Transforming Workforce Training Through Federal Leadership in XR Technology

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Summary

Today's unprecedented health and economic challenges demand a transformative approach to workforce training. Already, technology that immerses a person in a digital space (virtual reality) or that enhances reality with digital features (augmented reality) is making it possible to prepare workers faster and better for high-quality, high-demand jobs. Government investment in augmented and virtual reality (together known as "XR" technology) will supercharge workforce training, helping Americans across the country get into jobs that benefit them and our society.[1]

The Federal Government should partner with industry to identify and implement "shovel-ready" applications of XR technology. Initial efforts should focus on demonstrating proof of concept by deploying XR technology towards two goals; namely:

- Work through the Department of Health and Human Services (HHS) to train 50,000 nurses over the next four years.
- Work through the Department of Labor (DOL) and Department of Energy (DOE) to train 50,000 solar-energy installers over the next four years.

These goals are readily achievable thanks to existing programmatic infrastructure at agencies with explicit workforce-development missions. Follow-on work could expand applications of XR technology to workforce training in other domains and/or through other agencies.

Challenge and Opportunity

XR in Context: The Case for Federal Investment

There is bipartisan consensus that the United States needs a coherent policy to nurture domestic development of important new technologies such as artificial intelligence (AI), high-performance computing, advanced communications, biotechnology, and energy science. Mastery of such technologies underpins the capacity of the United States to effectively compete against economic and strategic rivals.

Immersive technology—also known by the shorthand "XR"—deserves a spot on the list of technologies prioritized by U.S. policy. While the United States is the birthplace of AR and VR technology, neither the executive branch nor Congress has consistently acknowledged immersive technology as a competitive or national-security priority.[2]

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[1] XR is an umbrella term that encompasses augmented reality (AR), mixed reality (MR), virtual reality (VR), and other forms of alternate, expanded, or immersive reality applications, including those not yet invented.

[2] Identification of prioritized technologies is a bipartisan feature of modern economic policy, despite the United States' longstanding reluctance to engage in "industrial policy." The Trump Administration has identified four "industries of the future" that are key to national security and economic interests. Democratic leadership in the Congress has likewise identified an overlapping list of 10 "prioritized technologies" for federal funding. See White House (2019), "America Will Dominate the Industries of the Future," https://www.whitehouse.gov/briefings-statements/america-will-dominate-industries-future/ and Todd Young U.S Senator for Indiana (2020), The Endless Frontier Act. https://www.young.senate.gov/imo/media/doc/EFA%20Summary%2005.26.2020.pdf.

Transformative use cases for XR are gaining prominence amidst the COVID-19 pandemic. These use cases lay the ground work for XR making telepresence a reality, where groups will interact safely and intimately when in-person gatherings are unsafe or impossible. XR will impact the future of telemedicine. XR also holds the promise of reducing barriers to education in high schools and higher education. And today, we are already seeing how it can create access to and enhance workforce development as well as enable safe training of workers in dangerous fields. To realize the full potential of XR, basic research and pre-competitive collaboration among industry is needed to overcome foundational technical hurdles. Government involvement—as our international competitors have already realized—can help achieve both.

Beyond Gaming—Use Cases of XR

The XR industry is growing quickly.[3] While there are still technical barriers to ubiquitous use of immersive computing, emerging applications foreshadow the transformational potential of XR and demonstrate the potential for government support and investment in XR domains that go beyond gaming. Consider the following examples:

- **Workforce development**. Virtual and augmented reality can accelerate worker training and upskilling. Major companies such as Walmart, JetBlue, and Verizon are already employing VR for workforce training. Boeing uses augmented reality to provide technicians with hands-free, interactive 3D diagrams as they install electrical wiring in its aircraft. Boeing reported a 40% improvement in productivity as a result of its AR training.[4] XR-based training is also especially relevant to public safety. XR enables realistic, scenario-based training that helps first responders, law enforcement, military personnel, and others to increase safety, efficiency, and performance while limiting risk exposure during training.

- **Healthcare.** The global XR market in the healthcare industry is expected to grow to nearly $11 billion (more than $5 billion in North America alone) by 2025, a compound annual growth rate of more than 36%.[5] Simulated surgical training for doctors and nurses is on the rise and will become even more effective with increasingly realistic visuals and subtle

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[3] In 2019, the market intelligence firm IDC predicted that "worldwide spending on augmented reality (AR) and virtual reality (VR) will reach $160 billion in 2023, up significantly from its $16.8 billion forecast for 2019." Even more significantly, the Seeing is Believing report from Pricewaterhouse Coopers (PwC) asserts that VR and AR could add as much as $1.5 trillion, or 1.8% GDP, to the global economy by 2030. See: PwC (2019). Seeing is Believing: How virtual and augmented reality are transforming business and the economy. P. 4. https://www.pwc.com/SeeingIsBelieving.

[4] Boeing (2018). Boeing Tests Augmented Reality in the Factory. January 19. https://www.boeing.com/features/2018/01/augmented-reality-01-18.page.

[5] Research and Markets (2019). Global Healthcare Augmented Reality and Virtual Reality Market by Technology, Offering, Device Type, Application, End-user, and Region 2019-2026: Trend Forecast and Growth Opportunity. ID: 4876656. December. researchandmarkets.com/reports/4876656/global-healthcare-augmented-reality-and-virtual?utm_source=dynamic&utm_medium=BW&utm_code=kd4rx3&utm_campaign=1333803+-+Global+%2410.82+Billion+Healthcare+Augmented+Reality+and+Virtual+Reality+Market+Trend+Forecast+and+Growth+Opportunity+to+2026&utm_exec=chdo54bwd.

differences in force sensation. Such realistic training improves surgical outcomes and reduces error. Other healthcare applications of XR take advantage of its analgesic and distractive effects for pain management, palliative, and hospice care. Researchers also use XR for 3D visualization of diseases at the molecular level.[6]

- **Manufacturing.** By better connecting workers and organizations, XR makes it easier to leverage internal expertise; provide relevant, timely, and meaningful training; and maximize productivity while minimizing manufacturing and maintenance errors. There are many case studies of how AR and VR are enhancing collaboration, streamlining workflow and raising quality.[7] Siemens, for example, has applied AR to aid employees inspecting circuit boards, reporting a 20–25% improvement in quality.[8]

The depth and impact of XR on these and other sectors will continue to grow as adjacent technologies mature.

Plan of Action

Unlike technologies such as AI,[9] quantum computing,[10] and 5G,[11] the U.S. government's approach to XR is nascent and undeveloped. While some agencies such as the Department of Defense, the National Aeronautics and Space Administration (NASA), and HHS have begun to support XR through acquisition or grants, many agencies and officials remain unaware about the transformative capabilities that XR can provide healthcare, education, job training, manufacturing, retail, and entertainment.

We recommend a two-part approach for federal action to address these gaps and promote XR.

Part 1: Launch Proof-of-Concept Pilot Projects

Initial federal efforts should deploy XR at agencies with existing and relevant programmatic infrastructure as well as explicit workforce-development missions. These efforts should focus on responding to pressing societal and economic needs. Specifically, we recommend the following:

- **HHS should partner with nursing schools to use VR to train 50,000 new nurses in four years.** The American Association of Colleges of Nursing has long sounded the alarm

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[6] Muioi, D. (2020). In-depth: Despite some hiccups, COVID-19 is VR's time to shine. Mobihealthnews, May 29, 2020. https://www.mobihealthnews.com/news/depth-despite-some-hiccups-covid-19-vrs-time-shine.

[7] CMTC Manufacturing Blog, "How Virtual Reality is Changing the Manufacturing Game." (n.d). https://www.cmtc.com/blog/how-virtual-reality-is-changing-the-manufacturing-game.

[8] Capgemini Research Institute (2018). Augmented and Virtual Reality in Operations: A guide for investment. P. 8. https://www.capgemini.com/wp-content/uploads/2018/09/AR-VR-in-Operations1.pdf.

[9] The White House (2020). Artificial Intelligence for the American People. https://www.whitehouse.gov/ai/.

[10] American Institute of Physics (2019). National Quantum Initiative Signed into Law. January 4. https://www.aip.org/fyi/2019/national-quantum-initiative-signed-law

[11] Federal Communications Commission (n.d.). FCC 5G Fast Plan. https://docs.fcc.gov/public/attachments/DOC-354326A1.pdf.

about a significant nursing shortage.[12] This shortage is only more alarming in the face of a global pandemic.[13] Nursing schools are already applying simulation training and seeing positive results. VR will take this training to the next level. The Robert Morris University in Pennsylvania, for example, developed a VR game to allow nursing students to practice urinary catheter insertion. Research showed that students spent more time practicing, completed more procedures in a 60-minute period, and gave higher marks to the immersive experience relative to conventional instruction.[14] An existing funding mechanism at HHS could be leveraged to increase the reach of VR in nursing training. In April 2020, HHS offered $2 million in awards of up to $500,000 each to expand technology-based simulation training for undergraduate and registered nurses.[15] As part of the next economic stimulus package, this program's funding should be increased to $25 million and should target applications using VR to train nurses. The program should be explicitly tied to an outcome goal of training 50,000 new nurses in four years. The HHS Secretary and the White House should use their convening power and bully pulpit to encourage private-sector commitments that contribute towards and build on this goal.

- **The Department of Energy (DOE) should incorporate VR into its SunShot Initiative, with a goal of training 50,000 new solar-energy installers in four years.** The Bureau of Labor Statistics projects that solar photovoltaic (PV) installation is the fastest-growing occupation in the country. Following the playbook from the 2008 economic recovery,[16] the DOL's Employment and Training Administration (ETA) should partner with the DOE's Solar Training and Education for Professionals (STEP) and SunShot Initiatives to train workers displaced by the current economic crisis. The partnership should focus on applying virtual reality to rapidly transition workers to green jobs. DOE should work with DOL to incorporate workforce training into the 2030 Sunshot Goals,[17] which currently focus on energy usage. Funding for VR training applications that advance U.S. competitiveness in solar energy could be allocated through DOE's American-Made Solar Prize program,[18] stimulating innovation by VR developers. These efforts could be positioned as part of the U.S. government's overall pandemic response—both through a focus on pandemic-displaced workers and through the provision of training that minimizes the need for close human contact.

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[12] American Association of Colleges of Nursing (2020). Nursing Shortage. https://www.aacnnursing.org/News-Information/Fact-Sheets/Nursing-Shortage.

[13] Fisher, D. (2020). Covid makes nursing shortage more severe. Granite State News, July 2. https://www.concordmonitor.com/Granite-State-News-Collaborative-35035591.

[14] Butt, A.L. (2018). Using Game-Based Virtual Reality with Haptics for Skill Acquisition. Clinical Simulation in Nursing, 16: 25–32.

[15] Health Resources & Services Administration (2020). Nurse Education, Practice, Quality and Retention (NEPQR) Simulation Education Training (SET) Program. https://www.hrsa.gov/grants/find-funding/hrsa-20-110.

[16] Barnow, B.S.; et al. (2018). Implementation of the American Recovery and Reinvestment Act: Workforce Development and Unemployment Insurance Provisions. W.E. Upjohn Institute for Employment Research, ETA Occasional Paper 2013-23. https://research.upjohn.org/cgi/viewcontent.cgi?article=1066&context=externalpapers.

[17] Department of Energy (2020). SunShot 2030: New Solar Opportunities for a New Decade. Solar Energy Technnologies Office, Office of Energy Efficiency & Renewable Energy. https://www.energy.gov/eere/solar/sunshot-2030.

[18] Department of Energy (2020). Energy Department Announces Grand Prize Winners of American-Made Solar Prize Round 2. Solar Energy Technnologies Office, Office of Energy Efficiency & Renewable Energy. https://www.energy.gov/eere/articles/energy-department-announces-grand-prize-winners-american-made-solar-prize-round-2.

Part 2: Develop and Implement a Whole-Of-Government Approach to Immersive Technologies.

To ensure that the United States is a global leader in XR revolution, we recommend the following:

- **Include XR in a set of prioritized basic and applied technologies for the United States.** Under the next administration, the White House should define a set of "prioritized technologies" of the future that are important for security and competitiveness goals. This set should include both basic technologies, such as artificial intelligence, and applied technologies, such as XR.

- **Provide strong federal support for technology development.** The past four years have seen simultaneous calls to prioritize industries of the future with massive cuts to R&D spending on the science required by those industries. The next administration must correct this dissonance. A good first step would be embracing the pending Endless Frontiers Act, which would add technology development to the National Science Foundation's core mission. In addition, the White House policy counsels should articulate and coordinate a formal strategic competitiveness policy for the nation. Goals identified by the new task force described below should be integrated into this broader effort.

- **Coordinate XR policy and initiatives through the Office of Science and Technology Policy (OSTP).** The OSTP Director should establish a staff-level task force consisting of agency officials to coordinate and integrate government initiatives addressing XR technology. The task force should inventory the scope of existing government investment in XR (e.g., through acquisition programs, R&D grants, and technical support) and should develop metrics to assess investment impact. The task force should also identify the most pressing obstacles to widespread adoption of XR, recommending ways that financial and technical resources could be directed to address those obstacles. The task force should issue recommendations on tax, education, immigration, and other policies that would bolster the development of XR in the United States.

Conclusion

Challenges with distance learning, telework, telemedicine, and other virtual applications during the COVID-19 pandemic underscores the imperative for better and more effective ways to connect, communicate, collaborate, and learn. This is precisely the promise of virtual, augmented and mixed reality. There is also a strong public interest in strengthening the XR industry in the United States for competitiveness reasons. The next administration should encourage the industry to advance in alignment with cultural values that place a premium on freedom of thought and expression, learning, cooperation and other standards of an open society.

This paper calls for immediately injecting XR into problem-solving applications through two near-term initiatives targeting workforce development. The first initiative focuses on one of the most promising use cases for XR, and the second on one of the most in-demand occupations at a time of recession and public health concerns. These near-term initiatives should be complemented by forward-looking activities that establish government-wide coordination and priority-setting mechanisms, ensuring that federal investments in XR are efficient, high-profile, and targeted to national strategic imperatives.

About the Authors

Elizabeth Hyman is the Chief Executive Officer of the XR Association (XRA), the trade association representing the technology manufacturers that power the virtual, augmented, and mixed reality industries. XRA is dedicated to the responsible development and thoughtful advancement of XR technologies across the globe.

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