They have already demonstrated substantial progress in sectors such as telecommunications equipment, payments systems, and the use of artificial intelligence in supervising social media. One industry view is that China will soon overtake the U.S. as the world R&D leader in pharmaceuticals.

The most pressing question for the U.S. role in the world economy now becomes: Do Americans want to buy the next generation of machines, medicine, and software from China – falling back from the forefront of global technology leadership just like Britain did after World War II? Or do Americans (and their leaders) want to increase scientific investment and reassert leadership through the creation of opportunity – which was the U.S. response after the Soviet Union launched Sputnik in 1957?

Any tariff-based confrontation with China today or in the near future is unlikely to help boost productivity or create well-paid jobs for Americans of all abilities and education levels. We need a different set of policies.

F. The National Security Benefits of Funding Science¹²

Congress should fund the science and economic development programs authorized in the “CHIPS and Science Act” in the FY 24 appropriations bills, including by fully funding the Commerce Department’s regional technology hubs program.

The “CHIPS and Science Act” provided appropriations for the CHIPS activities in the bill but only set authorization levels for the important science programs in the bill, which are designed create a growing base of new research and innovation around the country. The FY 23 appropriations bills started funding the programs but at levels significantly below what was authorized. The FY 23 appropriation for the National Science Foundation, for example, was about \$2 billion below the authorized level, and the House and Senate numbers for FY 24 are about \$6 billion below the authorization. The FY 23 appropriation for the regional technology hubs at the Department of Commerce was \$500 million – just a quarter of what was authorized.

Appropriating the money for the science portions of “CHIPS and Science” would represent a significant commitment towards ending the dramatic almost sixty-year slide that we have seen in government support of science in the U.S. In the mid-1960s, the U.S. spent almost 2% of our GDP supporting public research and development, which was far more than any nation on earth. We now spend less than 0.6% of GDP – placing us 14th in the world and, critically, well behind China.

But the argument for funding science is not just about history or international competition – it is about jobs and long-run economic growth. Evidence clearly shows that higher public funding of research and development creates economic opportunity: *Investing \$10 billion a year in government science funding would create 400,000 new jobs*. And the long-term growth prospects are even more impressive, with estimates suggesting a rate of return on public R&D spending nearly over 50%.

Importantly, these benefits are not just national – localized investments in science have outsized returns for the localities themselves. Recognizing this, the Commerce Department regional technology hubs program would reward areas with the best potential to be next generation technology hubs. This program has the potential to transform areas around the country that have operated in the shadow of the existing “superstar” cities on the coasts but which themselves can become the superstar cities of the future.

There is a long historical precedent for such transformational government investments. From the decades of economic growth that followed from government investments in public universities, to the jobs created by ongoing public funding of university research, government science funding has been a local growth catalyst. Consider east Orange County, Florida, part of the Orlando metro area, which due to a forward-looking collaboration between the University of Central Florida and the Navy, along with decades of military research funding, has become the world hub of the computer simulation industry and created 100,000 jobs over the past thirty years.

¹² This section reproduces a policy memo by Jonathan Gruber and Simon Johnson, circulated on February 1, 2024.

A common criticism of government-led efforts at economic development is that political considerations will interfere with allocating resources to the most promising economic opportunities. Fortunately, we now have two strong counterexamples to this contention. The first is the \$1 billion Build Back Better Regional Challenge run by the Economic Development Administration. This was essentially a “test case” for the tech hubs competition, with similar criterion for success but at a smaller funding scale. The results of this competition were 21 grants of \$25 to \$65 million that covered 24 states from all over the country, covering every region of the nation, rural and urban projects, including blue and red states alike. The second is the first round of the regional tech hubs competition. EDA designated 31 new Tech Hubs, once again spanning the entire country and a wide range of potential technologies. There has been no evidence that these processes did anything other than what they were designed to do: select the places with the best potential to develop into new technology hubs through innovative growth.

But this is just a start. Becoming a next generation tech hub requires competing with the existing coastal superstar cities that are the location of 75% of all venture capital funding and where 90% of the nation’s innovation sector growth was generated. This requires a massive commitment to “jump start” a region. The federal funding requires a local contribution, so the federal investment will generate the needed public and private investment at the local level.

For the 31 areas on the initial list of tech hubs, the argument for more funding for the tech hub program is clear. The \$500 million initially appropriated will not be enough to jump start more than a handful of these locations. Yet all of the places on this list have clearly shown the potential to benefit from transformational government spending. Moreover, another 18 areas were designated as Strategic Development Grant recipients, receiving small grants to allow them to develop their case for tech hub status further. That is 49 places around our country that are already positioned to benefit from more funding.

For this program to reach its potential, Congress must fully fund the Biden Administration’s requests for science funding. Only by investing fully in science can the U.S. reach its growth potential and return to the golden era when we led the world both in innovation and economic growth. And only by recognizing and rewarding those places with the most potential to grow can we spread the benefits of innovation-led growth around the country.

Chairman REED. Thank you very much, Dr. Johnson. Dr. Lockwood, please.

**STATEMENT OF JULIE A. LOCKWOOD, DIRECTOR OF BUSINESS
MODERNIZATION, INSTITUTE FOR DEFENSE ANALYSES**

Dr. LOCKWOOD. Chairman Reed, Ranking Member Wicker, and fellow distinguished Members of the Senate Armed Services Committee, good morning. I am honored to contribute to this timely discussion on trends impacting the Nation's defense civilian workforce.

My perspectives are informed by my own research, that of fellow economists, and also the work of many talented researchers at the Institute for Defense Analyses (IDA) and at other federally funded research and development centers supporting the Department of Defense.

I should State that the views that I expressed today are mine, and not necessarily those of IDA, as a nonpartisan institution. To succeed, the Department of Defense and its partners in the defense industrial base must maintain skilled, capable, and adequately staffed workforces.

Today's labor market is characterized by the convergence of several important trends, some of which have been discussed today already, which together produce intense competition for talent. Increasing job market polarization driven by technological advances has left many missed skilled workers behind.

Young men's rates of college attendance, enrollment, and completion are in decline. An aging workforce will bring waves of retirements to DOD, threatening continuity and also institutional memory. The gig economy, meanwhile, offers workers low commitment alternatives and a very flexible lifestyle, and remote work is here to stay in some form or other.

In addition, affordable housing shortages add to existing downward pressure on worker mobility, and rapid advances in AI and other technologies are accelerating competition for STEM [Science, Technology, Engineering and Mathematics] graduates. One or two of these concurrent trends alone would be troubling, but taken together, I believe they represent a sea change.

At present, there is excess demand for labor in the United States, with 9.5 million open positions for only 6.5 million workers. That is assuming every worker is well suited to the open positions, which they are not. DOD and its industry partners are not currently well positioned to compete effectively for the high demand talent that our national security requires.

These trends impact each segment of the labor force that this Committee seeks to address, wage grade workers in our shipyards and our arsenals, STEM professionals in our labs and in the acquisition workforce, and critical supervisors and middle managers on the GS schedule. A common set of prescriptions can improve the health of each.

To compete for the skilled workers that DOD and its partners in the industrial base need to accomplish their critical missions, the Department should act aggressively to hire faster, pay competitively, reward performance, manage underperformance, and set the

conditions needed for managers to make effective workforce mix decisions.

Moreover, DOD has an excellent opportunity to engage with this missing middle of mid skilled workers, a labor segment traditionally heavily involved in national defense, by filling critical shortfalls with a combination of trained workers and enabling technologies—some of the AI that my colleagues here I have spoken to already.

People need purpose and inspiration to get off the couch and back in the workforce. If you take away only one idea from my time with you today, please let that be that incentives matter. By incentives, I do not only mean the pay and benefits that employees might earn for an excellent performance.

I also mean the conditions under which DOD's many managers, workers, and researchers invest their personal effort and make day to day decisions that impact the Department's bottom line. I believe that DOD's dedicated workers generally want to make optimal choices but are often stymied in doing so.

You can set the conditions to align incentives within these decision environments, to make it easier for everyone to choose the sensible thing for the mission and for the taxpayer in their daily work, whether that is shaping DOD's workforce mix or when managing their teams. Incentive alignment will produce more effective decisions and free resources for other mission critical areas.

I personally think we could use a few more submarines. Decisive action can help achieve this incentive alignment and will reinvigorate DOD's civilian workforce by clearly signaling that the Department values its wage grade, professional, and defense industry personnel. That it will recognize and reward their contributions.

These innovations will allow DOD to advance as a high performing organization. Thank you for your time and I look forward to your questions.

[The prepared statement of Dr. Lockwood follows:]

Statement from Dr. Julie A. Lockwood, Director of Modernization, Institute for Defense Analyses

Chairman Reed, Ranking Member Wicker, and fellow distinguished Members of the Senate Armed Services Committee, I am honored to contribute to today's important discussion on appropriately and efficiently staffing the nation's defense civilian workforce. My perspectives are informed by my own research, that of fellow economists, and the work of numerous talented human capital researchers at the Institute for Defense Analyses and at other Federally Funded Research and Development Centers supporting the Department of Defense and the military Services. The views expressed in this testimony are my own and do not necessarily reflect those of IDA or its research sponsors.

To succeed in its mission to defend the United States (U.S.), the Department of Defense (DOD) and its partners in the defense industrial base must maintain skilled, capable, and adequately staffed workforces. Several societal and economic trends have converged in recent decades to produce a competitive—and increasingly globalized—labor market. In a number of important respects, DOD and its industry partners are not well-positioned to compete effectively for the high-demand talent that our national security necessitates. In this submission, I briefly enumerate some of these trends, review a selection of current features of DOD labor force management, and offer policy choices that might address some of the challenges raised for the DOD's wage grade and the General Schedule workforces.

Suggested policy action areas:

1. Reduce time to hire
2. Set competitive wages
3. Reward performance and effectively manage underperformance
4. Establish conditions conducive to efficient workforce mix decisions

Labor market trends

Despite the considerable size of DOD and our defense-related industries, DOD is not a market-maker. DOD and the private sector both compete for talent and must evolve to match market realities. At present, there is significant excess demand for labor in the U.S., with 9.5 million open positions competing for just 6.5 million job seekers.¹ The last 30 years have witnessed significant and accelerating changes in the American workforce and economy, impacting workers' choices in the labor market. Some U.S. workforce trends can benefit DOD, while others present challenges that require action.

¹ "Understanding America's Labor Shortage," US Chamber of Commerce, February 2024.
<https://www.uschamber.com/workforce/understanding-americas-labor-shortage>

Job market polarization by skill: Many economists have noted a hollowing out of the labor market at the center of the skilled labor distribution.² Automation, technological advances, and offshoring have led to high rates of job growth for workers at the highest and at the lowest levels of the skill distribution, and to a significant decline in opportunities for those in the middle of the skill distribution. Typical mid-skill industries observing a reduction in employment share include construction, manufacturing, and mid-level administration. Low-skill service sector employment and high-skill professional employment have driven much of the job growth observed over the last three decades in the U.S. The recent burst of innovation in AI Large Language Models is likely to continue the technology-driven reshaping of work across the skill dimension in the coming years. DOD and its industry partners can benefit by attracting the relative surplus of mid-skill workers to roles in DOD and the defense industrial base, including some who will be displaced by AI advances.

An aging workforce: According to employment projections produced by the U.S. Bureau of Labor Statistics (BLS), 14.3% of the American workforce was aged 55 and older in 2002, climbing to 20.9% in 2012 and 23.3% in 2022. BLS projects the share of older workers to surpass 24% by 2032.³ Individuals are also retiring later. While retention of experienced personnel is a major benefit to the DOD, it must prepare for coming waves of retirements. Intentional succession planning, even for mid-grade positions, would significantly benefit continuity of operations and institutional knowledge preservation.

Gig economy provides flexible options: Increasingly, workers—even those who are highly skilled—enjoy many options for extremely flexible, short-term “gig” employment. This reduces the attraction of traditional employment and reduces costs of prolonged part-time training or school attendance. Moreover, it gives DOD and its industry partners opportunities to attract workers seeking flexibility.

Varied careers: While commonplace in decades past, today’s workers do not often remain with a single employer or even within a single industry for the duration of their careers. This contrasts sharply with traditional federal employment typified by long tenures and vesting pension arrangements. Expanding offerings of portable benefits (such as increasing TSP benefits) and accommodating more variety in career paths would better align DOD and the defense industrial base with civilian employers.

² A seminal paper in this literature is Autor and Dorn (2013), “The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market.” *American Economic Review* 103(5): 1553–1597.
<http://www.nber.org/papers/w15150>

³ See <https://www.bls.gov/emp/tables/civilian-labor-force-summary.htm>

Housing costs, shortages, and decelerating geographic mobility: High home prices, high mortgage interest rates, and a shortage of affordable housing impede the geographic mobility of workers and slow the rate of household formation among young Americans. Curtailed geographic mobility disrupts the efficient flow of workers to high-demand areas, thus driving up employment costs.

Remote work: The move to remote work arising from the COVID-19 pandemic has further shifted labor market power to workers, and has induced migration out of costly metropolitan areas. This trend has disproportionately benefited the white-collar workforce, which matters for DOD and industry middle management and to Science, Technology, Engineering, and Mathematics (STEM) employment. While some rebalancing will occur, remote work is here to stay.

Deceleration in college achievement among young men: Bachelor's degree completion by young men has fallen behind that of their female counterparts. Young men differentially cite lack of interest in studies and availability of employment that does not require college as reasons for not completing a degree.⁴ DOD and its industry partners can benefit from this trend by ensuring that educational requirements for its tradesmen and wage-grade roles are appropriately set and by partnering more closely with trade schools and community colleges to create training-to-work pipelines.

Increasing competition for STEM graduates: Rapid technological progress in AI and other fields has markedly increased competition for professionals with advanced STEM credentials. Further exacerbating the labor market pressures faced by DOD, the majority of U.S. STEM graduates in key fields—such as engineering and computer and information sciences—are not U.S. Citizens.⁵ Current education-to-hire pipeline programs have shown recruiting success, but DOD risks alienating high-demand U.S. Citizen STEM professionals through outmoded hiring practices, uncompetitive pay, deteriorating the work content, and overly-bureaucratic working environments. Greater coordination among programs could improve outcomes and allow for optimization of these important hiring mechanisms.

⁴ For example, see "What's behind the growing gap between men and women in college completion?" Pew Research Center, November 2021. <https://www.pewresearch.org/short-reads/2021/11/08/whats-behind-the-growing-gap-between-men-and-women-in-college-completion/>

⁵ "STEM Jobs See Uneven Progress in Increasing Gender, Racial and Ethnic Diversity," Pew Research Center, April 2021. https://www.pewresearch.org/science/wp-content/uploads/sites/16/2021/03/PS_2021.04.01_diversity-in-STEM_REPORT.pdf

Policy Options to Enable DOD and Defense Industry Competition for Talent

1. Reduce time to hire and other structural barriers

To be an attractive employer, DOD must select and onboard employees more rapidly. Applicant wait times of three months to a year are commonplace. While long timelines discourage all applicants, delays particularly impede hiring the youthful talent the DOD urgently needs. New entrants fresh out of school, many with loans looming, often cannot afford to forgo months of wages while awaiting a hiring decision or the results of a lengthy security clearance investigation.

Hiring organizations must also endure long waiting periods, often with gapped positions and attendant inefficiencies. Requiring that an incumbent leave prior to posting a vacancy guarantees delays in hiring actions after a retirement and hampers succession planning. Gapped positions transfer workload onto remaining staff or create a backlog of work awaiting the unlucky hire. Either scenario damages morale.

Civilians are hired into the DOD using one of two methods: through competitive hiring authority administered by OPM (the standard method); or through direct hiring authority (DHA) which bypasses certain OPM procedures on ratings, assessments, certifications, and veteran's preference. Managers within DOD describe the competitive hiring authority as a "clunky, bureaucratic, and ineffective hiring tool that makes it difficult for the Department to compete for talent."⁶ Communications gaps between OPM and the hiring agency and stale hiring documents cause delays and ineffective candidate searches. Position descriptions maintained by OPM are frequently outdated or not well-crafted to the specific hiring need, particularly in STEM fields. OPM's filtering of applicants against outmoded position descriptions or lack of context for how the hiring organization values different training, credentials, and work experiences cause problems in identifying individuals who would be a good fit. DHA helps, and should be expanded to empower more hiring at the local level. OPM process reforms are also needed.

Equally troubling is a general lack of strategic planning around what civilian hires are needed, with one recent study concluding that "requirements are almost always structured around the existing workforce rather than around a strategic analysis of the work that needs to be done and how it could best be performed."⁷ DOD should aggregate and review staffing requirements annually to set strategic civilian hiring objectives, including a high-level assessment of the needed skills, desired experience profile, and

⁶ "Optimization of DOD Civilian Hiring Processes through the use of Cohort Hiring," Institute for Defense Analyses, November 2022.

⁷ "Accessing Critical Skills in the Department of Defense," Institute for Defense Analyses, November 2022.

expected turnover. Requirements should be reviewed at a mission-responsible level to ensure that trends can be systematically addressed, and to help focus a coordinated recruiting message to potential hires. The Defense Civilian Training Corps program might pilot such planning. Timely metrics and training on workforce mix management should be provided to those setting organizational hiring objectives.

The health of DOD's STEM workforce—approximately 150,000 strong—is particularly important to DOD's mission success. DOD offers many opportunities for internships, co-ops, and post-doctoral positions.⁸ Such education-to-career engagement strategies have proven successful in attracting talented individuals in high-demand STEM fields to roles in DOD and its supporting Labs.⁹ Such programs should be expanded, with expedited hiring authorities for applicants who have been vetted through program participation. Hiring programs should coordinate to share best practices and improve planning.

Finally, improving the visibility of open positions across hiring organizations and geographic locations can benefit each of DOD's workforces. Greater visibility can help us retain talent when employees need or want to move jobs or cities. At present, delays in posting positions combined with siloed information about hiring objectives stymies the mobility of talent across the enterprise. These measures would help DOD to retain the individuals it has invested in by facilitating transfers to new roles.

SUGGESTED ACTIONS TO IMPROVE HIRING OUTCOMES:

Form a civilian hiring strategy to identify key skills, roles, and shortfalls. Develop a related hiring plan and establish metrics. Review consolidated hiring plans for adherence to the strategy.

Provide **metrics and training** to those setting organizational hiring objectives.

Empower local managers to drive the hiring decision and cut red tape.

Adopt a **cohort hiring approach** based on best practices and empowered to target critical skills and leadership abilities.

Ensure that **job descriptions and postings are up-to-date** and meet hiring organization needs.

Allow positions to be posted for known future gaps in advance of the incumbent vacating the role.

Improve the visibility of open positions and hiring objectives across hiring organizations and geographic locations to facilitate retention of individuals desiring a move or new role.

⁸ Example programs within DOD include SMART, the Naval Research Enterprise Internship Program, the Army Educational Outreach Program Internships, and the Air Force's Premier College Internship Program.

⁹ "Understanding STEM Education Opportunities to Build the Future Workforce," Institute for Defense Analyses, August 2023.

2. Set competitive wages

DOD's wage-grade, General Schedule (GS), and private sector workforces are critical to accomplishing key defense activities, freeing Service members to complete military-essential tasks. Pay must be competitive to attract and retain talented civilians. While the Davis-Bacon Act of 1931 protects the wages of federal contractors, federal employees' wages are not always comparable to market rates.

Reform the Federal Wage System to offer competitive wages

The Federal Wage System (FWS)—which sets compensation levels for nearly 200,000 hourly federal workers within the DOD and other federal agencies—is a relic of 1970s-era statistical techniques applied to data collected through an unrepresentative survey and circumvented by pay caps and floors. Congress has the ability to drive wage-grade reform for the entire federal hourly workforce by modernizing this DOD-administered wage setting apparatus.

At present, the FWS groups all wage-grade occupations into grades. Federal hourly workers at each equidistant Step within a Grade receive the same rate of pay. Challenges in this pay system include:

- Pay rates set using the FWS structure are overridden by statutes, including application of the GS locality increase beginning in FY04 and subsequent pay caps beginning in FY11. Actual pay rates are frequently out-of-sync with local wages.
- The OPM classification of occupations into Grades—based on relative wages in 1970—bears little relation to today's labor market. Some occupations within a Grade and Step are overpaid relative to their current-day market wage, while other occupations are underpaid.
- Prevailing wage surveys underlying FWS calculations are unrepresentative and redundant to existing government surveys conducted by the Bureau of Labor Statistics (BLS).
- The calculation of FWS wages does not consider the market for the target occupation outside of a narrow geographic locality. As an example, DOD will not attract or retain adequate skilled labor in our shipyards if the relevant local wage is lower than the trade's national average.

Reform the General Schedule methodology to offer competitive salaries

While DOD's GS pay rates are in principle flexible to market conditions, pay is not competitive in all geographies and across all roles. Misalignments between DOD and private sector salaries can occur when the skills required in a role are not well understood by those grading positions, and when salaries for particular role-by-geographic area combinations do not align with trends.

As an example, Defense Health Agency has **struggled to hire in some areas due to misaligned wages**. Mid-skill medical technicians (GS-3 to GS-5) and some physicians are particularly difficult to recruit and retain at present wages in certain locations. Some have noted that the Department of Veterans Affairs has authority under Title 38 to pay providers more and may be competing with DOD for medical talent.

As in the case of the wage grade workforce, grouping GS occupations into grades and applying locality pay to account for geographic variations in living costs introduces inefficiencies. Setting salaries directly within occupation-by-geography bins to match prevailing civilian wages would be a more efficient and effective salary-setting methodology. This approach would account for local variations in demand for specific professions that impact salaries for some professions but not for others. If setting GS salaries directly at the occupation-by-geography level is not a feasible option, then DOD should consider studying pay differentials to identify specific areas of disconnect between private sector and DOD salaries.

Finally, while pay freezes appear to be a simple and expedient cost-cutting measure, freezing pay distorts the natural market-driven variation in wages across professions, reduces DOD's competitiveness as an employer, and subjects the workforce to undesirable non-market dynamics.

SUGGESTED ACTIONS TO IMPROVE FWS WAGE AND GS SALARY SETTING:

Determine FWS wages and GS salaries at the Occupation-by-Geography level (not by Grade category) with meaningful Step increases for superior performance and seniority.

Remove artificial caps and floors; **set wages annually based on current labor market conditions**.

Stop conducting unrepresentative prevailing wage surveys for all occupations that have a civilian counterpart; instead utilize the copious occupation-specific wage data already compiled by the BLS.

Reassign excess staff currently devoted to FWS pay calculations to readiness-enhancing activities.

3. Reward performance, manage underperformance

Like all people, DOD and defense industry employees respond to the incentive structures around them. Because DOD wants superior performance from its workforce, it must align the environment in which employees at all levels invest their personal effort, manage their careers, make choices impacting DOD operations, and ultimately excel.

If pay for high performers equals that of lackluster contributors, the most productive employees will become discouraged and may eventually seek higher pays in the private sector. Pay signals esteem.

Some supervisors have reported feeling constrained in the effective management of federal civilians. Examples given include a perceived inability to ask civilians to work long hours, a perceived inability to effectively manage underperformance, and a fear of career-damaging retaliatory complaints. Both uniformed and civilian supervisors need effective and efficient mechanisms for managing employee performance that do not open managers to spurious complaints. Instead, today's underperformers are often passed along to supervisors in other employment areas. It should not take years of administrative effort to remove someone who is not adequately contributing to the mission and who does not improve with reasonable training investments.

SUGGESTED ACTIONS TO INCENTIVIZE SUPERIOR PERFORMANCE:

Recognize superior performers with higher pays and bonuses. Tangible appreciation matters.

Ensure that both uniformed and civilian supervisors can effectively manage the performance of civilian employees. DOD and the Services need the means to accelerate reprimand or separation in cases of underperformance that does not improve with reasonable training investments.

Provide management training to civilian middle managers. Unlike their uniformed counterparts, mid-level civilian managers receive very little practical training for these important duties.

4. Establish conditions conducive to efficient workforce mix decisions

The DOD can obtain significant cost and operational efficiencies by staffing roles that are not military-essential with a higher complement of government civilians.¹⁰ Moving uniformed individuals out of such roles frees them for greater use at the “tip of the spear,” thus enhancing military readiness—essentially “militarizing the military.”¹¹ Civilian employees have more available working hours per year than uniformed members, who must complete military training, physical training, permanent change of station moves, and other military-specific duties. Civilians also serve at significantly lower cost per staff

¹⁰ See “Replacing Military Personnel in Support Positions With Civilian Employees,” Congressional Budget Office, December 2015.

¹¹ “Enhancing the Readiness of Expeditionary, Training, and Medical Workforces Through Workforce Mix Reforms,” Institute for Defense Analyses, September 2018.

year than either uniformed members (who accrue costly benefits) and contracted staff support (for whom DOD pays a premium). DOD has the necessary authorities and official Instructions¹² requiring use of the lowest-cost allowable staffing choice. However, significant research reveals the consistent overuse of uniformed military Service members and contractors relative to federal civilians. **Simply mandating that hiring managers make “efficient choices” will not produce the needed results. Only improvements in the incentive structure facing managers will succeed in altering behaviors.**

Minimize indiscriminate civilian cuts

While laudable in their cost-savings intent, cuts to DOD civilian personnel budgets have had a negative impact of the effectiveness and efficiency of the defense enterprise overall.

Defunding of civilian billets reduces military efficacy by pulling uniformed members into necessary duties previously performed by civilians. DOD officials have reported completing the burdensome process of converting military billets into civilian billets, only to find their civilian personnel budgets cut: effectively a “mil-to-nil” conversion. Managers will not make efficient workforce mix decisions if civilian staff are at risk of summary cutbacks. Cut organizations thus suffer a double hit to morale: uniformed members typically want to be operators, not administrators, while the remaining civilians are pressured with additional duties and worries that their roles are viewed as expendable. Research on corporate layoffs indicates that during staff reductions, often the most productive employees with the most marketable skills leave first. There is little reason to expect different behavior from civil servants.

Indiscriminate civilian cuts also increase the use of costly contractors to perform necessary duties. Use of contractors is attractive to commands because staff shortfalls can be backfilled immediately, OPM action is not required, and underperformers can be quickly dismissed. Contractors can be hired using operating funds when civilian billets have been eliminated. Unfortunately, these flexibilities come at high marginal cost. Pushing work to contractors appears to save manpower dollars but actually increases the total defense bill. Further, the remaining civilians’ time spent managing contractors increases at the expense of effort devoted to their original roles, further reducing morale.

Congress should improve the ability of DOD decision makers to make efficient force mix choices by aligning their decision incentives with taxpayer interests through the following actions.

¹² See DOD Instruction 7041.04, “Estimating and Comparing the Full Costs of Civilian and Active Duty Military Manpower and Contract Support.”

SUGGESTED ACTIONS TO INCENTIVIZE EFFICIENT WORKFORCE MIX DECISIONS:

Align DOD budgets for uniformed Service members, civilians, and contractor support staff at the level at which the staffing decision is made, and eliminate zero-budget-impact use of uniformed Service members. Currently, managers making the force mix decision do not bear the budget cost of military manpower, but they do pay for civilians and contractors. If Service members are free to a utilizing command, the command will generally not consider the total cost to the taxpayer of its workforce mix choice and will overutilize uniformed members.

Publicize official “manpower prices” to be borne by utilizing commands for all labor types. The Office of the Secretary of Defense’s Cost Assessment and Program Evaluation (CAPE) office currently has such a costing function. Prices should be updated annually, capture all employment-related costs and worker types, and be communicated actively to those making staffing decisions.

Ensure that both uniformed and civilian supervisors can effectively manage the performance of civilian employees. DOD and the Services need the means to accelerate separation or reprimand in cases of underperformance for all types of contributors.

Protect civilian billets and budgets from indiscriminate reductions. “Salami-slice” cuts to civilian personnel budgets disincentivize the use of civilian personnel and undermine morale.

Pilot the use of fixed-term federal civilian employment contracts. Frequently used by European firms in highly regulated employment environments, fixed-term employment contracts could offer DOD the ability to manage federal civilian employee performance over defined employment terms subject to bilateral renewal. This mechanism could enable the Department to manage billet allocation more dynamically across its needs and attract workers who prefer gig-style employment. This mechanism has been used by the Army Research Lab and might be studied and expanded.

Make it easier and faster to hire civilians.

Conclusion: Decisive Action will Improve Morale

Taken together, the decisive actions outlined here will reinvigorate the DOD civilian workforce by clearly signaling that DOD values its talented FWS, GS, and defense industry personnel and that it will recognize and reward their contributions. Cutting unnecessary bureaucracy, paying competitively, aligning incentives, rewarding performance, and filling staffing shortages can reinforce the entire DOD workforce, improve morale, and create conditions for DOD to advance as a high-performing organization. Thank you for your time and consideration, and I look forward to today’s discussion.

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Chairman REED. Well, thank you all for excellent testimony. Really superb, and this is, I think, the beginning of a dialog, not a one stop and move on. I like submarines, but I share that with Senator Wicker, and he——

Senator WICKER. Here, here. The only thing I take issue with is she said a few. It would be quite a lot more submarine.

Chairman REED. I agree. The only condition he puts on and they all have to be named after a city in Mississippi, but that is a small point. One of the issues that I see as I try to deal with these issues

is that we have a problem of bringing in new workers. We also have a problem at the supervisory level.

Discussions with people in the industry say that is probably one of the key things that is slowing them down. They can get by with younger workers, but without the supervisors, they can't leverage those workers. So, Mr. Taylor, and Dr. Johnson, and Dr. Lockwood, your comments.

Mr. TAYLOR. Well, indeed—I alluded to that. Thank you, Chairman Reed. We know that, and even in industries like the Tech Valley and Silicon Valley, the tech industries, we can get them employees to come in.

The difficulty is keeping those employees, and increasingly, the new difficulty is keeping people in middle management. In part because we have naively assumed that because one is a great mechanic, that one will be a great manager of mechanics.

So, we take that person. We don't invest in teaching them how to be a great people manager. They hate the job and the employees that work for them hate the job, and therefore no one wins, and that has led to the retention problem.

One of the areas that we strongly recommend the Department of Defense consider doing is investing in people management. How do you—it is not enough for someone to have the technical—the underlying technical skills.

We have got to teach them, you know, technically to do the job, but teach them how to manage people. Because listen, at the end of the day, we have all talked about compensation, and compensation does matter, but all of the data tells us that people will leave an employer if the only thing they are doing is making a lot of money but being mistreated, and they don't find that this is a good work environment.

So, people management work is a lot of the work that the Department of Defense should consider investing in.

Chairman REED. Thank you. Dr. Johnson, your comment.

Dr. JOHNSON. So, Senator, here is the good news, bad news aspect of artificial intelligence, you know, in answer to your question.

The good news is there is definitely potential, and we can see it already in some parts of the private sector to develop tools that will enhance the ability of supervisors to manage more effectively and perhaps make it more easy to transition to become a supervisor.

So, I don't think there is enough effort going into that. I think it would be something very good for the DOD to focus on also. But I think that the bad news part is there is also a tendency, and not I am sure, in this room, but elsewhere, to think about algorithms as replacing people and doing the work.

We can rely on them, and we can close our eyes and the car will drive itself. That is a bad mistake. But what we are looking at, as Taylor said, is different ways for people to interact with machines at the supervisory level.

But I would emphasize making those manual jobs more attractive, more interesting. Pulling younger people in with an AI element, not thinking about replacing people because that would be a mistake.

Chairman REED. Dr. Lockwood, please.

Dr. LOCKWOOD. Yes. I will just build on both of these gentleman's remarks by noting I wholeheartedly support Mr. Taylor's cry for additional training. I will note that among our defense workforce, that our uniformed personnel are frequently sent to special schools to learn managerial and leadership skills.

However, very little investment is made in our civilian managers, and this is a critical gap that you can fill. I will note that some important changes have been made, some progress has been made in the area of leadership training, for the acquisition workforce in particular.

But leadership is different than management, so this is a key opportunity for the Department. Thank you.

Chairman REED. Thank you very much. In terms of addressing our problems, one suggestion that I think everyone made directly or indirectly is we have got this pool of workers, military personnel that we can transition. Just very quickly because my time is expiring. Mr. Taylor, how do we encourage our military personnel who are leaving the service to go into industries related?

Mr. TAYLOR. Yes, we know that there currently exist transition programs, but we have got to double down on those.

If we know that an individual is within 6 months to 12 months away from either retiring or completing their military service, we have got to give them the skills to make sure that they can translate that either to role in the DIB, maybe not necessarily in the military, or within the private sector.

So, training them on how to become recruitable in the private sector would be the way to do it.

Chairman REED. Thank you. My time has expired, and there is one other question I want to—or comment I want to put on the table. One is, Dr. Lockwood focused on the acquisition forces in DOD and management training.

One of the areas I think, too, is in the civilian companies, the contractors. My sense is they don't do that very well. Dr. Lockwood or Dr. Johnson.

Dr. LOCKWOOD. I would respectfully take a question on the management within our contractual partners for the record.

Chairman REED. Very good. Thank you. Dr. Johnson.

Dr. JOHNSON. I think you are pressing on exactly the right issue here, Senator Reed. I think that we are under investing in managerial capabilities across a large part of our economy.

Of course, there is a big sucking sound as talent gets pulled toward the Silicon Valley type of sector, and the rest of the economy is neglected and underinvested in by itself, which is very counter-productive from an economic point of view and from a national security point of view.

I think you are—absolutely top priority in line with both—with certainly what Mr. Taylor said. I am sure with what Ms. Lockwood will say later.

Chairman REED. Last word very quickly, Mr. Taylor.

[No response.]

Chairman REED. Thank you very much. Senator Wicker, please.

Senator WICKER. Thank you, Mr. Chairman. In a 2023 Federal employee viewpoint survey, workers were asked whether they agree with this statement, in my work unit differences in perform-

ance are recognized in a meaningful way. Only 45 percent of respondents agreed with that.

The same survey asked if they agree with this statement, there are no poor performers in my work unit. Only 19 percent of employees said that. Dr. Lockwood, in your written statement, you say DOD needs to accelerate reprimand or separation in cases of underperformance that does not improve with reasonable training investment. Tell us about that and what can Congress do.

Dr. LOCKWOOD. Thank you for the question. I think the bottom line is that if high performers are compensated, promoted, and otherwise treated the same as mediocre performers, that those high performers will be discouraged and take their talent somewhere else.

So, I think we can pretty clearly say that that is suboptimal for the Department. I think there are a number of things the Department could do to enable managers. One thing is perhaps to limit employment terms. So, one might imagine a new form of Federal employment, a limited term contract.

We see this in several other developed economies. This would kind of split the difference, perhaps, between the use of a very flexible contracted solution through one of our industrial base partners or a typical Federal contractor, and what we understand now as Federal employment to give both the Department and the worker added flexibility.

Senator WICKER. Okay, so I asked what Congress could do and do you think it would take statutory changes to implement something like that?

Dr. LOCKWOOD. I do. In particular, because oftentimes both civilian and uniformed managers have concern of reprisal or other forms of unfortunate action should they do the hard work of trying to separate a nonproductive member of the staff. So, Congress clearly signaling that this is your intent and desired outcome, I believe would be helpful to the Department.

Senator WICKER. Let me ask all of you about the Federal wage system. It has not been reformed since 1972. It is going to be a long time. It has weaknesses, such as the system in determining the wage is hyper local. It is incredibly bureaucratic and complicated, and by law, public unions, public employee unions are heavily involved.

Dr. Lockwood let's start with you. In my opening statement, I mentioned welders and electricians. The Navy's public shipyards are struggling to hire and retain these critical workers. Does the FWS [Federal Wage Systems] have something to do with this, and what can Congress do to help?

Dr. LOCKWOOD. I believe it does. So currently, wages are set in pretty hidebound grades where we are taking a number of perhaps currently unrelated occupations, binding them together, and setting wages within a few steps for that grade.

Those grades were established back in the 1970s based on the prevailing wages at that time, and currently bend together occupations that don't resemble one another at all. I believe a far more effective approach would be to compensate on the occupational level, both with a view toward the local wage, but also understanding that should we need to draw workers into a labor market

that is relatively undersupplied, it will take a higher wage to do so.

We need to set wages cognizant of not only occupation locally, but also nationally.

Senator WICKER. It seems to me we are just going to basically have to give the Department flexibility beyond specific instructions.

Dr. LOCKWOOD. I believe that is the case.

Senator WICKER. Dr. Johnson and Mr. Taylor.

Dr. JOHNSON. I would just add, Senator, there is a very big issue coming to you soon with regard to workplace surveillance, because the tools for surveilling workers are already greatly enhanced.

In that conversation, there will be, and I think this is something that OSHA [Occupational Safety and Health Administration] will be looking to Congress for guidance on—I think you have to consider, to what extent that surveillance makes workers safer, more productive, and lines up with reasonable incentive systems, as Dr. Lockwood was saying, and to what extent it becomes oppressive and discourages workers from coming in to work for the defense industrial base. This is going to be a very hot issue very quickly.

Including that, Senator Wicker, in a discussion of the Federal wage system, could be quite a good idea. I would also emphasize the need for more housing. So, one reason wages have to be higher in some areas is because the community decided not to build housing. Now, that is the decision of the community.

It is not usually up to Congress, but I think deciding to spend your submarine dollars in places where housing is affordable suggests to me you will be able to build more submarines for the same wage bill.

Mr. TAYLOR. I would add, from the private sector side, we use the term pay for performance. If Congress can do anything to give the flexibility to the Government worker, the Department of Defense, you could actually help there.

Ultimately people—that doesn't surprise me, that 19 percent, say only 19 percent think they have no poor performers. The Government has for quite a while recruited people, and what part of the sell has been job security. Well, that is the downside. If you know that you have job security, then there is no incentive necessarily to do anything to not have your job.

But more importantly, why would you differentiate if there is no pay for performance? If I am going to make, give or take 1 percent more than the colleague who does barely enough to get past, then there is no incentive for people to work harder and for you to attract the best talent.

Senator WICKER. Thank you sir.

Chairman REED. Thank you very much. Senator Kaine, please.

Senator Kaine. Thank you, Mr. Chair, and thanks to our witnesses. A couple of topics I want to get into. First, Mr. Taylor, I appreciate that the Society for Human Resource Managers has supported a bill that I have been promoting for many years. I talk about it a lot in the HELP Committee, and they are tired of me talking about it, but I don't talk about it a lot at Armed Services, the Jobs Act.

We do not allow Pell Grants to be used for high quality career and technical education. It has got to be a college. An awful lot of

really high quality job training programs are not college semester in length. Instead of a 15 week course that you meet three times a week for an hour and a half, a lot of high quality job training is an 8-week course where you are 5 days a week, 8 hours a day, many more classroom hours than a semester.

We allow Pell Grants to be used for full time students, for part time students, for people who are incarcerated, if they are getting college credits that they can use to get employed when they are back in society, but we have never allowed Pell Grants to be used for high quality career in tech.

I think if we could pass the Jobs Act, and it is wildly bipartisan. I think I have got about 65 of my colleagues who are sponsoring it, particularly at a moment when we have just done a big infrastructure bill. Who is going to build it? We have just done a big manufacturing bill and who is going to make it?

We have just made a commitment to build subs with the Australians, but both the United States and Australia have some similar workforce challenges. So, I very much appreciate SHRM supporting the Jobs Act, and I would look forward to working with my colleagues to figure out some way to finally get movement on it at a time when the unemployment rate is low. To another topic that I would like to ask your opinion on.

There is a wonderful program that I have been involved with called the Accelerated Training for Defense Manufacturing Program that is done in Danville, Virginia, at the Institute for Advanced Learning and Research, and its investment to build the submarine industrial base.

In that program, we bring people from all over the United States who are working with suppliers in the industrial base—some of the main shipyards, but also some suppliers. They train side by side.

There is Aussies there now. Part of the AUKUS [Australia, United Kingdom, United States] arrangement. But also, I noticed the last time I went, there is a lot of Afghans, Afghans who served patriotically with the United States in Afghanistan. They moved to United States, and they are like, I will be a shipbuilder. Strikes me that one of the answers to this issue on workforce shortages is immigration.

An immigration reform system that prioritizes workforce is something that is really important. Oftentimes when we talk about immigration here, it is all about the border. We ought to talk about the border, but we also need to talk about the workforce.

An unemployment rate that is as low as ours right now. There is not going to be a solution to some of these problems that does not involve a work based immigration reform, and I was hoping that you might just each offer your perspectives on that.

Mr. TAYLOR. Senator Kaine, you mentioned something that is at the core of most of the conversations in human resource circles. The fact of the matter is that Americans have been having fewer and fewer children over the last 2 decades. So, we have a birthrate problem. We have a replenishment problem.

We at SHRM are very careful not to get into the political issues of immigration other than to say we need these 8, or 9, or 10 million jobs to be filled. It is just nonsensical that we would in many instances have people who we have allowed to come to the U.S., we

have educated them in our schools, and then we send them back when we have open jobs for them to fill.

Again, staying away from the political parts of it, the reality is employers are saying we need this talent. We don't have the luxury of saying, great, we are going to have a bias against people who are not born and trained here in the U.S. In fact, we need all the talent. So, SHRM is quite supportive of this immigration. Now, how we get to that is a different issue.

We need to ensure that we protect our border and our Homeland, and we need to know who is in our country, is our opinion. At that point, getting them to the talent, matching them up with organizations is something that we all are pushing for and frankly demanding at this point, with 3.7 percent unemployment.

Senator KAINE. Dr. Johnson and Lockwood.

Dr. JOHNSON. So, Senator Kaine, I see your two proposals as very tightly connected. My understanding is that the current Pell Grant system had its origins in the 1958 National Defense Education Act. Which is itself a response to Sputnik and a realization by Congress that we needed more engineers and scientists.

So, there is a big push at the higher end of education for math and science, but not so much for this—in this middle—the middle skill area that we are talking about. So that is a gap we have had for a long time.

I think your idea is absolutely brilliant and spot on. But then when it comes to immigration, I think the question is, are we providing sufficient opportunities to all the people born in the United States, including in that middle area? If we are and they are not taking them, or if we still have gaps, then I think the case for immigration on a work based or skills basis, immigration reform is very compelling.

MIT [Massachusetts Institute of Technology]—I am an immigrant, Senator, as you may have guessed, and I went to—I got a Ph.D. from MIT, and there is many other people in MIT currently who would love to spend their careers building the economy and strengthen the national security of the United States.

Many of them will be able to come in because we have not easy, but various points of entry, if you have a master's degree or higher, into the United States. But we don't do that for skilled labor, because in part of the insecurity and concerns about opportunities for native born Americans in that part of labor force.

But I think both your ideas together, Senator, I would make a package, because I think that is a compelling—joint in two fold attack on the same problem.

Senator KAINE. Thank you. Dr. Lockwood, I am over time, but you could be as succinct as Mr. Taylor was earlier when he closed over time.

Dr. LOCKWOOD. Yes. We absolutely need to invest in skills based education and we need to stop enshrining the 4-year degree as the only valuable and worthwhile thing that a young person can do. We have overinvested in bachelor's degree education and underinvested in core skills training.

So that is something Congress can do now. I will just also note that our immigrant base is wildly productive in terms of new business starts and general entrepreneurship, and skills based immi-

gration is definitely something that has been an incredible net benefit to the American economy and it ought to continue.

Senator Kaine. Thank you, Mr. Chair.

Chairman REED. Thank you, Senator Kaine. Senator Tuberville, please.

Senator TUBERVILLE. Thank you, Mr. Chairman. I would also like to add on to Senator Kaine's thoughts on Pell grants, Government grants, loans. I spent 40 years in the education business. It is out of control.

We need to use it for the right reasons. It needs to be redrawn. I have seen people take Pell Grants, go buy cars with them, drop out of school immediately after they get Pell Grants. I have seen the same thing with loans.

There is not enough oversight on it, but we need to put more emphasis on what we are doing, and what he's calling the Jobs Act. We can get more out of it if we would just concentrate on it and put some authority behind it, and let people know that you have got to do it the right way.

I am all for jobs training because I have seen a lot of these kids that go to 4 year universities and waste their time and get degrees, and they can't get jobs when they get out. Their job has got to be at Walmart or somewhere else like that.

It is not that Walmart's a bad job, it just if you spend 4 years of your money or the Government's money in going to school, you need to have some kind of opportunity to achieve something more successful.

You know, I come from Alabama, and we have an industrial base of about \$50 billion annually, 300,000 jobs that work in our military industrial base. We have Alabama Shipyard and Austal USA. We build ships, submarines, you name it. It is an amazing place. I enjoy going into these buildings and watching these people work.

What is amazing to me, the stories I get are from some of these major corporations, is they take their own initiative. They are going to fast food places and recruiting, and watching people work. One shipbuilder told me that their best welders have come from fast food joints because they are willing to work. Dr. Lockwood, be careful, you are telling people, get up off the couch and go to work.

You don't need to say that around here. But they do, we have got to get people back to work. So, Dr. Johnson, you brought up a few minutes ago that our workforce has dropped since WWII. Well, we all know that.

You know, I mean, that is the problem. What is the cause and what is the solution to that? I mean, we got to have—what is the cause for—we all know we have to have the cause of that since WWII and the solution. Is it NAFTA [North American Free Trade Agreement], that we send our manufacturing overseas? Because China has five to one manufacturing plants compared to us here in the United States. Is that part of it?

Dr. JOHNSON. Well, Senator, when I think of Alabama, I think of Huntsville and the remarkable success there, the rocket program, which was basically built from scratch in a place that had tremendous, no doubt potential, but had not previously established itself in that area of technology.

We used to do that a lot, Senator. That was a big lesson out of WWII. We used to do it all around the country, and the private sector did it as well as the public sector. But unfortunately, what has happened due to market forces, and so I am not blaming any single individual, is we have shifted much more of that innovative activity toward the East Coast and the West Coast.

These are cities that don't like to build more housing prices. Housing is very high. It is hard to move there. A lot of the expertise in the middle, the middle skills part of manufacturing, for example, in the Midwest of the United States, is stranded there because the opportunity is in other places, but they can't afford to move because of the housing market, and we are not making a best use of our talent.

So, I think more investments in more communities, including Alabama, which is featured very highly in our book, by the way, that is the right geographic approach in general to bolstering science and technology. When it comes to national defense, Senator, I think it lines up even better because we want to build communities with these skills. People don't move that much.

Great, so their skills will stay in this community that is focused on producing submarines or rockets or whatever that community is. That that is going to be a very strong local regional defense base. So, we will use a little bit of our disadvantages in our favor in this case, and I think we will get a better economy and more national security as a result.

Senator TUBERVILLE. I think still in our country, we still have a lot of patriotism out there. Sometimes we don't see that, but people want to work for our military industry. They make very good money, I mean, but you got to pay a price.

You got to sacrifice, and we can't overlook our education in this country. Our education is going south. Take it from somebody who has been in high schools all over this country as my former job. The things that we are teaching are not conducive to push these young men and women in making better for themselves.

I mean, they just say, if I get a degree or if I get a diploma in high school, that is good enough, and that is really not good enough. They have got to be incentivized in how to do it. Mr. Taylor was talking earlier about that. We have got to incentivize. But again, it all goes back to our military industry.

As you said, Huntsville. It is growing. I just bought a new house up there and watched it go up, okay. There wasn't—in the entire time that that house was built, there wasn't one white American, one black American, or one Asian American that worked on that house. It was people from other countries, okay.

I don't know whether they were legal or not. They said they were. I asked them, I said, make sure there is not—I happen to be a Senator. Make sure there is people that are Americans that are working on this house.

But we can't build anything, we can't build anything unless we have immigration in this country. I truly believe that. I truly believe that. But we got to do it the right way. Thank you very much. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Tuberville. Senator Rosen, please.

Senator ROSEN. Well, thank you, Chairman Reed, for holding this hearing. I would also like to thank each of the witnesses, of course, for testifying today.

I worked in my former career in STEM and so I am going to talk a little bit about the STEM workforce shortage. As mentioned in the National Defense Industrial Strategy, we have to find creative solutions to upskill our manufacturing workforce so that we can meet our Nation's strategic production targets and our goals.

Mr. Taylor, can you speak to the labor shortages in STEM fields, the impact on our defense industrial base, and if there are specific sectors impacted by the skilled workforce shortage more than others?

Mr. TAYLOR. Right. As you can imagine—thank you, Senator Rosen. You know, one of the problems is we wait too long to talk about what the talent problem is.

We look to employers and say, you have not hired enough engineers this year, for example. The reality is this is a PK [pre kindergarten] through 12 problem, and we are not looking at it—we want to solve for it immediately. We have a pipelining problem from the diversity, for example, of the types of Americans who come through the systems K through 12 educations, we know disproportionately underperform in communities—underrepresented minorities.

Then you wake up and say, well, we don't have enough diverse talent in STEM. Well, it is because that started 13, 14 years ago. It didn't start immediately, and so, employers are committed to the idea of increasing and solving for their STEM worker talent shortages, but we know when we say at SHRM, it is the two Es. It is education and employers.

We have got to start a lot earlier in the process. The other thing that the Senator just spoke to is that increasingly companies are going straight to high schools and saying—in fact, some new instances of going to middle schools and saying, I am going to identify your kids now and ensure that they are obtaining the skills that we need to—the STEM skills, you know, the basic math, the sciences, et cetera, and we essentially are going to pull them through and mentor them so that we have potentially employable people 10, 12 years later. As opposed to hoping that the K through 12 system will provide the pipeline.

Senator ROSEN. I am glad you brought that up because my very first bill is called Building Blocks of STEM, and it does exactly that, and allows to build that STEM pipeline, K through 12 schools all across America to invest in STEM education.

I have seen the greatest programs in kindergarten and elementary school, how they kind of use little robotics and fun things that kids don't even realize they are learning STEM, but they are learning all of these great things of logic. So, thank you for bringing that up and I was glad to have a bill pass to do that.

I am going to move on to Dr. Johnson. As DOD, we are going to focus on partnering with the private sector. We know that is really important to increase our workforce preparedness. How can the Department expand its outreach to encourage more of the private sector in the advanced manufacturing process?

Dr. JOHNSON. I think that is a great question, Senator, and I think focusing on hubs areas, geographies where the private sector

has the potential, where you can—you have the labor force, you have the potential labor force, including with your admirable STEM initiative.

Thinking about where housing can also be built, Senator Rosen. I think too often there is great opportunities in places where the communities don't want to build housing, so the housing just becomes super expensive.

Then you have to pay a very high wage, or nobody is going to move there. So, I think looking for those geographic partnerships is something that has not previously been sufficiently emphasized, Senator.

Senator ROSEN. Well, this isn't for defense, but we are becoming a new tech hub in Reno, and this is the kind of thing that we are talking about happening in Nevada. But I am going to move on to Dr. Lockwood quickly because I want to talk about the impact of budget delays.

I know the impact of failure to pass a full year funding deal, including for the DOD, it constrains are long term strategic plans. It has negative impacts for all of our prime contractors, for our sub-contractors. They can't prepare and plan, and when you can't plan, you can't have the workforce.

If you lose the talent workforce and they go somewhere else for a job, they may not come back, and it takes a long time to build a qualified welder for a submarine and all of those kinds of things.

So, if we are going to build those resilient supply chains for our defense industrial base, Congress must pass regular appropriations in a timely manner. So, Dr. Lockwood, can you talk to us about the impact of the Federal funding, the uncertainty all across our defense industrial base, what that really means for our safety and security across the world?

Dr. LOCKWOOD. Absolutely. I do view uncertainty in the timing of Federal budgets to have a very negative impact on our total readiness posture.

In addition, I would say that further dampens interest in Federal employment by creating the perception of turmoil or an unnecessary politicization of these critical roles that we need filled.

I will also add that particularly for young people who are just entering their careers, extremely long delays in time to hire often become untenable. They have loans looming. They need to start work immediately.

They can't afford to wait 6, 12 months to be certain of having a job. So, this is something that we can address. Thank you.

Senator ROSEN. Thank you, Mr. Chairman. I yield back.

Chairman REED. Thank you very much, Senator Rosen. Senator Sullivan, please.

Senator SULLIVAN. Thank you, Mr. Chairman, and I appreciate the witnesses today on a really, really important topic.

By the way, I agree 100 percent with Senator Kaine on his Jobs Act. I think it is something—and Senator Tuberville, on what we need to do, but I think it is a really good opportunity and we should keep moving forward on that.

As you know, when we are looking at our strategic competition, one of the things that the dictators in Beijing, Xi Jinping and others, are really scared about is our submarine force. It is an asym-

metric advantage that is still very significant, and they are terrified by it, which is why we should be building a lot more submarines.

I met with the CNO [Chief Naval Officer] of the Navy yesterday and just talked about how there is so much bipartisan interest here in the Congress to increase our capacity to build ships and subs. My staff have done some research for me.

We have the capacity. We have done it before. A lot of people don't know, our country had a 2-year head start before Pearl Harbor on increasing our ship capacity. So, in 1937, we had 335 ships in our fleet.

By Pearl Harbor, December 7th, 1941, we had 790, okay. So, we doubled the size of the fleet before we got into a war, and it is a dangerous time right now. Very analogous to the 1930s, in my view, and a lot of what happened was Congress acted. Four laws in particular, the Vision Trammel Act, the Second Vision Trammel Act, the Naval Expansion Act of 1940, and the Two Ocean Navy Act of 1940.

I want to start with you, Dr. Lockwood. What are the big ideas, big ideas—we have done this before, right. We don't want to start building our industrial base out once the bullets start flying. The time to do it is now, and we have done this before. We have the capacity to do it as a nation before.

What are the big ideas that you think we need, particularly as it relates to subs. The estimates are we need over 100,000 new trained workers. But I think the bipartisan nature of what is needed—we would be open to anything, even a new shipyard. What are the big ideas? I want to hear from you very briefly, and then the others, if you can actually respond in a request for the record.

Dr. Johnson, I have a quick question for you on what is happening in Silicon Valley. But Dr. Lockwood, the biggest thought pieces you can do here, quickly.

Dr. LOCKWOOD. Thank you. Let me quickly say that the submarine force is near and dear to my heart, as the wife of a current serving commander of a fast attack boat for—deployed in Guam, the USS *Asheville*.

Senator SULLIVAN. Well, Xi Jinping is scared to death of what your husband has—

Dr. LOCKWOOD. Indeed. I believe that to be a true fact, sir.

Senator SULLIVAN. We need a lot more of them.

Dr. LOCKWOOD. Yes. I do believe—the analysis I have seen has indicated there is simply no way that this country can meet its own needs and also support its AUKUS commitments without an additional shipyard.

Senator SULLIVAN. So, you agree with the idea of an additional shipyard?

Dr. LOCKWOOD. I do.

Senator SULLIVAN. A public shipyard?

Dr. LOCKWOOD. I think we need all available options, sir.

Senator SULLIVAN. Okay.

Dr. LOCKWOOD. I would be open to performing additional analysis to try and determine exactly what format would be most effective. I will note that in WWII, tanks rolled off the floor of the Ford plant, and they are damn proud of it, and they should be.

Senator SULLIVAN. Good. Well, if you can get back to us with more details on that idea and other big think ideas on this. The way the Congress acted prior to WWII, very impressive. Dr. Johnson, real quick, I agree with Senator Tuberville that there is still very much patriotism in our country that wants to help.

One of the ironic areas that I have kept a close eye on over the last several years is the return of patriotism in Silicon Valley. Ten years ago, they didn't have it, right. They were much more interested working with the goddamn Chinese communist than American military industrial capabilities.

That is changing. It is a great opportunity for us as a country. It is a strategic advantage the Chinese and Russians don't have. But the Pentagon's culture in rules don't allow us to take advantage of it. You have heard this phrase, the valley of death, right.

You have a—high tech companies got great capacity, can't break into the Pentagon system, and then the company goes out of business because it takes 5 years to get the Pentagon interested.

What is your thoughts on what we can do to enhance the ability of our industrial capacity to take advantage of this new interest with some of our high tech companies who want to help us, want to help America be strong, and not fund the Chinese, like so many of them used to do, which was very pathetic and un-American in my view.

Dr. JOHNSON. Yes, Senator. I think you are spot on with that overall characterization. I think you need some carrots. It could be prizes. It could be prestige. Things that pull those tech companies toward the problems that you want them to solve.

Because if you leave them to their own devices, we know what they are going to do. It is more social media, or it is more digital ads. I don't think that particularly helps national defense at all.

So, I think defining—using DARPA [Defense Advanced Research Projects Agency] type approach and defining, this is the problem to be solved, which could be a direct military problem, or it could be health care related to the military. It could be transitioning military personnel to civilian. It could be education more broadly.

There is a lot of really important goals that matter a lot to you on this Committee, and Silicon Valley pays zero, almost zero attention to them. I will also, by the way, Senator, send you some enhanced—some reinforced—reinforcement for your talking points on the role of submarines in WWII, the role of U.S. innovation on naval aircraft prior to WWII, which was actually huge.

The fact that this country was producing roughly one aircraft carrier per month at its peak in WWII because we were able to move so much of our production when it was needed but not prematurely. So, you are right about the base that was built. Anyway, Senator, I will followup with you directly on that.

Senator SULLIVAN. Thank you. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Sullivan. Senator Warren, please.

Senator WARREN. Thank you, Mr. Chairman, and thank you for holding this hearing on workforce dynamics. You know, the strong economic recovery under President Biden is a win for the United States.

We have 14.8 million jobs created. Fastest growth in real inflation adjusted wages of any recovery in more than half a century. But there is still work to do. We need to invest in our defense manufacturing workforce and make sure that we have the workers that are needed to meet our national security needs.

One tool that I would like us to talk about, for making sure that the labor supply keeps up with the labor demand, is providing the quality, affordable childcare that workers need so they can actually go to work. You know, we do this to some degree already, including with the DOD's excellent childcare program.

But while we could invest a whole lot more for our military and our civilian families, over half of Americans right now live in childcare deserts. That means children outnumber the childcare slots by three to one.

That means millions of families across the country that need childcare and either can't find it, or if they can find it, they can't afford it. Professor Johnson, you are an economist at MIT, former Chief Economist at the IMF [International Monetary Fund].

So, let's do some econ 101 and drill down on the root of this problem. How does insufficient supply of childcare affect labor supply, including the defense workforce?

Senator WARREN. The lack of adequate childcare obviously limits the ability of women to participate in the workforce. Of course, many of those aircraft carriers and submarines that were built in WWII were built by women.

Senator WARREN. Yes. So not enough childcare means not enough workers to power our economy in the defense industry and basically everywhere else. But let's go down one more level on this. Professor Johnson, help us understand the bottleneck in childcare. If we want to increase the supply of childcare, what is the key input that we need more of?

Dr. JOHNSON. You need more people willing to work in the childcare, private sector.

Senator WARREN. Okay, so we need more childcare workers to help unlock this labor supply across the board. How can we do that? Why don't we just pay childcare workers more money?

Dr. JOHNSON. Well, that is the best idea, and that is what would work. But just emphasize, these childcare centers, for the most part, operate on razor thin margins. So, there's not much else to squeeze.

The money that's paid by parents goes to the childcare workers. But the parents can't afford to pay the childcare workers enough to pull people into that childcare work. So, the market, I am afraid Senator Warren, is failing us here.

Senator WARREN. Okay, so the market fails, but DOD has stepped up. DOD child development centers capped fees at 7 percent of family income.

Then the Federal Government picks up the rest of the cost. It is a worthwhile investment in military readiness. But DOD has not updated its pay scale for childcare workers for 30 years now, and unsurprisingly, DOD is struggling to attract the workers it needs. Meanwhile, Federal investments in civilian childcare fell off a cliff last year when the pandemic funding ended, and that exacerbated childcare shortages.

So, Professor Johnson, if the Federal Government stepped up its investments in childcare, particularly to increase childcare worker pay, what impact would that have on the defense workforce?

Dr. JOHNSON. I think it would strengthen the defense workforce. More women would be able to go to work. You would also have more opportunity for women to build the skills that we have all been talking about, emphasizing across all range of skills earlier in their careers.

So instead of having to take some years out of the labor force, they would continue to be engaged, and that is really important for having supervisory talent, for example, when you reach a certain age.

Senator WARREN. I take it, Mr. Taylor, do you agree with this?

Mr. TAYLOR. Not only do I agree, it is an issue that you are increasingly seeing on the private sector side. Corporations are underwriting it, and we don't have a 50 year old lag in terms of compensation. So many, increasingly organizations are building their own childcare facilities and fully subsidizing them to draw talent in and to retain that talent.

The other thing, though, Senator Warren that I think is really important is increasingly we speak about, and we are seeing this in all of our data, it is dependent care. So more than just childcare.

Many of us find ourselves in the middle of this sandwich generation, where you have to decide not to go take a job because no one is there to provide for your elderly parents or grandparents. So, we are seeing a big theme in all of our data that says not only childcare, but broadly dependent care.

Senator WARREN. So, I think this is terrific. You know, I am all for building a strong defense manufacturing workforce, the topic we are here today to discuss.

But let's treat it like the supply chain issue that it is, and address root causes like underinvestment in childcare and dependent care, and childcare workers.

I am glad to be working with Members of this Committee to invest in the DOD's childcare program. I want to call out my partner in this, Senator Scott. We are working on this in our subcommittee, and we are going to keep fighting for affordable childcare for our defense workforce and for all Americans. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Warren. Senator Scott, please.

Senator SCOTT. I want to thank Senator Warren. We have had a good subcommittee on Personnel, and we are we are having one this afternoon. It is going to talk about injuries from, I guess, more noise—yes, it is going to be—it will be interesting because we have got to deal with this. So here is what I don't understand.

Do you know how many full time jobs have been added in the country in the last 9 months or last 3 months? Anybody know? We have lost 1.5 million. We are adding part time jobs. So, you are trying to figure out, why is this happening? I became Governor at the end of a big downturn. I became Governor in January 2011, and I went to a National Guard. They were coming back from overseas, and they had 30 percent unemployment. Then I ran my whole cam-

campaign on getting people jobs. I said, I would get 700,000 jobs. So, I tried to figure out how to get that done.

So, we just tried to figure out. I had to go recruit companies every day to try to get them to come to Florida, because people were moving out of Florida back in 2010 when I got elected. So, we did a variety of things. First off, we—as the Federal Government, we give a lot of money to our states to—for workforce boards.

You know how many people and they were filling jobs for? Nobody had any idea. There was no measurement. So, the first thing is we required them to give us a daily report. It was over—I think it was over \$250 million a year that we were spending of Federal money. That is number one.

Number two is we—I am a veteran, and I think it is ridiculous that people come back from overseas and don't have a job. I remember I was getting out of the—I didn't go to Vietnam, but I served during Vietnam era, and when Vietnam ended, it was impossible to get a job in this country.

All my friends here now couldn't find a job. So, we sort of—we started getting monthly reports on that and it took about a year. We did a variety of programs. We did a lot of workforce meetings and things like that. It took about a year, but actually our unemployment went—was lower for our veterans than it was for non-veterans. It was way higher for veterans when I started. I think it was almost 15 percent or something like that when I started. Unemployment for the state was over 10.

Then what we started doing is we, when I became Governor, all they wanted to do is say, oh, if you don't go to college, you know, man, you know, you must not be very smart. You are not going to have any opportunity, which is complete BS.

Most of my family didn't go to college. I am the exception of my brothers and sisters, my nieces and nephews, and they are never unemployed. They always have a job. The other thing we did is we waved a whole bunch of things for our veterans. So, there will be—here is my first questions.

So, we have all these rules for schools, and we have state schools, we have not for profits, we have for profits—we have all this stuff. Should there be different standards for everybody? I mean, when you guys hire somebody, you say, man, I think they ought to be a different standard for how they get Federal money or Pell Grants or any of this stuff. Should there be? Should it be treated differently just because of their—how they are organized?

Does anybody have a view on that? Because I mean, I could give you an example, if you are a university, you have no obligation to help people get a job. I changed the formula in Florida, and we became number one in higher education because I said, I remember I am a kid that had no money, went to school and did junior college that cost only \$200 bucks a semester. University was expensive at \$255.

They said, we are going to give our universities money based on three things, do you get a job? How much money you make? What is the cost to get a degree? It is actually how people got degrees and we kept tuition low. So, by the time I left, we were number one in higher education.

Now, University of Florida, according to a lot of studies like Wall Street Journal, is the number one public university in the country because we paid for our result. So, what do you guys think about having the same standards for—if we have standards for proprietary schools that they have to help people get a job or they don't get money. Same standards for all schools.

Dr. JOHNSON. So, Senator, I work for an engineering school that spends a lot of time trying to get its graduates jobs, and I fully agree that is a very important emphasis. I also point to Orlando. It is, to emphasize, I believe it is one of the leading examples of public private partnerships generating skills related to defense industrial base, and also generating huge amount of jobs.

Do I think that one size—we should have one size fits all for even higher education, even the university sector? I think some diversity and competition is good. I think at MIT does very well in that competition. I think encouraging others to do exactly what you are saying is a good idea. Would I require it? I think in this country, such requirements are hard to make work and often get a backlash.

But I think where you are pushing, Senator, that education of all kinds should be linked to finding jobs, and keeping people in jobs, and measuring outcomes and making that data available to everyone, I think that is tremendously important, Senator.

Senator SCOTT. Can I ask one question real quick? So, the other thing I did was if you came down, if you were Harris, and you were going to expand or let's say Northrop Grumman, they said they are going to add—they were removing the stealth bomber, so I tried to get them to do more of in Florida.

So, they said we are going to need x number of jobs. So, we guaranteed—I guaranteed, because I paid for it as state budget, I said, we are going to graduate these peoples with these degrees. Some of them were university, some more technical schools and stuff like that. So, do you think that that is what we ought to be doing with our education dollars?

Dr. JOHNSON. I think workforce planning, Senator, of exactly the kind you are talking about is very good. I think we you need to be careful about over subsidizing the private sector with things they would otherwise have done.

But if it is a net increase to the defense industrial base and on a Federal, State partnership basis, I absolutely agree that making sure people have the skills and are incentivized to stay in Florida, which is also what obviously happened, I think that is really important for the development of the defense industrial base.

Senator SCOTT. Thanks.

Chairman REED. Thank you, Senator Scott. Senator Hirono, please.

Senator HIRONO. Thank you, Mr. Chairman. We know that there is a workforce shortage in just about every business, every industry, from restaurants to the defense industry—this is for Mr. Taylor.

The DOD has established the Defense Civilian Training Corps (DCTC) to attract top talent into the defense ecosystem and specifically relating to acquisitions. So how is this Training Corp doing

in terms of attracting the kind of people that the defense industry needs?

Mr. TAYLOR. Thank you for the question. I think Dr. Lockwood would be more familiar with that particular DCTC program.

Dr. LOCKWOOD. Thank you. I will note that there are actually currently several STEM employment, workforce coordination programs going on in the Department of Defense, and certainly that one is among them.

I believe that these programs would be far more effective if there was a greater degree of coordination among them. For example, sharing of hiring objectives and even of candidates. Likewise, to the other Senator's point earlier, providing metrics for such programs would be very important.

Senator HIRONO. Well, why isn't there coordination? Why aren't there metrics to measure the effectiveness of these programs? Whose responsibility is it to ensure those aspects are addressed?

Dr. LOCKWOOD. Thank you for the question. As to the particular statutory authority, I will take that for the record. I will note that a mandate to coordinate among programs, to share best practices, to ensure that these programs are appropriately targeted to market and are adequately innovating would be very effective, and I believe that is something that the Congress, and the Senate in particular, can draw greater attention to.

Senator HIRONO. Okay. You can help us, my staff to better focus on some of those kinds of changes that we need to change.

Mr. Taylor, I was particularly gratified that you mentioned that if we want people to have STEM experiences in education, that it is really something that we should look at from pre-K to 12, and that, we also should pay attention to diversity. So, yes, Senator Rosen has a bill that would encourage, I think, more emphasis on these kinds of programs.

I have a bill that would focus on women and minorities in STEM education. What ideas do you have that would focus us on the need for paying attention to K-12 and onward if we want more people to—being STEM educated?

Mr. TAYLOR. Thank you for that question. I had the good fortune of once running what was called the Thurgood Marshall College Fund, which represents the country's publicly supported historically black colleges and universities, 47 of them. In fact, Mr. Gates here was my colleague.

We specifically created a program where we went into three markets that were largely populated with historically underrepresented people. We took kids who were between the ages of, and I want to get the numbers right, 9 and 13, with a specific focus on taking those kids in afterschool programs that were STEM oriented to expose those children and their families to STEM careers, but more importantly, the importance of taking certain types of curriculum early on so that by the time—if you wanted to go to college to be an engineer, there are things you needed to do in high school, courses you had to take, et cetera.

So, we mapped them. We gave them—oftentimes their families did not have—they didn't have parents who were college graduates, or if they were college graduates, they weren't STEM college graduates.

We literally took those kids, and we followed them through 10th grade, preparing them up to and including taking the SAT, ACT, et cetera. So those sorts of programs helped us yield a significantly higher number of future STEM workers from those communities than we would have without them.

Senator HIRONO. So, you are saying that we have to be very intentional about how we are going about it, and that you have some longitudinal data that shows that when you are this focus, that you will have people going into the STEM areas. Because, for example, women and minority people drop out of the STEM pipeline at every step of the way because especially for women, for example, there are not very many models for women in STEM.

In terms of workforce training, we are building a drydock at Pearl Harbor Shipyard. It is the biggest infrastructure project that the DOD is engaged in. It is \$3.5 billion. I hope that it will come in at that price.

But they had a hard time finding workers for this project. Some 2,000 plus workers will be needed to build this drydock over the next 2 years or so, and in the meantime, we have an apprenticeship program for Pearl Harbor Naval Shipyard, one of four public shipyards that we have.

They had 2,500 applicants for 152 positions. So obviously, there are a lot of people who want to get this kind of training so they can be in the pipeline to work in our shipyards, but we are not creating enough spaces for them. Do any of you have any ideas of what we can do to accommodate these young people who want to be trained in our workforce? Anyone?

Dr. LOCKWOOD. Yes. It has already been mentioned by a few of my colleagues here, but school to work training pipelines and close public, private partnerships with educational institutions are very effective at establishing firm pipelines for workers.

We have demonstrated this many times in the private sector, particularly in the auto industry, in some of the states represented here, reinforcing the training at community colleges and trade schools, and linking those skilled professions directly into where the jobs are needed.

Dr. JOHNSON. Senator, apprenticeships powered by AI, I think that is where the future is, and that is what the private sector is not going to do enough, without your prompting.

Senator HIRONO. Thank you, Mr. Chairman.

Chairman REED. Thank you very much, Senate Hirono. Senator Mullin, please.

Senator MULLIN. Thank you, Mr. Chairman, and thank you for the witnesses who are here. I just find it, the irony of us talking about what we need to do to get a workforce going and, you know, from a guy that is owned multiple trade companies—I mean, we incentivize in Congress.

We incentivize people to stay home. They can work the system. I mean, here we are legalizing drugs, marijuana for medical purposes, and we are incentivizing kids to get a medical card to smoke marijuana in high school at 18 years old, and they can't pass a drug test to get hired by DOD to begin with. I mean, we do it to ourselves here in Congress. If we want to really get our workforce

going, then we need to incentivize people to work, not have an excuse to stay home.

If we have a program that gives people a helping hand, we won't give them a helping hand to push them into the workforce either. Like get a helping hand, stay on a platform, and then you disincentivize them to build a step up. I have had hundreds of employees that refused a raise over the years that I have been self-employed because they can't afford to take the raise, because if they take this raise to \$18 an hour, they lose these benefits.

If you can't take a raise \$18 an hour and do that job, you are never going to get the job that can do \$30 an hour because the ladder stops at that point. It is our fault, and so, if we in Congress want to get serious about the workforce, then we need to figure out how we incentivize people to get into the workforce.

That means we need to push them into the workforce, not allow them to become dependents of the State. That is exactly what we have. We have three generations now of people that are dependent on the State. But that is me ranting. I will stop and I will move on to ask you my questions.

Dr. Lockwood, I would like to start with you. As the largest maintenance repair and overhaul facility in the world, which is at Tinker Air Force Base, we have a huge number of civilian employees, around 16,000.

Most of these employees are wage grade maintainers and many have decades of experience. We have received reports from—or reports that the DLA, which is the Defense Logistics Agency, is increasingly relying on contractors to do these kinds of jobs at other sites. Are you familiar with this?

Dr. LOCKWOOD. Yes.

Senator MULLIN. Okay. With a followup question on that, then, when using contractors instead of Government employees, what are the vetting requirements for bringing them in on our bases?

Dr. LOCKWOOD. It is my understanding that like other workers on military facilities, that they must pass a background investigation.

Senator MULLIN. Or are we concerned about moving that direction with contractors instead of having actual—our own contractors or our own employees working for the Department of Defense in a civilian capacity, relying more on that?

Dr. LOCKWOOD. I will note that the use of contractors in general is very costly to the Department. In many cases, the Department is paying a heavy premium rate for the use of contractors.

So, rather than necessarily take the expedient route of simply contracting out for that additional labor support, I would encourage instead the Department to correctly align incentives for the management of its own civilian personnel.

Senator MULLIN. Because we are paying a much higher price to have outside contractors, and so, if we can pay that wage for outside contractors. What is it that is keeping our Government, us, from upping the wages of individuals?

Because we have—we are literally losing employee contractors at Tinker because they are getting picked off by outside industries. Just give them a \$10,000 sign on bonus, and then we are turning

back around and hiring them as contractors to come back in and work on the base for an exuberant amount more.

Dr. LOCKWOOD. You are absolutely correct.

Senator MULLIN. So, what do we need to do to change that here in Congress?

Dr. LOCKWOOD. Right. I will note that currently the Department of Defense does not have the salary flexibilities that it needs in order to pay workers a going wage.

It is bound to the Federal wage schedule, which has been superseded several times by statute, creating great distortions in that wage that is actually offered to workers on the ground. Furthermore, the structures that surround civilian hiring are cumbersome, and it is very difficult for civilian employees of the Department, civilian managers to actually manage that workforce effectively.

Dealing with contractors is far simpler. If you need to dismiss someone for underperformance, you can do that immediately. You don't need to justify it. You don't need to go through a year's worth of write ups and large paper trail, and your job will not be in any way threatened by spurious complaints to the Inspector General.

So, as a result of this, the use of contractors is very expedient, but incredibly costly to the taxpayer.

Senator MULLIN. But—I agree with that. We also need to talk about direct hiring, which we have done this in McAllister Ammunition Plant, which Mr. Taylor, I was going to ask you about that because onboarding also takes forever to bring them on.

People aren't going to wait 6 months for a job to on board on going through the process, so direct hiring is important. But going back to this, and I will wrap it up real quick, Mr. Chairman, if we are—we are not saving us a dollar by keeping our wages down, it is costing us because we are all we are doing is gaming a system by going out and hiring contractors who come in and do the same job because it is faster, but actually it is because we need the workforce.

So, we, here in Congress, really need to start looking at the wages that we are paying and get on a scale to what it is today. I mean, look at how much wages have increased in the last 4 years.

I mean, it is astronomically, right? We haven't actually adjusted our pay wage at a serious look to keep up with inflation, especially with inflation being at 17 percent. We haven't actually adjust that in over 2 decades almost. Is that correct?

Dr. LOCKWOOD. That is absolutely correct. The Federal wage system is an antiquated relic of the 1970s, where we set wages in specific bends, binding occupations together that no longer bear any relation to one another.

Furthermore, we apply this antiquated methodology to an unrepresentative set of data that is currently collected by the Department of Defense. Completely redundant, in my personal opinion, to that already collected by the Bureau of Labor Statistics, which conducts a much larger and comprehensive survey of all American professions.

Senator MULLIN. Thank you. Thank you, Mr. Chairman, and sorry about going over time.

Chairman REED. Thank you very much, Senator Mullin. Senator Shaheen, please.

Senator SHAHEEN. Thank you, Mr. Chairman, and thank you to each of our witnesses for being here today. I think most of us would agree that the Federal wage system is broken. It gets hung up on political ideology differences and trying to fix it, and that is the problem.

But I don't know, I think maybe it was you, Mr. Taylor, who said that we have, my recollection was 9 million job openings, but only 6.5 million workers was—isn't one of the challenges that we are facing, the demographics of this country?

That we are not producing—because of our birthright, we don't have the number of people that we need to fill the jobs that are being created?

Mr. TAYLOR. Undoubtedly, and I mentioned that, that we have a birthrate problem. We have had so for the last 2 decades. What comes as a surprise to people is you are talking about a post-COVID impact.

During 2020 and 2021, the birth rate dropped 4 percent. We saw a significant—so it was already on its way down and then it dropped, and for good reason. No one wanted to go to a hospital during that period of time.

Senator SHAHEEN. On top of that, we have had the most restrictive immigration, legal immigration rates, in my lifetime in the last 6 years or so. So, that also exacerbates the problem. If we can fix our broken immigration system, we would do much better in terms of having the workforce that we need.

But can you—one of the things, and I understand Senator Warren talked about how we were able to out produce our adversaries during WWII, and one of the ways was by getting women into the workforce. How can the defense industrial base better leverage women's participation? I don't know who might like to answer that.

Dr. JOHNSON. Well, the discussion with Senator Warren, which I think is exactly on this target, Senator Shaheen, was about childcare, and women not being able to participate in the workforce. Both keeping the numbers down, but also meaning that at an important developmental part of their career, they are not in the workforce and not acquiring the skills, and therefore they can't move up later, including to supervisory positions.

So, you are missing people in a static sense, but also in a dynamic sense.

Senator SHAHEEN. Childcare is clearly an issue. It is something that I appreciate having had three children and having a challenge with childcare for the 30 years that they were at home.

But I think we have got a bigger problem in that, as I have visited schools, that young girls are not as engaged in the STEM subjects as young boys are. So, for robotics competitions, for example, girls are much—less likely to participate than young boys. Are there ways that we can encourage girls to think about those subjects that we are not already doing? Dr. Lockwood.

Dr. LOCKWOOD. Thank you for the question. I have a young daughter at home, and she told me when she was 3 that when she grows up, she wants to be a doctor and a mommy and a scientist, and I want that to be possible for her, so I determined I certainly was not going to quit.

To double down on the childcare issue, I do believe this is a critical thing, but to your point, it is really important that the child can envision herself doing the job. Children are not going to study.

They are not going to invest in things that they think are for other people. So, the broader we can make opportunities to engage in after school activities, to put the robot—to put the drone remote in the hands of all the children is a good thing.

I will also note that among the developed economies, the United States has among the shortest school day. This creates an incredible burden for all working families. There are in many areas good before and after school—

Senator SHAHEEN. Yes, you don't have to explain that to me.

Dr. LOCKWOOD. Okay.

[Laughter.]

Senator SHAHEEN. I understand that.

Dr. LOCKWOOD. So, yes.

Senator SHAHEEN. To follow on Senator Hirono's question about the submarine industrial base, excuse me, over the next 10 years, the submarine industrial base is going to need to hire nearly 100,000 trained workers at both primary construction yards and 17,000 people at vendors to support the supply chain.

You talked a little bit about ways that we could encourage apprenticeships and other ways we could encourage workers to join in the submarine industry. Are there ways that suppliers can also improve the labor environment for skilled workers?

Dr. JOHNSON. Well, I think it is going to take all of them. That is really interesting. This is about a human capital strategy.

We can decide that we are going to opening a number of shipyards or whatever we do, but ultimately, your point, well-crafted H.R. strategy, where you say we need 100,000 people at this period of time means we will get some percentage of people from this sector, the supplier community, the Government, et cetera.

This requires a comprehensive strategic overview and plan. What we have seen is there are no shortage of programs within the Federal Government, but they are not orchestrated, and they are not specifically identified, time limited, budget limited, et cetera, to get the results.

In the private sector, if I said I was going to need 100,000 employees, as has often been in the companies where I have been, fortune 500 companies, CHRO, you are told 5 years from now we are going to need this many of these types of employees in these geographic locales, and we build a strategy around it.

That is HR at its best and it can be done, but very intentionally.

Senator SHAHEEN. The Portsmouth Naval Shipyard, which is one of those four public shipyards which shares the border between New Hampshire and Maine, has taken an approach that integrates its workforce into decisionmaking, and that has really kept the workers there. It is really focused on working with management on good labor practices. So, I would agree, that is a great way to better keep people in the workforce. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Shahee. Senator Budd, please.

Senator BUDD. Thank you, Chairman. I thank the witnesses for being here today. As Senator Kaine mentioned a few moments ago,

expanding the Pell Grant for short term skills based education, it is one of the quickest in the best ways to combat these labor shortages that we are talking about today and the ones we have seen around the country.

I think that my proposal, the Pell Act, which the House is actually taking up this week, is one of the best ways to approach expanding this program. So, my bill allows a variety of educational institutions to participate in the grant program with guardrails that empower institutions to produce high demand workers for high paying jobs. That is exactly what we need to buildup our defense industrial base.

Dr. Lockwood, the need for a strong pipeline, switching gears here to cyber—cyber workers. That need has grown exponentially, given the current threat environment that we are in. So, a two part question, what can the DOD learn from the private sector on recruiting and also retaining cyber talent, and simultaneously, how can the DOD better compete against the private sector for that talent pool?

Dr. LOCKWOOD. Thank you for the question. I think one of the key lessons of the private sector is that a 4-year degree is not necessary. We need to enable our young people to become productive workers as soon as possible.

Dr. Johnson has earlier mentioned AI enabled training. I will just offer that DOD already has experience with AI enabled training, and particularly in the IT field, where the Navy some years ago piloted a program to train its shipboard computer technicians using an AI assisted digital tutor.

This was an incredibly effective training methodology and quickly was brought to bear to skill up, in this case, an enlisted force, individuals entering without a college education, and quickly make them wildly productive.

Not only were they very quickly trained, but the quality of their training was significantly superior to those who had gone through the traditional schooling. Sir, I am sorry, could you remind me of your second question?

Senator BUDD. How can the DOD better compete against the private sector for that talent pool? Because they are going to be using some of these same things that you are mentioning. So how can we differentiate DOD?

Dr. LOCKWOOD. Yes. Thank you. I think one thing that the Department can offer that the private sector cannot is purpose that is driven by something other than a profit motivation. To some extent, the Department will not always be able to compete on wages. It can compete on purpose.

I would encourage you to develop a revolving door mindset to make it easy for workers to flow in and out of public service and private employment. Right now, it is more of a one way exit than a revolving door, so making it easy to recapture that talent, to give reentering either servicemembers or civilian workers time to recover their career track within the DOD apparatus would be, I believe, very effective. Thank you.

Senator BUDD. Thank you. So, you know, every high school or college here with a STEM major, they are aware of all these opportunities with Google, Amazon, and other big tech firms.

Do you think the Pentagon can improve its advertising or public education on severe—excuse me, on civilian career opportunities, and what recommendations, if any, would you have that would allow us to further increase the visibility of DOD opportunities?

Dr. LOCKWOOD. Thank you for the question. During the time of COVID, DOD and even its industrial partners' footprint in public schools was significantly curtailed and it has not recovered. I think face time is very important with our young people and the public schools provide an important avenue for that.

Senator BUDD. Critical to the defense industrial base and the DOD civilian workforce is not only hiring talent, but retaining talent, as you know. Are you aware of any barriers in OPM's [Office of Personnel Management] promotion process which could inhibit retention within the DOD civilian workforce? Dr. Lockwood.

Dr. LOCKWOOD. Yes. Thank you for the question. I will note that the OPM process for nearly all personnel actions is quite bureaucratic, and it takes very long time. In many cases also the position descriptions are outdated and perhaps not well honed for the actual work that needs to be done. This would inhibit timely promotion and advancement if candidates are being screened by OPM against outmoded job descriptions.

Senator BUDD. One of the things of my colleagues have mentioned is the shipbuilding challenges, undersea submarine building challenges coming up.

You know, as the Navy works to expand the size of its fleet, so what incentives are particular to that would you suggest for the Department of Defense and the manufacturing workforce in this particular area related to shipbuilding and undersea capabilities? Any of you.

Dr. LOCKWOOD. We need to draw more workers into this field. So, in terms of incentive programs, I think we need to fix the broken Federal wage grade system and, compensate for these high demand skills.

There needs to be a very visible public campaign to advertise these availabilities and to really put ourselves out there and say this is critical for the national defense, and let's all get after it.

Senator BUDD. Thank you.

Mr. TAYLOR. Senator Budd, just very quickly to that point, we actually went to the civilian workforce and asked the question. This is broadly. Only 46 percent of working American, civilians have even considered the Department of Defense as employer.

When we asked them specifically why, the primary reason that was cited was a lack of knowledge about the DOD's culture and their employer brand. So, in addition to raising salaries and providing all sorts of benefits and talking about it, we need to sell that this is an actual opportunity. People just don't think of doing it. They think about, go to the military or not.

Senator BUDD. Very helpful. Thank you all.

Chairman REED. Thank you, Senator Budd. Senator Kelly, please.

Senator KELLY. Thank you, Mr. Chairman, and thank you to our witnesses for being here today. Dr. Johnson, I appreciated the focus of your testimony on the CHIPS and Science Act, which I helped negotiate, and I particularly appreciated your focus on the science

and economic development investment in the science portion of that bill.

As you noted, while we were able to provide advanced appropriations for the Critical CHIPS Act programs, there are many other new programs created that are going to rely on an annual appropriations.

Now, I come from 15 years at the space program where we see this firsthand, but Dr. Johnson, can you expand upon your testimony and explain how investments in basic science and innovation can yield economic growth, even if we can't always foresee exactly how those investments will pay off?

Dr. JOHNSON. Yes, Senator. So, as you know, this was a big revelation to us actually from the 1940s. It came out of the war effort accelerated by Sputnik and then the creation of the space program.

What we have come to understand, and now there is a lot of data on this, which is summarized in my testimony. We have a whole book on this topic. Is that when you put money into basic science, you generate a whole range of ideas, many of which you don't expect to see.

Then you if you have a process of channeling that into specific applications—the space program would be one public purpose program, but there is many other commercialization, including everything that is brought through digital computers and the internet, for example, and mobile telephone communications.

That machinery that we have in the United States is actually pretty strong, the private sector piece. But the private sector does not invest enough in basic science because it is all about the spillover effects. It is all about all those unexpected effects. It is all about being able to suddenly invent a vaccine because you have got a new disease you would never heard of before, but you have that capability and so on.

The Federal commitment to science is fundamental to our economic prosperity but also, Mr. Chairman, to our national security because this is what we have been very good at, this is what has propelled us forward in many ways, and this is what China has learned from us and what they are doubling down on now. So, we have to invest more just to stay up with them. I think we can do even better than that.

Senator KELLY. Is it true—I was always of the understanding that the private sector is not going to invest in something that has a return on investment that goes beyond 5 years. I don't know if that number is the number you go by, and that is why it is up to the Federal Government to be making these basic science investments because private sector just can't do it if they are not going to see a return on the money.

Dr. JOHNSON. It can be about time horizon. I think much more, it is about spill—spillover effect. So, the Human Genome Project, for example, shopped around some private venture capitalists in the 1980s. They turned it down because they said, look, great project. You are going to create a lot of knowledge, but we won't be able to capture the value of that in—ourselves. It will be general knowledge.

So, the Human Genome Project was funded, as you know, by the Federal Government. Massive success. 300,000 jobs created, tre-

mendously strong industry. A big part of our economy, and produces drugs, therapies, and vaccines that are essential to everybody in this country. But it needed that public impetus.

This, of course, is what the National Institutes of Health does really well. But we need more of that. We need more of that across more sectors.

Senator KELLY. Well, as somebody who is always trying to sell our space program, I would—you know, stress it, it wasn't about like a product like Velcro, it was about creating industries, industries that no longer existed. I mean, our aerospace industry here in the United States has become a big part of our economy. That didn't exist before the 1960s really.

So, from a national security perspective, what opportunities—I want to connect us to the CHIPS and Science Act. So, what opportunities are we missing by not fully funding the CHIPS and Science Act? Because this could be really a long overdue and historic investment in American research and innovation.

Dr. JOHNSON. Oh, it is a breakthrough piece of legislation, absolutely, Senator. That taps into what was done previously in the 1940s and with the space program but it goes much further. It is a little bit painful that the appropriation is not followed through.

So, the Congress recognized the opportunity and I think agreed on a very broad bipartisan basis. But you have got to put some money into it. Then, Senator, I think the question becomes, what next?

What are the next sectors where we want the breakthroughs? What is the next equivalent of satellites, next equivalent of the internet, next equipment of mobile communications? There is a lot of opportunities in biomanufacturing. There is a lot of opportunities in other parts of semiconductors.

There is opportunities in critical minerals, for example. There is a long list and I think Congress needs to engage with that. I think you should be thinking about CHIPS and Science Act 2.0, after, of course, you fund the first version.

Senator KELLY. Yes. I had other, you know, some questions that led to STEM education. But I look at basic science and STEM education as being sort of like kind of in the same bucket. You know, this is like the seed corn for—you know, it is the catalyst for what grows the economy, both education and investment in science. So, thank you.

Dr. JOHNSON. The National Defense Education Act of 1958 and NASA, the two big reactions to Sputnik, they were both brilliant moves by Congress, Senator. So, I am sure we can do it again.

Senator KELLY. Well, thank you, and, Mr. Chairman, I have a couple of questions for the record.

Chairman REED. We will accept those, Senator. Thank you very much.

Senator KELLY. Thank you.

Chairman REED. Senator Schmitt, please.

Senator SCHMITT. Thank you, Mr. Chairman. Dr. Johnson, I wanted to kind of explore your idea of these tech hubs. I am from St. Louis area, and St. Louis has been identified, and there is a lot of assets there.

So, you have got NGA, you have got the Taylor Institute there. There is a lot of alignment that can be a draw. One of the challenges, I think, as we talk about workforce is there is a bit of a—there is a misalignment in higher education, right?

You have got a lot of 4 years that chase degrees for enrollment. You have got community colleges trying to figure out where they fit in. The you have got these apprenticeship programs that, as you mentioned in your opening comments, maybe sometimes are limited to what that particular company might need. So, with that is sort of the backdrop, how does this actually work?

Because am intrigued by this and I think it is an encouraging idea. We do need to have, I think, an industrial base that is more widely dispersed. We have talked about the dangers in our supply chain.

Let's just take St. Louis as an example. It could be anywhere. It could be in Rhode Island or somewhere else. How does this actually work? How do we get into, you know, 5 to 10 years in a place where somebody who wants to work on nuclear submarines, so not necessarily just the engineer that has got the 4-year degree—how does this work—how does alignment work in a tech hub?

Dr. JOHNSON. St. Louis is a fascinating example, Senator, in part because you were one of the country's leading tech hubs, 100, 120 years ago, right. One very unfortunate thing that happened, and I don't have any particular person to blame on this, is that as innovation moved East and West Coast, you got less innovation, less corporate headquarters in St. Louis, but not for any particular good reason, right.

I mean, people have got strange reasons like the way where airline routes went and so on, but it is not—you have got a lot of talent. The talent can't move, doesn't want to move, shouldn't need to move.

I think tying it to—with the mindset of Senator Kelly, if we have, if Congress has and if the relevant agencies have priority sectors to pursue and places that are available, including with State and local support, which would be making sure the workforce develops, Senator Scott made very good points about that—also available housing, I would say, Senator.

So, you are not adding 10,000 workers, but they have no way to live. So, the price of housing goes up and that means you have got to pay a higher wage, or they just won't come. So, I think that looking for that combination, and I think St. Louis scores very highly in our metrics, because it seems to us that you have exactly that kind of combination of circumstances. But we found 102 places in 36 states that have potential.

Honestly, a country this size, with science being so important to our economy and to our national defense, we should be running a massive portfolio of these deep science investments. Looking for ways to commercialize them, getting those public, private partnerships with State and local support.

But the Federal Government is the catalyst. Without the Federal Government, you are not going to be able to move the needle. We have done it before, and you agreed to do it again in the CHIPS and Science Act.

Senator SCHMITT. So that is—from your answer there, it seems like that is the research investment side. But on the workforce because I am genuinely curious.

So, let's say I am a 17 year old in high school, and I want to pursue this path where, you know, like there is some immediate opportunities. What does that look like, or what should it look like for that individual to try to navigate to get to a place where we want to be, within that tech hub?

Dr. JOHNSON. So, Senator Scott talked about workforce planning at the state level. I think that is better on a State and local than at the Federal level, where he was matching up incoming investment or defense contractors to say, we are going to need this kind of jobs over this many years.

He was a match up with people coming out of the high schools, I think in particular high schools, in the technical colleges. I think that is exactly the right thing to do, Senator. I think that apprenticeships are undervalued by the private sector because you lose the—if you train the apprentice, the apprentice leaves, so the private companies don't want to do it.

But from a public policy point of view and from a St. Louis point of view, more people who have completed apprenticeships is good for the local economy. Particularly if they don't want to move or are not inclined to move to the East and West Coast. Then you have got this very strong, trained labor force, including with the middle skills that we have all been emphasizing, agreeing on.

I think this is a completely bipartisan consensus across the country as I—when I talk to people. It is not politicized at all. Everybody wants something in this direction. The Federal Government, though, is the critical catalyst.

Then deciding which sectors and lining it up with the defense industrial base, that is a brilliant piece to add. Because if we know that submarines are important or if we know that aircraft are kind of important then—and you know there is going to be a 20 year commitment to that from a national security point of view. Then you can plan a lot more activities around that, including the location for those innovations.

Senator SCHMITT. If you guys have anything to add to—

Mr. TAYLOR. Yes, Senator. The reality is, if I am going to use the example of that 17 year old, first of all, he or she needs to know what the opportunities are. So, I am sitting out in Florida, St. Louis, or wherever I am, and I just don't even know what the possibilities are by virtue of my background.

Then we have got to specifically articulate a pathway that may not and oftentimes doesn't require a 4-year college degree. It could be that young man, if you do this for 6 months, this could prepare you for an apprenticeship that could get you this job, et cetera.

So, we literally—the biggest problem that we are hearing from young people is they understand what the Government says it needs or what our country says it needs, they just don't know the pathway to get there.

So, educating old school guidance counselors. Like right, everyone is not going to college and maybe go into the workforce. This is how you prepare yourselves for that. Those are the two most important things as we are hearing from younger, potential workers.

We talk to high school students a lot and they are like, listen, I know what I think I want to do. That sounds interesting, and if you can pay me \$35 bucks an hour, 20 years old, why not, without debt from college, et cetera. I just don't know how that works. So, articulating to the future workforce how it all works will go a long way toward solving for these talent challenges.

Dr. LOCKWOOD. Bring back shop class. Let them work with their hands. Let them build things. Let them tinker. Let them print things with the 3D printer. Let them be creative. They can see then, that there is a path for me to do these mid skill jobs, that there is dignity in that, that the country needs that. It is valued, and in that shop class you can make the pitch.

Senator SCHMITT. Bring back civics and shop class. Let's do it. All right, thank you. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Schmitt. Senator Blumenthal, please.

Senator BLUMENTHAL. Thank you, Mr. Chairman. Shop class is good. I don't know about in the era of AI, artificial intelligence, how many shop class enlistees there will be, but maybe the nature of shop class should be changed. I want to engage in kind of a thought experiment. I am the CEO of Electric Boat.

As you know, Electric Boat in Connecticut makes the most capable and reliable submarines in the world. If you look at employment patterns at Electric Boat, they have mountains and troughs. The reason they have mountains and troughs is that the Pentagon often changes procurement requirements.

We want two submarines a year, no *Virginia*-class. We want one sub, maybe one plus the *Columbia*-class, plus—you know, if you are a manufacturer, pretty hard to engage in recruiting, hiring, training that involves investment when those procurement commitments are changing. Just to mention the elephant in the room, right now we have no budget for this fiscal year.

So, the Pentagon is kind of scratching its head and saying, okay, we think we know what the budget is going to be. Chairman Reed has done extraordinarily skilled and excellent work in passing the National Defense Authorization Act, which provides a basic contour for what procurement should be, but the money has to be approved.

To what extent does this indecision by the Congress and by the Pentagon, indecision and reversal of decisions affect the ability to recruit, train, and hire a workforce like Electric Boat?

Dr. LOCKWOOD. The workers will go somewhere else. They are not going to sit around and wait for us to get our act together. They have families to feed. So, unless we can really maintain the continuity of that production pipeline, which I agree we desperately need, we will struggle to retain.

Mr. TAYLOR. The prospect of that, even the prospect of potentially not knowing, so the idea of not knowing—employers, employees or voting with their feet. So even if you have the employee, they are currently working in these industries, this level of indecision gives them an anxiety that will often lead them to come to the private sector because they are like, at least to there, I kind of know what I know.

Dr. JOHNSON. Senator, I completely agree with where you are going and what my colleagues just said, but I would also remind

everyone that the V12 Merlin engine that powered the Spitfire and the Hurricane in WWII and was decisive for keeping Germany out of Britain, started to develop in 1929 before there was any public procurement guidelines for that engine. There was a private sector innovation, Senator.

What you really need in this country is not just better organized procurement exactly as you are wanting. You need people who are pushing on the innovative frontier for the new stuff the Pentagon is not—doesn't even though they want yet, right. How do we incentivize that?

How do we encourage that? How do we build the skills? I think the shop class has never been more important, Senator, because I think losing those manual skills, losing our thinking with our hands is a huge disadvantage when we think about the world. Because the engineers who built the Merlin, who built the Spitfire, who built the American effort in WWII were very hands on people, once they understood how to bend metal.

That is the key to a lot of these innovations that we are talking about.

Senator BLUMENTHAL. You know, I think what you are saying about shop class, which is not just what happens in the classroom, but the manual skills and the instinctive approach to how to put things together and make them work, that is what Electric Boat is trying to hire, the welders, the electricians, the pipefitters.

People who are skilled at the trades. Not only in shop class, but frankly, in high school. I think we need to do a better job of selling people, future workers, on the idea, you know, you can have not just a job, but a career, a real career. Making a lot more money than let's say my four children. They were all educated in liberal arts institutions. Three of them are lawyers like me.

But there are a lot more lawyers per person maybe than there need to be. We need more of the folks who can do the work at Electric Boat, with the careers that really provide not just financial gratification, but real dignity, the dignity of work. You are nodding, so I assume you agree.

Dr. JOHNSON. Dr. Lockwood said it already—sorry, Dr. Lockwood said. I totally agree. Dignity and status and purpose, but you have got to also pay people good money, right? Because people have to live, and that is a question of how much you pay them relative to what it cost to live in the areas that you are trying to develop.

But if you get that right, which we have done in this country before, Senator Blumenthal, and you have got very strong, obviously, places in Rhode Island and in Connecticut that also get this right, then we can do incredible things.

Mr. TAYLOR. Senator, there is—

Senator BLUMENTHAL. Go ahead. Mr. Taylor.

Mr. TAYLOR. Yes. I would just submit to you that we oftentimes talk about and believe that our talent pool must come from the K through 12 system. We increasingly have that middle group, that middle 45 to 55 year old who is now displaced, wants to work. You want to talk about dignity of work, and so many of our training programs disproportionately focus on young people.

That is good, but we are ignoring that there is a significant swath of the population that is available, wants that dignity of

work, needs to do it, and we don't provide reskilling and upskilling programs from the Government, frankly, to them.

We will give you a Pell Grant all day for the kid, but what happens to that 45 year old whose job has been significantly changed on the account of technology and they could become a welder, but themselves don't know how to do that and don't think there is a pathway to that.

So, I would not ignore that significant portion of our population that wants to work but doesn't know how to reskill.

Senator BLUMENTHAL. I thank you all for your insights, and by the way, Chairman Reed and I have just come back from a trip to Ukraine, and the Ukrainians are taking what seem to be often very low tech drones, and because they have those manual skills, they are able to reconfigure them, I don't know what the technical term would be, and make them lethal.

Now, they still need arms. They need support. They need the resources. They are sadly lacking, and we need to give it to them in the supplemental that is now before the House that we passed here in the Senate. But they have been extraordinarily innovative and creative because they have many of those manual skills. Thanks, Mr. Chairman.

Chairman REED. Thank you, Senator Blumenthal, and thank you for your not just participation today, but for your willingness to travel to Ukraine and to do so many other things.

But this has been a very, very helpful and useful panel. I would like to touch on, again, on something that was mentioned, but that is the perception of working for either the Department of Defense or a defense company seems to be very negative. That is an issue we have to deal with, and let me just quickly, Mr. Taylor, Dr. Johnson, Dr. Lockwood.

Mr. TAYLOR. Yes, we actually—I don't—at the end of the day, it is far more attractive to most employers. They know of the brand name. You know, it is like Lockheed Martin, Boeing, et cetera, that is a far more attractive opportunity to them than—and they don't even think about the opportunities.

As I know, half of the American civilian workforce has said they don't think about the Department of Defense proper. So, to the extent that we could create—this is what the job is, it doesn't matter if it is at the Department of Defense or the rest of the industrial base, I think we could solve for some of the problems. Private sector has a one up on the Government in those roles.

Dr. JOHNSON. It is a very interesting problem that you are articulating Senator because I do think serving the Armed Forces is still prestigious and sought after. I served in the military when I was young, not in this country unfortunately. I did register for Selective Service when I was eligible. I got turned down because I was slightly too old, which was disappointing.

But I think the reason for that—and those were regarded as good things and those were great experiences. I think that is because we have this perception and correct understanding that you build skills in those military roles and somehow—and perhaps it is about the wage classification system, as was articulated.

I am not saying that there isn't—there aren't deep structural problems, but somehow that same prestige, that same conviction

that you are building, leadership—we have great students in our MBA classes who are former military, for example, and who are terrific leaders, and everybody automatically assumes that is what you get if you are bringing a lieutenant or captain into an MBA program.

Somehow that is not coming across in the defense industrial base. I think Dr. Lockwood has got some very good ideas, and as do you Senator, about how to fix that. But I think the way you articulate just in those terms is exactly right.

Chairman REED. Thank you. Dr. Lockwood, please.

Dr. LOCKWOOD. Yes, I think it is to some extent about prestige. It is also about what people know about. I will note that there has been a great consolidation in the military footprint. When you ask young people, do you know a veteran, fewer than ever say yes. So, we just need to be out there in the community.

We need to say that this is not someone else's duty. This is not something I can outsource. This is our responsibility as all Americans, to participate in some way in making sure that our country and, you know, that of our allies is safe.

So, I think if we couch it as a community responsibility, and if we put ourselves out there in new ways, that both our partners in the industrial base and our defense civilian workforce can get more of the attention that it rightly deserves. Thank you.

Chairman REED. Well, thank you all for excellent testimony. As I said initially, this is not a one stop. We look forward to your collaboration and your input too. If there are issues that we are not dealing with, or we should be dealing with, or if there is advise you can give us, don't hesitate, please.

Thank you very much. With that, I will adjourn the hearing.

[Whereupon, at 11:32 a.m., the Committee adjourned.]

