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Office of Science and Technology Policy
Executive Office of the President
Eisenhower Executive Office Building
1650 Pennsylvania Avenue
Washington, D.C. 20504

RE: Document # 2021-21975; Document Citation 86 FR 56300

Dear Office of Science and Technology Policy:

The XR Association is pleased to submit comments in response to the Office of Science and Technology Policy's Request for Information on Public and Private Sector Uses of Biometric Technologies.

The XR Association (XRA) represents the broad ecosystem of the XR industry including headset manufacturers, technology platforms, component and peripheral companies, internet infrastructure companies, enterprise solution providers, and corporate end-users. The founders of XRA are Google, HTC Vive, Microsoft, Meta Platforms, Inc. (formerly Oculus by Facebook), and Sony Interactive Entertainment. XRA is leading the way for the responsible development and adoption of XR – virtual reality (VR), augmented reality (AR), and mixed reality (MR) – by convening stakeholders, developing research and best practices, and advocating on behalf of our members and the broader XR industry. Our mission is to champion the thoughtful advancement of XR solutions that foster positive societal outcomes.

While immersive experiences have in the past typically been associated with entertainment and gaming, XR technology has come a long way and is now widely considered to be the next major computing platform.¹ Indeed, XR technology is rapidly being adopted across industries as an enterprise solution, particularly as companies look to technology to help them weather and recover from the COVID-19 pandemic.² While the technology is still emerging, the importance of biometric data to XR's success cannot be understated, as it ensures users can realize the benefits and experiences made possible by XR. Without biometric data, XR programs will simply not work as designed.

Immersive experiences in XR may utilize a variety of human body characteristics and related data, depending on the platform, program, and intended experience or use case. XR may include sensors for eye-tracking, eye movement detection, and pupil dilation; facial recognition; head position; gait tracking; and sometimes heart rate and skin response, such as sweating. Some of these characteristics are considered biometric technologies in the sense that they may be used for identification, while others are not. The XR industry has been a leader in the advancement of biometric technologies, while also intensely focused on developing measures to ensure the data created in connection with XR technologies is not misused. As XR continues to mature, there is a deep commitment to consult with

¹ "Accelerating the Next Computing Platform," Medium.com, Jan. 28, 2020. <https://michaeltefula.medium.com/accelerating-the-next-computing-platform-fb3ed88d01e1>

² "XR-Based Workforce Training Identified As Key Tool In Addressing America's Employment Crisis," XRA Association Survey, Nov. 4, 2021. <https://xra.org/xr-workforce-training-addressing-americas-employment-crisis/>

various stakeholders and, through consultation and innovation, advance the practice of “privacy by design” to the greatest extent possible.

We believe that, if properly incubated and supported here in the United States, the advantages of biometrics can and will overcome the risks. Indeed, biometric technology promises significant benefits across the board including sophisticated healthcare; navigation assistance; identification efficiency; U.S. defense and public safety advantages; enriched social and educational experiences; and outstanding entertainment, among many others. In the interest of brevity with respect to this comment however, we will focus on workforce training and safety, and the unparalleled benefits provided to the disabled community.

Benefits of XR for People with Disabilities

XR technology offers tremendous benefits to people with disabilities - whether at home, at school, at work, or in social settings. The safe, responsible use of biometric data is essential to ensuring XR can be used by people of all abilities, including people with both cognitive and physical challenges. Some have even suggested that XR can “democratize technology” for people with disabilities by providing them with experiences and interactions that they may be unable to experience in the physical world without the aid of VR, AR, and MR.³ For example, immersive experiences have allowed people with low vision to see more clearly;⁴ given those with mobility challenges the ability to surf or climb mountains;⁵ given amputees a more effective way to exercise and strengthen their muscles;⁶ and allowed individuals with autism to navigate challenging social situations in a virtual setting, thereby learning new skills and gaining confidence.⁷

XR technology is also being explored for use in pain management as an alternative to opioid prescriptions;⁸ in treating mental health disorders, such as post-traumatic stress disorder in U.S. military veterans;⁹ in diagnosing and treating people with Alzheimer’s disease;¹⁰ and in complimenting traditional therapies for stroke patients and individuals with neurodegenerative diseases.¹¹

³ “What the Future of Virtual Reality Means for Accessibility,” Bureau of Internet Accessibility, June 23, 2020.

<https://www.boia.org/blog/what-the-future-of-virtual-reality-means-for-accessibility>

⁴ “A Rare Disease Robbed Me Of My Sight. VR Brought It Back,” Alex Lee, *Alphr*, March 27, 2018. <https://www.alphr.com/virtual-reality/1008932/vr-vision-loss-sight-blindness/>

⁵ “Affordable Virtual Reality Opens New Worlds For People With Disabilities,” Lindsey Hoshow, *NPR*, Oct. 22, 2015.

<https://www.npr.org/sections/health-shots/2015/10/22/450573400/affordable-virtual-reality-opens-new-worlds-for-people-with-disabilities>

⁶ “VR games open new doors for people with disabilities,” Yoon So-Yeon, *Korea JoongAng Daily*, Dec. 15, 2020.

<https://koreajoongangdaily.joins.com/2020/12/15/culture/gamesWebtoons/VR-game-recovery/20201215193206600.html>

⁷ “Virtual Reality Training Improves Social Skills of Individuals on the Autism Spectrum,” Center for Brain Health at University of Texas, Sept. 18, 2016. <https://centerforbrainhealth.org/article/virtual-reality-training-improves-social-skills-of-individuals-on-the-autis>

⁸ Virtual Reality for Pain Management in New York: An Alternative to Opioids, Miranda Felde, MHA, CPHRM, Vice President, Patient Safety and Risk Management, the Doctors Company, December 2018. <https://www.thedoctors.com/articles/virtual-reality-for-pain-management-in-new-york-an-alternative-to-opioids/#7>

⁹ Virtual reality exposure therapy for posttraumatic stress disorder: a meta-analysis, *European Journal of Psychotraumatology*, August 2019. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6713125/>

¹⁰ Use of Immersive Virtual Reality in the Assessment and Treatment of Alzheimer’s Disease: A Systematic Review, *Journal of Alzheimer’s Disease*, April 2020. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7306888/>

¹¹ Virtual reality-based rehabilitation for recovery of stroke and neurodegenerative disease patients, reviewed by Emily Henderson, B.Sc., *News Medical*, December 2020, available at <https://www.news-medical.net/news/20201214/Virtualreality-based-rehabilitation-for-recovery-of-stroke-and-neurodegenerative-disease-patients.aspx>

The XR industry has been working with accessibility advocates, industry, and non-profits, such as XR Access, to ensure that as new XR technologies emerge, they are inclusive by design. Working with these partners, the XR Association developed and published a chapter for the XRA Developers Guide entitled “Accessibility & Inclusive Design in Immersive Experiences.”¹² The guide offers a set of industry-backed best practices for developing inclusive platforms and software that can provide enhanced experiences for all users. In 2021, the XR Association also collaborated with the Department of Labor’s Partnership on Employment & Accessible Technology (PEAT) to draft a white paper entitled “Inclusive XR in the Workplace.”¹³ The paper details how accessible XR technology can help employers upskill and diversify their workforce with employees with disabilities. The XR industry believes that inclusive XR can help expand job opportunities for people with disabilities, and we have been working diligently toward that goal.

Benefits of XR in the Workplace: Worker Safety and Job Training

The use of XR job training programs has been increasing in recent years. [ABI Research](#) predicts that by 2025 upwards of 60 million people will use XR training applications, and that the industries likely to see the greatest adoption of XR training include healthcare, logistics, Architecture, Engineering, and Construction (AEC), and manufacturing.¹⁴ U.S. companies, particularly manufacturers, are quickly becoming reliant on XR technology to increase worker safety, increase productivity, and train employees. With XR applications, inexperienced personnel can be trained in low-risk environments without the need for expensive additional resources. What’s more, by digitally simulating production processes, dangerous maneuvers can be identified in advance for even the most experienced individuals. Success stories include Tyson Foods, where 89% of workers said they felt more prepared for their jobs after VR training,¹⁵ and Ford Motor Company, which reduced the injury rate for its more than 50,000 U.S. “industrial athletes” by 70%.¹⁶ Lockheed Martin and Boeing are using XR for space and aircraft manufacturing, and even astronaut training.^{17 18 19}

Other industries are embracing XR as well. In 2018, construction giant Bechtel announced it was using a variety of XR products to train crane operators and improve the quality of safety procedures on its construction sites.²⁰ And XR training programs for firefighters are helping to reduce cancer exposure

¹² XRA’S Developers Guide, Chapter Three: Accessibility & Inclusive Design in Immersive Experiences, October 2020.

<https://xra.org/research/xra-developers-guide-accessibility-and-inclusive-design/>

¹³ Inclusive XR in the Workplace, PEAT and XRA. https://peatworks.org/pdfs/InclusiveXRWhitePaper_PEAAndXRA.pdf

¹⁴ AR Remote Expertise and Training Applications to have Almost 60 Million Active Users by 2025, ABI Research, Oct. 14, 2020.

<https://www.abiresearch.com/press/ar-remote-expertise-and-training-applications-have-almost-60-million-active-users-2025/>

¹⁵ Tyson Foods reduces worker injuries, illnesses with VR safety training, Riia O’Donnell, *HR Dive*, Sept. 18, 2018.

<https://www.hrdive.com/news/tyson-foods-reduces-worker-injuries-illnesses-with-vr-safety-training/532452/>

¹⁶ Ford Reduces Production Line Injury Rate By 70 Percent For Its More Than 50,000 ‘Industrial Athletes,’ Ford Motor Company release,

July 16, 2015. <https://media.ford.com/content/fordmedia/fna/us/en/news/2015/07/16/ford-reduces-production-line-injury-rate-by-70-percent.html>

¹⁷ Lockheed Martin Embraces AR on the Factory Floor, *Assembly* magazine, Aug. 27, 2019.

<https://www.assemblymag.com/articles/95163-lockheed-martin-embraces-ar-on-the-factory-floor>

¹⁸ Boeing Conducts First-Ever Astronaut Training in Virtual Reality using Varjo Headsets, Boeing release, June 11, 2020.

<https://www.boeing.com/global/boeing-in-europe/news/2020/boeing-conducts-first-ever-astronaut-training-in-vr.page>

¹⁹ Boeing Tests Augmented Reality in the Factory, Boeing release, Jan. 19, 2018. <https://www.boeing.com/features/2018/01/augmented-reality-01-18.page>

²⁰ Using Extended Reality to Improve Safety on Construction Sites, Bechtel, Nov. 8, 2018.

<https://www.bechtel.com/blog/innovation/november-2018/using-extended-reality-improve-safety-construction/>

and other significant hazards attending live fire trainings by allowing new and veteran firefighters to prepare in safe environments, while learning the skills they need to fight real world fires.²¹

Privacy By Design

In late 2021, the Institute of Electrical and Electronics Engineers (IEEE) published a comprehensive report detailing privacy concerns related to biometric data generated by XR users. As the report notes, biometric data is intrinsic to the functioning of XR technology and the benefits it can provide:

This pervasive capture of personal “sensitive” data is unique to XR relative to other consumer technologies, but fundamentally necessary. Such sensing underpins much of the core functionality that makes this technology, and the software that runs on it, so compelling to futurists. It drives the capability to create more usable spatial interactions, enables new applications that better address accessibility needs, and enhances understanding of the user’s context, behavior, and needs that drive better AI assistants. For example, an XR headset without sophisticated optical sensing would feature greatly degraded performance in all use cases. Many current consumer devices would lose the ability to accurately track its position and orientation in the world, meaning it would be unable to render the exocentric (world-fixed) spatial virtual content that underpins immersive virtual and augmented reality experiences.²²

The XR industry places a premium on the need to safeguard sensitive biometric data. Indeed, the industry ideal is the concept of privacy by design, in which XR hardware and applications are engineered with privacy protections in mind from the start. Examples of privacy protections already available on XR platforms include on-device encrypted computing and the ability to opt-in or opt-out of specific data collection features, among other things.

Still, the industry’s commitment to privacy by design aims to go even further. It must be recognized, however, that privacy by design involves significant engineering challenges that are not easily solved. As an emerging technology, the XR industry needs the regulatory space to create and experiment in a way that will not stifle innovation as it works toward enhanced privacy protections and other technical features.

The Importance of U.S. Competitiveness in XR

XR is and will continue to be an integral part of the future technology ecosystem. As noted, XR is considered the next major computing platform (predecessors being the personal computer in 1984; the World Wide Web in 1993; and the smart phone in 2007), and the U.S. must be at the forefront of designing and creating it. XR will be the vehicle used for accessing the next iteration of the internet - what is often referred to as “the metaverse,” currently. The U.S. Senate recently recognized the impact of XR when it included immersive technologies in its list of “key technology focus areas” to be prioritized for research and development in the United States Innovation and Competition Act of 2021 (S. 1260).

²¹ “XR a ‘Tool for the 21st Century Firefighter’, Execs Say,” Demond Cureton, *XR Today*, Aug. 12, 2021.

<https://www.xrtoday.com/mixed-reality/xr-a-tool-for-the-21st-century-firefighter-execs-say/>

²² Extended Reality (XR) and the Erosion of Anonymity and Privacy, IEEE Industry Connections Report, November 2021.

<https://ieeexplore.ieee.org/document/9619999>

U.S. tech luminaries have built ambitious strategies around the development and adoption of XR. Mark Zuckerberg announced his newly renamed company, Meta Platforms, Inc., would be investing \$10 billion in AR, VR, and related hardware in 2021 alone, saying during the company's 2021 3rd quarter earnings call that "the metaverse will be a successor to the mobile internet. ... It will unlock a massively larger creative economy [...] than what exists today."²³ Microsoft, through its HoloLens hardware and its cross-platform development tools (Azure, Mesh, etc.) has been aggressive in the enterprise space²⁴. HTC, Sony, Valve and others are continuing to make significant advancements in hardware and software.²⁵ And Apple, Google, and Unity have each built substantial AR development platforms in pursuit of democratizing consumer access to AR technologies.

But U.S. companies are not alone in pursuing advances in immersive technology innovations. Foreign powers are rapidly advancing on the U.S.'s historical domination in the field. China recognized the outsized potential of immersive technology years ago and has taken impressive steps towards controlling its future. XR is featured prominently in the CCP's Made in China 2025 strategy, and the Ministry of Industry and Information Technology, the National Development and Reform Commission, the Ministry of Science and Technology, the Ministry of Culture and the Ministry of Commerce have all released detailed strategies concerning XR. In addition, Chinese provincial and municipal local governments are proactively building industrial parks and labs to promote the development of local VR industries.²⁶

Harvard University's Belfer Center for Science and International Affairs recently highlighted China as a "full-spectrum peer competitor" to the U.S. in the technology race.²⁷ And China is not the only nation investing heavily in XR. Countries that had early 5G commercialization strategies, including Japan and South Korea, planned for VR as a key 5G application field. Governments worldwide are generously funding XR research and development, and XR-related inventions are increasing exponentially.²⁸

Still, China remains the United States' chief rival in terms of defining the future of technology. China aims to control the technical and ethical standards for those technologies it believes will be both foundational and ubiquitous in the 21st Century,²⁹ including XR.

In order to ensure that technologies that rely on biometric technology are imbued with U.S. cultural values, we must promote their development here in America where regulations are predominantly influenced by U.S. legislation. What's more, U.S.-based companies' commitment to privacy is a key advantage that should be leveraged, experts say. In a presentation to the National Academies of

²³"Facebook's metaverse spending will top \$10 billion this year," Janko Roettgers, *Protocol*, Oct. 25, 2021. <https://www.protocol.com/bulletins/facebook-metaverse-10-billion-dollars>

²⁴ "With Apple and other rivals in the wings, mixed reality is Microsoft's race to lose, Daniel Rubino, Windows Central, April 2, 2021 (<https://www.windowscentral.com/microsofts-bet-hololens-paying>)

²⁵ "The AR, VR future coming in 2022: What we learned from CES" Scott Stein, CNET, January 10, 2022 (<https://www.cnet.com/tech/computing/vr-and-ar-looked-to-the-metaverse-at-ces-2022/>)

²⁶ "Virtual Reality/Augmented Reality White Paper," China Academy of Information and Communications Technology (CAICT), 2017. <https://www-file.huawei.com/-/media/corporate/pdf/ilab/vr-ar-en.pdf>

²⁷ The Great Rivalry: China vs. the U.S. in the 21st Century, Graham Allison, Harvard University Belfer Center for Science and International Affairs, Dec. 7, 2021. <https://www.belfercenter.org/publication/great-rivalry-china-vs-us-21st-century>

²⁸ Allies like the United Kingdom are taking a strategic approach to XR. The Digital Catapult is the British government innovation agency for the digital and software industry, developed in conjunction with Innovate UK. Digital Catapult explicitly lists immersive technology as one of its three specialty areas for provision of assistance. This focus is accompanied by extensive grants and investments in R&D by the UK government to support the immersive technology sector in the UK. See also <https://www.digicatapult.org.uk/technologies/immersive/virtual-reality>

²⁹ China Task Force Report, Michael T. McCaul, Chairman, U.S. House of Representatives, September 29, 2020.

Sciences, Engineering, and Medicine in 2020, Jason Matheny, founding director of the Center for Security and Emerging Technology, said that “new advancements in privacy technology and a ‘commitment to privacy protection’ may also offer strategic advantages.”³⁰

The Belfer Center report also notes the U.S. tech industry’s commitment to both innovation and transparency:

*The U.S. continues to have many advantages, including a greater number of top research universities; **tech companies that are more accountable to the public**; a more transparent form of government allowing for popular participation; a wider range of technology partnerships abroad; a persistent appeal to high-skilled migrants; an unparalleled advantage in emerging technologies including aeronautics, medicine, and nanotech; and a tradition of protecting and enabling blue-sky innovators.*

U.S. leadership in XR development is needed to ensure the technology advances in alignment with cultural values that place a premium on freedom of thought and expression, learning, cooperation, and other standards of an open and flourishing society. Technology reflects the culture and values of the people who create it.³¹ America’s competitiveness will quickly wither if the U.S. prematurely limits the use of biometric data - a situation that would stifle innovation, negatively impact economic growth, and prevent U.S.-based companies from providing leadership on issues of privacy and security.

Conclusion

It is not a question of if, but when, XR technology will become ubiquitous and replace our current modes of computing, and no one doubts that technologies that employ biometric data will be developed to push that movement forward. What remains to be decided is whether that innovation will happen here in the U.S., where companies are more accountable to the public and have a stronger commitment to privacy and security, or on the other side of the world where individual rights are not afforded the same level of respect.

To ensure that the U.S.-based XR industry can continue to lead, innovate, and provide benefits to consumers, workers, people with disabilities, and our national security, we must resist the impulse to place stringent restrictions on the development of biometric technologies. While legitimate concerns exist about the use of biometric data, the U.S. XR industry is committed to imbuing their products with privacy by design. And only in the U.S. can that goal become a reality.

For additional discussion of XR’s benefits to industry, society, and U.S. technological advancement overall, please see XRA’s 2021 white papers “The Integrated Technology Landscape of the Future and the Synergistic Effect of Immersive Technologies,”³² and “Immersive Technology and Infrastructure:

³⁰ “The Future of Data Science,” Jason Matheny, keynote speech at the National Academies of Sciences, Engineering, and Medicine, Nov. 4, 2020. <https://cset.georgetown.edu/article/the-future-of-data-science/>

³¹ “China’s AI tech leaves aside questions of ethics,” Yasu Ota, *Nikkei Asia*, August 23, 2020. <https://asia.nikkei.com/Spotlight/Comment/China-s-AI-tech-leaves-aside-questions-of-ethics>

³² “The Integrated Technology Landscape of the Future and the Synergistic Effect of Immersive Technologies,” XR Association, 2021. <https://xra.org/wp-content/uploads/2021/04/EFA-White-Paper-Final.pdf>

Building America's Future,"³³ as well as our 2020 letter to the Department of Health and Human Services on the use of XR technology to reach aging, underserved populations.³⁴

We hope the information above helps the Office of Science and Technology Policy to better understand why biometric technologies are essential to the functioning of XR technology; the tremendous societal benefits this technology provides; the industry's commitment to continuing to develop the principles, practices, and policies governing their use; and the stakeholders that may be impacted by their use or regulation. We welcome further discussion on this topic and are glad to answer any questions you may have.

Sincerely,



Elizabeth Hyman, CEO

XR Association

³³ "Immersive Technology and Infrastructure: Building America's Future," XR Association, 2021. https://xra.org/wp-content/uploads/2021/06/XRA_Immersive-Technology-and-Infrastructure_Whitepaper-1.pdf

³⁴ Letter to Dr. Leith States, Chief Medical Officer, Office of the Assistant Secretary for Health U.S. Department of Health and Human Services, December 2020, Document # 2020-25328; Document Citation 85 FR 73280. <https://xra.org/wp-content/uploads/2020/12/HHS-RFI-Final.pdf>