

Testimony of William B. Bonvillian to the House Defense Appropriations Subcommittee, Hearing on Workforce Development and the Department of Defense, October 26, 2021

Chair McCollum, Ranking Member Calvert and Members of the Subcommittee:

I want to thank you for the opportunity to meet with your Subcommittee today. I have been asked to speak about the problems facing American workforce education overall, to discuss some of the possible solutions, and to focus on Defense workforce education in that context.

Our economy has low productivity which affects our economic growth and therefore our financial well-being. There are two inputs to improving productivity: technological advances and a more skilled workforce. U.S. firms and policies have historically tended to favor the first not the second. So, education and training are lagging behind available technology, which affects our ability to adopt the technology. Now is a critical time to improve the workforce input. This is a message that applies to DOD as well: If it wants its modernization agenda, it needs a stronger industrial base, and this means workforce development must be a key input on its agenda.

Key Workforce Education Problems

What are the challenges we face in workforce education? We don't have a working system for workforce education and we need one. Let me briefly summarize what I believe are the key problem areas in this system that isn't a system:¹

- We have a **disconnect between work and learning**. We have school on one side and work on the other, but few clear routes from school to job. They are disconnected.
- Workforce education has faced **disinvestment by government and employers**. Despite the growing workforce needs, workforce spending by both has been in decline.²
- **Few federal programs reach higher technical skills and incumbent workers**. This is important because we need to teach advanced skills and "upskill" the current workforce. And our **workforce programs are not well-linked or complementary**.
- **Vocational education** in secondary schools was **largely dismantled** starting in the 1970s. We said we were going to instead send everyone to college, but then we didn't. Only 36% of those over age 25 have college degrees.³ Those who didn't get through college missed out on technical education in high school as well.

- **Community colleges are underfunded.** They lack resources to provide advanced training in new fields and their student completion rates are too low -- only 40% complete Associate Degrees within six years.⁴
- **Colleges and universities are disconnected from workforce education.** Although the college degree is now the critical differentiator for workforce success and economic wellbeing, many colleges think career education is someone else's problem.
- **Lifelong learning is missing.** Although new skills are being required at a rapid pace, particularly in the information technology area, we have no system for lifelong learning.
- We have **underfunded advanced technical education programs, including at the DOD's Advanced Manufacturing Institutes.** DOD's nine Manufacturing USA institutes can take on advanced technical training curricula and training but it's a big task and they lack needed resources.
- We have a **broken a broken labor market information system.** Strong markets require strong information systems. But employers lack information on the skills job applicants have, employees don't know what skills employers need, and educators don't know what skills they should offer training for.
- The existing actors in workforce education are in **"legacy" sectors and these are hard to change.**

The Quality Job Challenge

Against this backdrop, the U.S. has quality job problems. Technological advances, especially in information technologies (IT), are putting many quality jobs out of reach for workers who didn't get the proper skills and training. So upskilling is ongoing, with jobs increasingly tending to go to college educated. Having at least some college has replaced high school as a core job credential. But we don't really know what most college degrees stand for. Too often it's a default credential that employers require without looking at the competencies behind it. Meanwhile the growing IT sector demands new skills. The result is that new high or middle skills jobs will require education beyond high school. But again, only a little above 1/3 of Americans over 25 have a 4-year college degree and this college degree does not necessarily prepare one with the skills needed in the workforce.

The Need for a New System

We have what economist David Autor has called a barbell problem. On the barbell we have a bell that represents a thriving and growing upper middle class. The bar of the barbell – the middle class – is thinning out. And the bell on the other end, with lower-end, lower-paid services sector jobs, has been growing, with too many in the middle class shunted down the bar to the services sector bell. But Covid-19 has made the problem worse. It hit lower end services sectors particularly hard – in-person retail, hospitality, food service, travel and tourism, etc.⁵ – with 7.7 million now unemployed.⁶ Many of those

service jobs are taking a long time to come back, while job openings tend to be in jobs requiring more skills. We have a jobs mismatch, with stranded jobs. We have jobs that require more skills but the potential workers are missing the skills to fill them. Facing these odds, many potential workers have simply taken themselves out of the workforce - we have our lowest labor participation rate, 61%, ever.⁷ A key part of the answer to this mismatch is that we need a new workforce education system. And we need it soon to deal with this dilemma.

If you ask Americans what high school or college are, they know. If you ask them what is the workforce education system, you get a blank stare. We need to build this system, and by building it we will open up new opportunities for the too many Americans who are being left behind.

The Scale-Up Role of New Education Technologies

We can't just do more of the same and expect change. We can't keep turning out the same numbers we have in the past, we need to scale up our efforts. One promising development is that there are new education online technologies evolving that could help with scale. While coronavirus taught us that much education for over-18s could go online, video business conferencing tools, like Zoom, Webex or Teams, didn't take advantage of what we now know about learning science. Asynchronous online video that is self-paced with continuous assessments, in 10-minute chunks that fit the attention span, with feedback loops, and repetition, can offer much better education than conferencing tools. Key parts of workforce education must be hands-on, but much content learning can be moved online, saving instructors for mentoring and learning-by-doing. Online education is becoming widespread and can be optimized with blended - combined in-person and online - learning. Online can be joined with: virtual and augmented reality (VR/AR) technologies for learning by doing, with computer gaming and simulations, with blockchain certification (which enables secure rapidly accessible verified credentials), with in-person bootcamps, and with digital tutors for more individualized instruction (when artificial intelligence (AI) advancements make further progress). This is just one option, what are others?

We can start to see the shape of a new workforce education system. It could include:

- **New education technologies**, including online, VR/AR, gaming, digital tutors and AI, as described above.
- **Short Courses** that take weeks and months not years and better fit student schedules. These can be developed as stacked modules that also embed industry-recognized credentials. These short courses and credentials in turn should connect to community college certificates and degrees.
- A **"Trifecta"** of programs at community colleges that reach not only community college students, but incumbent workers and high school students.
- **Apprenticeships or "Apprenticeships Light"** to break down the current work/learn barrier. These can be offered collaboratively by community colleges,

high schools and employers. Regional coordination can include employer and regional associations and local government.

- **Raise community college completion rates.** Too often these can be in the 30% range but the workforce situation would get a lot better if they were 70%. Starting students with technical courses, so they can see their career opportunity, and combining them remedial courses, which are tied to career skills, is an effective way to do this.
- **Technical and Comprehensive High Schools.** While some states kept their vocational high schools, too many were closed. States and regions can support new technical schools or build skills programs into existing high schools.
- **We need an expanded employer role.** This is vital for apprenticeships, training standards, industry-recognized credentials and programs at community colleges and high schools that reflect employer needs.
- **New curricula for advanced fields.** We lack curricula for new, emerging fields, particularly in advanced manufacturing. There is a key role here for the advanced manufacturing institutes.
- **Unified efforts at the state level.** Federal workforce programs are stove-piped, and these stovepipes are duplicated at the state level as states carry out these programs. But some states are connecting these programs at the state level, enabling a more unified workforce education approach.
- **A new labor market information system** is needed by employers, education institutions and workers. A stronger information system means stronger labor markets that benefit all participants.

The Defense Workforce

How do we tie these overall recommendations to the Defense Department and its needs?

DOD has massive workforce education needs. It must train service personnel in operations, maintenance and repairs. It needs to help departing service members and veterans to keep military service an attractive option, it needs to upgrade its own industrial base workforce of 88,000 at depots, arsenals, and shipyards. And it needs to upgrade the skills at tens of thousands defense contracting firms, small and large, that make its platforms and equipment which employ millions of workers. Up to one-third of the 250,000 U.S. manufacturing firms have defense contracts.⁸ Because the services have well-established training programs for their military personnel, I want to focus here where there are less established workforce systems – in the categories of the defense industrial base, defense contractors and departing service members. Jobs in manufacturing are a particular focus for these groups.

DOD, then, faces a series of workforce challenges, including: adopting advanced manufacturing, preparing service members for subsequent careers, and in emerging technology areas where it needs expertise, such as artificial intelligence (AI) and cybersecurity.

Advanced manufacturing is a particular challenge for DOD, as DOD has now clearly recognized.⁹ The U.S. manufacturing productivity rate is at historically low levels, stagnating for the last 15 years. Small and mid-sized manufacturers (SMMs) are falling behind larger firms in efficiency and productivity and this gap is widening, yet almost half our industrial output is from these smaller firms.¹⁰ The U.S. has been ceding major parts of its manufacturing base to foreign competitors and falling behind in new manufacturing technologies. This is a major problem for DOD given its need for secure and reliable supply chains.¹¹ Advanced manufacturing – applying our still-strong innovation capacity to innovation in manufacturing technologies and processes – is the way out.¹² It will enable us to build the efficiency and productivity we need to compete. This means developing technologies in such areas as robotics, AI, 3D printing, power electronics, optics and photonics, advanced materials, and production cybersecurity. DOD's industrial base, operators and contractors need to implement all these technologies to get to the new manufacturing efficiencies and cost savings it requires.

But we won't get to the new manufacturing technologies unless we have a workforce ready to implement them. So, we need new workforce training systems and DOD must be a part of this because it has particularly acute needs. Yet small firms won't support workforce education in new manufacturing technologies unless they have orders in place requiring these new technologies. Thus, technology implementation has to accompany workforce implementation – these programs must work in tandem.¹³ Education and training lag behind technology adoption, as noted above, which creates a skills gap and slows adoption of advanced manufacturing technologies. So proactively developing workforce education alongside the emerging manufacturing technologies is essential to close the skills gap and increase the adoption of advanced manufacturing. The advanced manufacturing institute program is well-positioned to do this.

When DOD looks at education programs it needs for its workforce, it can consider encouraging and promoting many of the new policies outlined above. DOD can play an important role through active support for new online education technologies, for short modular courses that can be stacked to lead to certificates or degrees, for embedding employer-recognized credentials in education programs, for programs that reach incumbent workers, for apprenticeships, for efforts to raise completion rates, for developing new curricula in advanced fields, and for labor market information systems for skills and skill demand. DOD's massive contracting role gives it an influential role in a series of important industrial sectors. In addition, these are best practices that DOD can promote and encourage in programs for its own industrial base workforce, and for departing servicemen and women and veterans.

DOD Workforce Education Programs

How should DOD engage? One area for workforce engagement is in DOD's extensive modernization agenda involving advanced technologies. While it has undertaken technology development planning, it has not mapped workforce skill needs and demands required for modernization against its development plans to create a skills map that can line up against its technology mapping. Obviously, it's very important that the two match up. This Subcommittee has recognized this need in its FY22 report asking for a study on how DOD's "modernization strategies may impact these [workforce] needs and possible future gaps in the next five to ten years."¹⁴

DOD has some important assets to deploy in this effort to engage its workforce. Let me highlight four that I believe are particularly positioned to make a difference on defense workforce education: the advanced manufacturing institutes, the IBAS program, the services' programs applying virtual reality for training, and its office for local defense community cooperation.

Advanced manufacturing institutes: DOD's OSD ManTech supports nine of the 16 manufacturing institutes and collaborates with the others that are part of the Manufacturing USA program first launched in 2013.¹⁵ Each institute has programs in workforce education in its advanced technology area. The institutes have the right mix of key actors - industry, education institutions and state and local governments - to perform three critical tasks: develop innovative learning programs using new tools like digital and blended learning; create programs that can scale across multiple regions and technology domains; and promote a positive image for careers in manufacturing achievable through relevant certificates, community college, or advanced degrees. Various Institutes have made significant accomplishments in developing online education modules for advanced manufacturing, applying virtual reality technology, developing programs to educate departing service members for advanced manufacturing careers, and developing and promoting high school curricula in advanced manufacturing. OSD ManTech understands this workforce need well and is pushing programs to support its manufacturing institute efforts.

Best Practices: A new National Academies of Sciences report has recommended that the institutes:

- Develop "knowledge, skill and ability (KSA) elements and corresponding competencies" since these will be key to effective advanced manufacturing curricula,
- Develop "educational materials with and to be used by its education and industry ecosystem,"
- Develop "online materials" to scale up their education and training programs, and
- Develop "industry-recognized credentials" with industry partners,
- Form "regional engagements" with area industry and education institutions to introduce advanced manufacturing training;
- Map "skill demand and develop skill roadmaps" that complement their technology development roadmaps.¹⁶

The study found these were key best practices that need to be in place at each institute. Many of the institutes are already undertaking a number of these efforts, but they are not now adequately resourced to support them.

Networking Across Institutes: The Academies report also noted that employers won't want to train for just one advanced manufacturing technology. In other words, they will want to adopt skill packages for a range of new technologies: 3D printing, robotics and digital production plus specialty areas like flexible electronics or lightweight materials., depending on their needs. These technology skill sets will need to be interoperable and complementary. But the institutes must be focused, appropriately, on their particular technology and related skills. The report therefore recommended that a cross-institute mechanism be developed to support the institutes in combining these skills into common packages so manufacturing firms can more readily adopt them, and not be forced to deal with them one at a time.¹⁷ Overall, as noted, the institutes are not adequately resourced to undertake their major workforce tasks. They require an additional supporting mechanism across the institutes to address such gaps as: reaching SMMs, improving workforce diversity, expanding online training, data gathering on workforce demand and needs, and increasing partnering with community colleges and industry. A centralized program element operating across the institutes could be a big enabler to expand workforce effectiveness. The ManTech program understands this need to facilitate network functions and collaboration on workforce projects across the manufacturing institutes and their manufacturing technologies, but needs the resources to undertake this step.

Common Online Platform: The Academies report also strongly encouraged, and many of the institutes have already developed, online workforce education materials. To enable access, OSD ManTech is developing an online education site through Open edX for posting these materials not only from the Institutes but from other DOD sources as well. This could be a key step in both developing curricula in advanced manufacturing, which is in significant part missing now, and in scaling up access to it.

Overall, the Manufacturing Institutes can play a critical role for DOD in implementing workforce education in advanced technology fields, and OSD ManTech requires more support to accomplish its important workforce education goals.

Industrial Base Analysis and Sustainment (IBAS): IBAS has the responsibility for strengthening and maintaining critical skills in the defense industrial base. As you know, while ManTech and the Manufacturing Institutes help enable advanced manufacturing, IBAS maintains ongoing manufacturing skills and capabilities in the defense industrial base. It has invested more than \$300 million directly into the industrial base over Fiscal Years (FY) 2019-2021. Since FY19, through its [National Imperative for Industrial Skills](#)¹⁸ initiative, the IBAS program has partnered with industry and academia and invested over \$80 million in industrial workforce development and training projects to help improve or scale workforce pipelines supporting a range of defense weapon system development, production, and sustainment needs, with a focus on skills such as welding, advanced machining, electronics, precision optics, metrology, digital/additive manufacturing and other Industry 4.0 skills that have entered production facilities.

The IBAS workforce education projects under its National Imperative for Industrial Skills, that enable industry and education institutions to partner to solve ongoing defense workforce needs, deserve continuing and increased overall support for competitively-offered projects. The workforce education efforts in manufacturing clearly need to scale up if DOD needs are to be met and change is required.

Service Training Development Centers: Each of the military services has a center for training development adjacent to each other in Orlando, Florida, where new education technologies can be demonstrated and developed, particularly virtual reality and augmented reality joined with computer gaming and simulation platform technologies.¹⁹ These centers are moving the new education technologies into a central focus for training service men and women in their operational tasks. There is nothing quite like this in the civilian sector. This unique development capability could be applied not only to operational training but to advanced manufacturing and other DOD workforce education needs if requirements were formulated.

Office of Local Defense Community Cooperation: this program (formerly the Office of Economic Adjustment) provides a way to assist communities affected by defense contracting or employment opportunities. In general, it assists communities and regions in supporting DOD missions, particularly its defense manufacturing community support program, which includes workforce education efforts along with development of defense critical technologies.²⁰ It is a means for DOD to support workforce education on a regional basis with competitive awards to defense-dependent communities.

Conclusion

We have a workforce education system that isn't working well as a system and needs large scale reform. We have a deep disconnect between work and learning, workforce education is underfunded, our federal programs don't mesh, we lack programs and curriculum for the advanced skills that are increasingly required, existing programs don't reach incumbent workers that need upskilling, we dismantled most of our vocational high schools, we underfund community colleges, we don't offer lifelong learning, and we have a broken labor market information system.

These are big challenges, but we are seeing a mix of new ideas and new programs that show us a way out: short courses with modules that stack to degrees and certifications, programs that reach incumbent workers and high school students with advanced skills, new apprenticeship programs, new online education technologies, improved community college completion rates, better integration between employers and education institutions, new curricula in advanced fields, unified workforce programs at the state level, and improved labor market information all offer ways out.

DOD has a big stake in strengthening our industrial base and therefore in strengthening its workforce. Innovative workforce education approaches for its own industrial base workforce, for the tens of thousands of firms that are defense contractors,

and for its departing service members and veterans, are key. The new best practices summarized above should guide DOD's efforts with these groups. But it is not only about incentivizing others, DOD has workforce programs it can deploy. I have highlighted four particular programs that I believe can play an important role in getting DOD the workforce it needs – ManTech and its advanced manufacturing institutes, IBAS, the services' training development centers, and workforce efforts at the office of local defense community cooperation

My thanks, again, to the Subcommittee for this opportunity to testify.

ENDNOTES:

¹ Detailed in, William B. Bonvillian and Sanjay Sarma, *Workforce Education, A New Roadmap* (Cambridge, MA: MIT Press 2021), 43-59.

² Bonvillian and Sarma, *Workforce Education*, 44-47.

³ U.S. Census Bureau, Education Attainment in the U.S., Release No. CB20-TPS.09, March 30, 2020.

⁴ National Student Clearinghouse Research Center (NSCRC), *Completing College, National and State Reports*, Dec. 2021, 4, https://nscresearchcenter.org/wp-content/uploads/Completions_Report_2020.pdf

⁵ Susan Lund, Kwellin Ellingrud, Bryan Hancock, James Manyika, and Andre Dua, *Lives and Livelihoods: Assessing the near term impact of Covid-19 on US Workers*, Mckinsey Global Institute, April 2021, <https://www.mckinsey.com/~media/mckinsey/industries/public%20and%20social%20sector/our%20insights/lives%20and%20livelihoods%20assessing%20the%20near%20term%20impact%20of%20covid%2019%20on%20us%20workers/lives-and-livelihoods-assessing-the-near-term-impact-of-covid-19-on-us-workers.pdf>.

⁶ Bureau of Labor Statistics, *The Employment Situation September 2021, Household Data, Summary Table A, Unemployed*, Oct. 8, 2021, <https://www.bls.gov/news.release/pdf/empisit.pdf>.

⁷ Bureau of Labor Statistics, *The Employment Situation, Labor Force Participation Rate, September 2021*, Oct. 8, 2021, 2, <https://www.bls.gov/news.release/pdf/empisit.pdf>.

⁸ Ben Armstrong, *Advanced Technology, Advanced Training, A New Policy Agenda for U.S. Manufacturing*, MIT IKIM, May 2021 (report for OSD ManTech), 10-11.

⁹ Office of the Secretary of Defense, *Acquisition and Sustainment Industrial Policy, Report to Congress on Industrial Capabilities*, 2020, Jan. 2021, 8-20, <https://media.defense.gov/2021/Jan/14/2002565311/-1/-1/0/FY20-INDUSTRIAL-CAPABILITIES-REPORT.PDF>.

¹⁰ Armstrong, *Advanced Technology, Advanced Training*, 11.

¹¹ OSD, *Report to Congress on Industrial Capabilities*.

¹² William B. Bonvillian and Peter L. Singer, *Advanced Manufacturing, the New American Innovation Policies* (Cambridge, MA: MIT Press 2018).

¹³ Armstrong, *Advanced Technology, Advanced Training*, 21-24.

¹⁴ House Appropriations Committee, *Report to Accompany the Department of Defense Appropriations Bill for Fiscal Year 2022*, 59-60,

<https://docs.house.gov/meetings/AP/AP00/20210713/112896/HMKP-117-AP00-20210713-SD003.pdf>.

¹⁵ DOD Manufacturing Technology (ManTech) Program, Manufacturing Innovation Institutes, <https://defenseinnovationmarketplace.dtic.mil/business-opportunities/manufacturing-usa-institutes/>

¹⁶ National Academies of Sciences, National Materials and Manufacturing Board, DOD Engagement with its Manufacturing Innovation institutes, report, October, 2021, 3-8 - 3-10, C-22, and Recommendation 3.1). (Note: the author served on the committee that developed the report)

¹⁷ National Academies of Sciences, DOD Engagement, 3-12 and Recommendation 3.1.

¹⁸ Industrial Base Analysis and Sustainment,

<https://www.businessdefense.gov/IBAS/Opportunities/> and https://sam.gov/opp/9373c7a3654c4f318908aeb5c7814b40/view?keywords=cs-2%200-1601&sort=-relevance&index=&is_active=true&page=1.

¹⁹ Bonvillian and Sarma, *Workforce Education*, 4-6, 231-232.

²⁰ See, for example, DOD, Defense Manufacturing Communities Support Program, award announcement, Sept. 22, 2021,

<https://www.defense.gov/News/Releases/Release/Article/2785070/dod-approves-25-million-in-grants-under-defense-manufacturing-community-support/>.