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Principles and Policies to Unlock the Potential of AR/VR for Equity and Inclusion

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To maximize the benefits of AR/VR technologies, developers, policymakers, and organizations implementing them should consider a variety of user needs from the outset. Government should lead by example as an early adopter of inclusive AR/VR, and it should and establish standards and best practices for equity and inclusion in immersive experiences across sectors.

KEY TAKEAWAYS

- Establishing a strong foundation for equity and inclusion in AR/VR solutions can expand the potential user base and accelerate adoption of these technologies.
- To maximize the benefits of these technologies for a broad range of users, policymakers and industry leaders should integrate input from groups that are often underrepresented in product and policy development.
- Because immersive environments are digitally rendered, they can deliver individualized experiences that meet users' unique accessibility, privacy, and safety needs.
- AR/VR developers should consider the impact of broader equity concerns, such as access to enabling technologies, diverse representation, and accessible real-world alternatives to virtual services and spaces.
- Policymakers should mitigate regulatory uncertainty by clarifying how and when existing accessibility, anti-discrimination, and privacy laws apply to AR/VR solutions.
- Government agencies should invest in research and development to spur AR/VR innovations that could expand equity and inclusion, such as accessible design, and implement inclusive AR/VR solutions across government.
- Policymakers should work with industry leaders and stakeholder communities to develop detailed guidelines and clear standards for inclusive AR/VR, both for government and private sector use.

INTRODUCTION

Augmented and virtual reality (AR/VR)—immersive technologies that enable users to experience digitally rendered content in both physical and virtual space—are beginning to move beyond early adopters and enter the mainstream. Most AR/VR devices and applications are still in the early stages of adoption for both personal entertainment and enterprise use, but as devices and applications become more advanced, affordable, and user-friendly, they could have wide-reaching, transformative impact on the way people work, learn, and communicate. AR/VR enthusiasts envision a world where virtual spaces are just as ubiquitous, engaging, and easy to access as real-world alternatives.

AR/VR Equity & Inclusion Series

This transformation will not occur overnight, but it will occur sooner if developers, policymakers, and organizations implementing AR/VR solutions consider a variety of user needs from the outset. For example, accessible AR/VR devices and applications that meet the needs of people with disabilities could expand the potential user base for these technologies by making them valuable and available to more individuals. Similarly, inclusive AR/VR applications that give individuals more choice in how they portray themselves in virtual environments will enable businesses, schools, and other organizations to deploy the technology across a diverse user base. Further, taking safety and security concerns into account early on can help mitigate the potential for unintended negative impacts that could draw time and resources away from further innovation.

Importantly, establishing a strong foundation for equity and inclusion in AR/VR design and implementation from the outset could expand opportunities for many underserved groups. But the converse is also true—overlooking diverse user needs could create additional barriers to employment, education, and public services for some people and heighten the potential for AR/VR to cause some types of harm.

This report offers recommendations on how to create a path forward for inclusive AR/VR innovation, drawing on the insights and solutions offered by a variety of stakeholders in key areas of equity and inclusion. The quotes included in this report capture some of the key comments that experts and advocates made during a series of interviews and roundtables.[1] The report summarizes the opportunities, risks, and challenges that AR/VR technologies present for equity and inclusion. It then presents overarching considerations that should form the foundation of equitable and inclusive AR/VR solutions and offers recommendations for policymakers to drive the development and implementation of AR/VR solutions that expand opportunities while mitigating risks to vulnerable users and their communities.

This is the third report in a three-part series exploring the issues of equity and inclusion in AR/VR.

SUMMARY: OPPORTUNITIES, RISKS, AND CHALLENGES FOR EQUITY AND INCLUSION IN AR/VR

There are many ways that AR/VR devices and applications can help increase equity and inclusion. For users who might face barriers to daily activities such as accessing healthcare or

going to social engagements due to distance or mobility limitations, AR/VR devices and applications can allow them to navigate these spaces virtually from their home or another easily accessible location. In addition, they may offer new channels to build communities and support systems across distances. Further, the multi-sensory and highly adaptable nature of these technologies could create new assistive technologies that will allow underserved communities, such as users with disabilities, to more conveniently interact with their surroundings in real-time. Finally, because immersive experiences give users the feeling of being "really there," AR/VR devices and applications are uniquely positioned to help people better understand the perspectives of others—a useful tool that could help engineers to design better products and police officers to recognize their implicit biases.

Policymakers, developers, and organizations implementing AR/VR solutions should explore the wide-reaching potential benefits of these technologies, while also considering the possible negative impacts or barriers to use that some potential users could face.

However, these technologies can also exacerbate barriers to opportunities for some of the users and communities who stand to benefit from them. Vulnerable users already face greater risks of harm from discrimination, harassment, and abuse, which persists in virtual spaces. Many users who would benefit from AR/VR solutions also face barriers to accessing these technologies, whether due to accessibility concerns for people with disabilities or intersecting disparities such as financial barriers, lows levels of technical literacy, or lack of access to high-speed Internet. These challenges could exclude a number of potential users from engaging in immersive experiences for personal or professional use, which could have broader impacts on diversity, equity, and inclusion efforts across sectors, and limit AR/VR's potential to grow beyond a limited user base.

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KEY CONSIDERATIONS FOR INCLUSIVE AR/VR

Inclusive AR/VR solutions should meet the needs of a broad set of users, address unnecessary barriers to adoption, and mitigate potential risks that might arise from the use of these technologies. Specific equity and inclusion needs will vary among different solutions and use cases, such as personal entertainment, workplace use, healthcare or school settings, and public services. However, there are three key principles that should form the foundation of any AR/VR solution. First, to the extent it is practicable, product designers as well as implementing organizations should actively seek out and integrate input from the communities that are often underrepresented in product development and implementation processes to ensure consideration of their needs and concerns. This will help ensure that AR/VR solutions effectively and efficiently mitigate potential risks and barriers and expand opportunities for vulnerable and marginalized users. Second, inclusive solutions should take advantage of the highly adaptable nature of AR/VR devices to embrace universal design principles, especially to accommodate a wide range of user preferences and abilities. Finally, policymakers and industry leaders working to address equity and inclusion in AR/VR should consider factors beyond the devices or applications themselves,

such as adoption and access to high-speed Internet, when developing and implementing AR/VR solutions.

Integrating Lived Experiences of Underrepresented Groups

Both the possibilities and challenges that AR/VR technologies present for vulnerable and marginalized individuals are incredibly complex and deeply rooted in existing and often intersecting barriers that these users and their communities face. Inclusive AR/VR solutions across all sectors should integrate the input and expertise of anyone whom these technologies could impact. "The way we can mitigate social and technical biases is…[by] making sure we have the right people there to help build it, reiterate it, [and] launch it, across the spectrum," said April Boyd-Noronha, a diversity, equity, and inclusion expert who leads the Cyber XR Coalition, an organization advocating for inclusive AR/VR.[2] Indeed, including diverse perspectives across the product development and implementation process may not only ensure AR/VR solutions accommodate a broad range of user needs, but also help developers identify potential unintended impacts—many of which are relatively easy to mitigate—well in advance.

Both the companies developing AR/VR devices and applications, and the organizations, employers, government agencies, educational institutions, and other entities implementing them should actively seek out and integrate input from potential users and any others who could be impacted by these solutions, including underserved and underrepresented groups such as racial minorities, low-income individuals, people with disabilities, and LGBTQ individuals. The goal should be to better understand technical and non-technical barriers to adoption, as well as the potential unintended consequences of the technology, so as to design solutions and approaches that would maximize the potential of these technologies to meet a broad range of user needs.

Industry leaders and implementing organizations should consider the ways in which they could integrate input from underserved and underrepresented users within existing features.

While developers and implementing organizations cannot reasonably anticipate or accommodate all individual needs, the highly adaptable nature of AR/VR allows these devices and applications to offer a broad selection of user preferences without substantial additional costs. Industry leaders and implementing organizations should consider the ways in which they could integrate input from underserved and underrepresented users within existing features. For example, if advocates in the LGBTQ community express concern about specific forms of harassment and abuse in a multi-user experience, developers can take these concerns into consideration when creating user preferences or safety features.

Ideally, this input should be consistent and iterative, spanning from before a product's development begins to after it is in the market. Rather than a separate, additional effort, it should be integrated within existing product cycles, starting at the conception phase and, to the greatest extent possible, with product teams. Most organizations already do user testing, so they should make sure that this process includes a diverse set of user backgrounds, including those who may have been underrepresented in existing product testing. Product development as well as implementation should consider feedback from individuals who may face barriers to adoption or risks of harm from the use of the technology. "It's thinking about launch not as an endpoint, but an opportunity for growth," said Cynthia Bennett, a researcher at Carnegie Mellon University's

Human-Computer Interaction Institute. "After launch, being prepared to receive feedback when it doesn't work for people and being prepared to make improvements … it's important to have an attitude of 'this is a learning and growth opportunity.'"[3] By including the perspectives of a diverse set of users, developers and implementing organizations can ensure AR/VR solutions evolve to meet best practices for accessibility, safety, and security needs of a widespread user base.

This process is not limited to developers or customers. As AR/VR solutions become more widespread across sectors, policymakers shaping government and regulatory approaches to these technologies should also seek out diverse perspectives. Much like the companies developing AR/VR devices and applications, policymakers and government agencies should ensure that both government use of these technologies as well as the existing laws and regulations that may apply to other uses maximize potential benefits while also anticipating and mitigating potential unintended consequences. As disability rights advocate Lydia X.Z. Brown noted: "policymakers have to consult, collaborate with, and center the perspectives of people who are most directly impacted, and who have the most to lose."[4] In doing so, policymakers can ensure that AR/VR solutions offer the greatest possible benefit to as many people as possible, including those in underrepresented communities.

Promoting Personalization and User Choice

One advantage of AR/VR technologies is the opportunity to deliver highly individualized experiences. Applications can give users the ability to alter the digitally-rendered elements of AR/VR—both fully immersive virtual spaces and digital elements layered on to physical space—to meet their unique needs without compromising the overall experience. This allows AR/VR devices and applications to create more inclusive experiences that mitigate many of the risks and challenges for underrepresented users by allowing them to customize their own experiences based on their safety, privacy, and accessibility preferences.

Adaptive solutions are a critical component of accessible devices and applications: as accessible user experience (UX) designer and educator Regine Gilbert noted, "accessibility is all about providing options."[5] Partially or fully virtual environments are able to provide users with more options and at lower costs than their physical counterparts, positioning AR/VR devices and applications to integrate accessible and inclusive design as a part of their UX design. When faced with inaccessible technology, the burden of finding workarounds or alternative solutions often falls on users—whether they have a permanent disability or temporary impairment, such as holding a conversation in a noisy location or using a device one-handed. Presenting options that anticipate accessibility needs from the outset removes the need for users to come up with solutions on their own. This includes both the controls and commands that users rely on to navigate virtual experiences, as well as the ways in which applications present virtual elements to them. For example, users should be able to interact with virtual environments using device-provided controllers, secondary accessible hardware, or voice commands; traverse a virtual space through physical motion or manual controls; and receive information about their environment through audio, visual, and even tactile feedback.[6] Importantly, these individualized elements should be present for the entirety of the user journey, from the moment someone picks up a device to the end of their session within a virtual experience. The range of accommodations may vary by application: for example, a program used for healthcare or physical therapy may include

more direct features for people with disabilities, while a social experience or entertainment application might allow, but not be designed directly for, third-party accessibility hardware.

Another aspect of individualization that should not be overlooked is avatar selection. A thoughtful and inclusive avatar selection process is the first step toward building more inclusive social and collaborative AR/VR applications.[7] Many of the larger social VR applications already have complex avatar selection processes in place. The extent of customization may vary based on experience: for example, workplaces might require employees to use relatively accurate representations of themselves, while social experiences could allow or even encourage users to experiment more with their appearance. However, it is important to give users autonomy over how they present themselves in virtual spaces. On one hand, this ensures that real-world diversity is translated into virtual space by allowing users to present their authentic selves in a virtual environment. On the other, it allows users to decide whether to obscure certain aspects of their identity that may put them at risk of harassment or abuse, particularly in unfamiliar social settings.[8] Inclusive avatar selection options may include—but are certainly not limited to—face and body shape, hair, skin tone, clothing (including culturally or religiously significant clothing), and mobility aides. To the greatest extent possible, virtual experiences should make this customization the norm rather than a handful of defaults.

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Finally, users should ideally be able to determine the information they share with others in multi-user virtual experiences, in the same way that social media users can decide which aspects of their profiles to make public. This aspect of user choice is important to ensure that multi-user virtual experiences—whether intended for personal entertainment, professional collaboration, or other forms of person-to-person communication—give users control over their personal autonomy. It also allows users with acute privacy and safety needs the opportunity to mitigate potential harms. Indeed, as Lydia X.Z. Brown said, "giving users significant choice and control over their own privacy, autonomy, and ability to restrict other people's access to their information and their visual appearance online is an important move in the right direction."[9]

This is particularly critical to users who face higher risks of harassment and abuse within virtual experiences (and because of this, may be hesitant to engage in these spaces). When possible, users should have the option to create private spaces where they can interact only with users or colleagues they choose to include.[10] However, individuals should also be able to participate in large or unfamiliar multi-user experiences without fearing for their personal safety. This requires a combination of both community-wide rules and individualized user tools. "Robust enforcement, robust tools to monitor these spaces and allow people to self-select who they're dealing with and give them a very quick way to get out of a situation that they don't want to be in, are also a part of this conversation," said Carlos Gutierrez, deputy director of the nonprofit LGBT Technology Partnership and Institute.[11] AR/VR applications can empower users by providing tools that give them the ability to establish boundaries that prevent others from invading personal space, to mute or block other users, to remove themselves from an interaction or experience, and to report instances of harassment and abuse to moderators or other enforcing entities. Similarly, in

addition to safety tools, AR/VR applications can give users the ability to alter how they present themselves in different types of experiences. For example, they may wish to include visible indicators of a disability, such as a mobility aid, in private social spaces, but not in public or even professional settings.[12] While rules and norms may dictate some user behavior, such as following a dress code for avatars at school or using photorealistic avatars in the workplace, many users will likely welcome the opportunity to personalize their experience and showcase their individuality.

Developing Holistic Approaches to Inclusion

As more employers, educators, government agencies, and individuals discover the value of AR/VR, the impact of these technologies will widen. To maximize this impact and ensure it is equitable, developers should aim to do more than simply design for the average user or to accommodate only a few user needs. Rather, developers, implementing organizations, and policymakers alike should approach AR/VR technologies as part of a broader effort toward more inclusive spaces in both virtual experiences and the physical world. "Wherever civil society, or government, or companies are focusing on diversity issues," noted Larry Goldberg, one of the leaders of the XR Access Initiative, "they should remember diversity is a diverse issue, and it can be inserted in any policy work where people are trying to level the playing field."[13] The same holds true for AR/VR devices and applications: by taking on a holistic view of equity and inclusion, those who are designing and implementing these solutions can mitigate potential blind spots, reduce the need for after-the-fact accommodations, and ensure that potential benefits are as widespread as possible.

Developers, implementing organizations, and policymakers alike should approach AR/VR technologies as part of a broader effort toward more inclusive spaces in both virtual experiences and the physical world.

Inclusive AR/VR approaches should consider the various technical capacities and means of access of their potential user bases. For example, some users may not have access to a reliable or adequate Internet connection, and will only be able to use devices and applications that either do not require a connection or utilize other technologies. As Regine Gilbert said, "acknowledging, from an inclusive perspective, [that] not everybody has high-speed Internet … has to be incorporated and thought about as part of accessibility and inclusion."[14] Similarly, not all users will necessarily choose or have access to advanced headsets or wearable devices to access AR/VR applications, and will instead rely on mobile devices or personal computers. Potential user location also matters: some users may only use AR/VR devices and applications in shared spaces including public areas, university campuses, or other locations that may limit their range of motion, privacy, or time available to engage in an immersive experience. Developers and implementing organizations should consider how their potential users are most likely to access these experiences and design them accordingly. For example, employees using an application in advanced manufacturing would likely be doing so in a setting where high-speed Internet is easily accessible, while teachers deploying an immersive educational tool in rural schools may not be able to count on this kind of connectivity.

Representation is also an important aspect of inclusive AR/VR. If only users of certain demographics appear to be active in AR/VR experiences, others may be discouraged from

exploring these new technologies, which would significantly slow wide adoption.[15] Representation starts with avatar selection and by including stakeholder perspectives in design and implementation, but extends to the ways companies market AR/VR devices and applications, researchers examine them, and organizations introduce them.

Finally, regardless of quality and availability, AR/VR will not be the right solution for everyone. As Carnegie Mellon researcher Cynthia Bennett noted, inclusive AR/VR solutions should "prioritize making a system that works for people who have been systemically marginalized from that service in the past"—and in some instances, advanced immersive experiences may not be what works best for underserved communities.[16] Potential users could find AR/VR devices and applications physically uncomfortable or stressful, have concerns about safety and privacy that developers cannot reasonably address, or simply find themselves in a scenario or environment where they are unable to conveniently use a device. Because of this, it is critical that immersive experiences complement, rather than replace, existing alternatives. Businesses, healthcare providers, or government agencies that offer virtual access to their services should maintain accessible alternatives for those who need them. AR/VR-driven customer service and maintenance solutions should not replace websites, phones, or onsite assistance.

RECOMMENDATIONS

AR/VR technologies have enormous potential to expand opportunities in education, employment, healthcare, and communications. In order to maximize these impacts for the widest base of users, developers, policymakers, and other stakeholders should intentionally put equity and inclusion at the forefront of AR/VR innovation.

The U.S. government should take the lead in ensuring a more inclusive immersive future. As early adopters, government agencies are uniquely positioned to engage with developers and industry actors as well as diverse stakeholder communities to both establish guidelines for inclusive AR/VR and to lead by example by integrating these solutions into government activities and services. Policymakers should prioritize clarifying the existing regulatory environment, investing in inclusive AR/VR innovation, and establishing standards and best practices for equity and inclusion in immersive experiences across sectors. These efforts should integrate the considerations described in this report to build a strong foundation for equity and inclusion in immersive experiences as these technologies continue to evolve.

Review and Clarify Accessibility, Anti-Discrimination, and Privacy Laws for Immersive Technologies

The regulatory frameworks that are already in place to address accessibility concerns and prevent discrimination in physical space can also mitigate the potential for these types of harms in virtual settings. However, it is not always clear how and when existing laws and regulations will apply to various AR/VR solutions. Regulatory uncertainty can hold innovation back and lead to legal repercussions if compliance requirements are not clear from the outset. AR/VR devices and applications do not require new, technology-specific regulation related to equity, access, and inclusion—but regulators should clarify how existing laws apply to these solutions. Regulators should review existing rules and issue guidelines for baseline compliance in the context of both AR and VR applications.

Ensure Accessible Technology

Existing laws and regulations around accessibility will also apply to AR/VR, but existing clarifications or guidelines for two-dimensional media or digital tools may not translate directly to immersive experiences. Additional guidance would give developers and implementing organizations a clear baseline for compliance with existing accessibility requirements. The Department of Justice should review compliance requirements for entities subject to Title II and Title III of the American Disabilities Act, including "effective communication" rules to ensure people with vision, hearing, or speech disabilities can effectively receive audiovisual information, to determine when and how these requirements apply to AR/VR devices and applications.[17] This should consider accommodation needs in both fully (VR) and partially (AR) virtual experiences. Similarly, the GSA should offer guidance on Section 508 compliance for federal agencies, or their contractors, developing and implementing AR/VR solutions for workforce development, service provision, or other engagement with employees or members of the public.

Prevent Discrimination

Without safeguards in place, AR/VR solutions could exacerbate risks of harm from discrimination in two ways: first, by inadvertently disclosing information, such as gender, race, age, or disability, that could lead to discrimination; and second, by excluding individuals who are unable, hesitant, or unwilling to fully participate in virtual experiences. Existing U.S. laws that prohibit discrimination in employment, education, housing, and critical services largely cover the former by preventing employers, service providers, and others from discriminating against protected classes of individuals whether or not they disclose that information—but the latter is not as straightforward. Both require clarification in the context of existing anti-discrimination rules, particularly in relation to employment-related discrimination. The EEOC should issue guidance on how existing laws apply to AR/VR devices and applications used in hiring, training, and other workplace functions, including employer obligations to provide reasonable accommodations for candidates and employees with disabilities and on how to mitigate discrimination and harassment within multi-user virtual experiences that would be illegal if it occurred in physical space.

Protect Constitutional Rights

As explained in a prior ITIF report, AR applications raise concerns about reasonable expectations of privacy in public space, as they can not only record audiovisual information, but also process and aggregate data about a user's surroundings in real time.[18] This information gathering may present special considerations for bystander privacy, especially when government and law enforcement use the technology. To address potential concerns, the Department of Justice should issue guidelines for law enforcement development and implementation of AR/VR solutions to ensure they maintain First and Fourth Amendment rights protections for the communities in which they deploy this technology.

Invest in Research and Development of an Inclusive AR/VR Ecosystem

Efforts to design and implement AR/VR solutions that accelerate equity and inclusion are already underway. However, they remain relatively ad-hoc and relegated to specific sectors or use cases. Government investments in relevant research and innovation—including implementing inclusive AR/VR solutions within government—will help to form a strong foundation for equity and inclusion in AR/VR more broadly.

Accelerate Research and Innovation in Inclusive AR/VR

Although there are a number of initiatives working to address equity and inclusion in AR/VR, there are significant knowledge gaps that prevent more widespread exploration and adoption of inclusive devices and applications. These knowledge gaps range from adequate understanding of the potential physiological and psychological effects of immersive experiences, to the efficacy of AR/VR-based education and training, to the potential uses of these technologies as assistive devices or in other specific applications. To accelerate these efforts, government agencies should provide funding for projects and initiatives that build a robust knowledge base around both the ways in which AR/VR can promote equity and inclusion as well as the potential risks or barriers that AR/VR solutions might raise for underserved communities. A more robust understanding of the potential benefits as well as the challenges or drawbacks of immersive technologies can inform more effective and inclusive AR/VR solutions. While many of the opportunities, risks, and challenges outlined in these reports warrant further research, policymakers should first prioritize accessible design and empathy trainings in areas such as law enforcement or other sensitive interactions with the public.

Build Accessible Design Solutions for AR/VR

Perhaps the most immediate need is greater research into accessible and inclusive design, as knowledge of what is possible and effective is needed before policymakers and industry actors can put standard practices in place. As XR Access Initiative advisor Dylan Fox noted, there remains "a great opportunity to make this tool accessible from the start, as opposed to having to play catch-up for years and years."[19] This includes both identifying and addressing the accessibility challenges that AR/VR devices present, and uncovering new opportunities to use them as assistive technologies. The longer these questions go unaddressed, the more difficult it will be to integrate universal design principles into AR/VR devices and applications. There are a handful of university research centers and independent organizations conducting the research necessary to understand how AR/VR both enhances and complicates accessible design—but more is needed to keep pace with rapid innovations in these technologies.[20] To address this knowledge gap, the National Science Foundation should dedicate funding to establish research projects and programs that explore creative solutions to designing immersive experiences that create value for users with disabilities. In addition, Congress should provide funding to the U.S. Access Board to develop federal standards for accessible AR/VR so each agency does not have to resolve these questions independently.

Understand the Opportunities and Limitations for Immersive Implicit Bias and Empathy Interventions

Some experts in the corporate Diversity, Equity, and Inclusion (DEI) space hope that AR/VR tools could reduce instances of implicit bias and discrimination by creating immersive trainings or simulations that let participants take on the perspectives of others. However, other equity and inclusion advocates have cautioned that such interventions could have adverse consequences.[21] More research is needed to understand whether, when, and how to use AR/VR applications to address bias and discrimination. If government agencies wish to implement immersive trainings to mitigate bias, they should first invest in research that explores the efficacy of these interventions, potential drawbacks, and best practices for designing and implementing these approaches in ways that reduce rather than exacerbate biases. This research is necessary for each specific application, as the benefits and potential for negative impacts could vary between use cases. Priority should be given to agencies that oversee critical points of engagement with

the public. Flagship research investments should engage the Department of Education, the Department of Justice, and the Department of Health and Human Services to determine whether AR/VR-based empathy interventions could reduce instances of bias in education, law enforcement, and health or other public services.

Implement Inclusive AR/VR Solutions Across Government

In addition to facilitating greater understanding of equity and inclusion in VR, policymakers should strive to put this research into practice by introducing inclusion-oriented AR/VR solutions across government activities. This would create more demand for inclusive AR/VR innovations, encouraging these approaches in both the development and implementation of AR/VR solutions in other sectors beyond government use. Although there are many opportunities to implement AR/VR technologies for public sector use, the greatest opportunities to align government objectives with inclusive immersive experiences are in three key areas: workforce development, government services, and accessibility. Policymakers should prioritize investments in these areas to accelerate innovation in inclusive and accessible AR/VR solutions.

Enhance Federal Workforce Development

Government agencies should explore possible uses of AR/VR solutions to recruit, train, and engage a diverse federal workforce. AR/VR's ability to enhance virtual collaboration and communication is particularly valuable to federal agencies that rely on coordination between multiple offices across the country. AR/VR can also expand the pool of potential candidates by creating new possibilities for highly collaborative telework, opening opportunities to those who may otherwise have difficulty relocating to or accessing physical workspaces. Inclusive workforce development efforts should also maintain a high standard of accessibility and inclusion to encourage innovation and set expectations for workplace development solutions in other sectors beyond government.

Develop Virtual Public Services

The ability to overcome challenges of physical space would also allow government agencies to make public services more easily available to individuals or communities with limited access due to distance or other physical barriers. While some public engagement can be achieved through two-dimensional digital media, such as websites or digital communications, others may benefit greatly from levels of physical or in-person interaction that these mediums cannot achieve. Federal agencies should examine aspects of their services that require this heightened person-to-person interaction and determine whether they could benefit from immersive virtual alternatives, including AR-based "see-what-you-see" remote assistance, simulated assessments, and real-time communication or collaboration. For example:

- Conducting remote inspections that use AR to annotate physical spaces in real time, without requiring physical travel
- Offering virtual skills assessments, such as driving or operating equipment, for individuals who are unable to find transportation to a physical testing location
- Establishing VR alternatives to in-person offices for services such as mental health counselling, physical therapy, or group-based activities

These applications will take time to develop and implement, particularly as these technologies continue to advance. By determining potential uses of these technologies while they are still

developing, federal agencies can better prepare to implement them when factors such as adoption levels, technical capacities, and cost are appropriate for these uses.

Expand Access

For AR/VR to become mainstream, it will need to be made available to more than those who currently have the resources, physical ability, and technical knowledge necessary to take advantage of them. Government agencies should include initiatives to mitigate both technical and non-technical barriers to access whenever they implement public-facing AR/VR solutions. At the most basic level, this means ensuring more potential users have access to the necessary AR/VR devices and high-speed Internet. One way to affordably expand access in an equitable way is to expand community access to these devices, such as through public libraries, schools, or community labs.

Establish Standards for Equity and Inclusion in AR/VR Experiences

Without clear policies, standards, and best practices in place, even the most well-intentioned AR/VR solutions will have to build the necessary elements for equity and inclusion from the ground up. This forces developers to make costly trade-offs if they want (or are required) to create inclusive and accessible immersive experiences. Established practices, tools, and standards will reduce this opportunity cost. Policymakers should work with industry as well as stakeholder communities to develop robust and actionable guidelines and clear standards for inclusive AR/VR.

Government Procurement and Auditing

Federal agencies should establish baseline standards for accessible and inclusive AR/VR by including these parameters in procurement and auditing processes. Private companies and organizations may also turn to this guidance when considering AR/VR solutions for their own internal or public-facing needs.

The GSA should work with stakeholders to develop guidelines for developing and implementing AR/VR solutions that include and exceed the basic accessibility and equity requirements required by law. For any application of AR/VR, whether for workforce development or public-facing services, federal agencies should consider key equity and inclusion questions such as:

- Do the device, relevant applications, and physical requirements meet basic legal compliance needs, as defined in the context of immersive experiences?
- Are the necessary devices and/or relevant applications compatible with third-party accessibility devices?
- Is the service or experience available through alternative mediums, such as web applications or mobile devices?
- In multi-user applications, do users have the ability to determine how to represent themselves as they choose to within the virtual environment?
- In multi-user applications, do users have access to privacy and personal safety tools, including the ability to report instances of harassment and abuse?

As the AR/VR landscape expands and new use cases arise, policymakers should revisit these guidelines to ensure they accurately reflect both the benefits and the risks and barriers that these solutions could present to vulnerable and marginalized users and their communities.

Industry Standards and Best Practices

In addition to establishing parameters for equity and inclusion in government use of AR/VR, policymakers should facilitate the development of both technical standards and more broadly defined best practices to ensure equity and inclusion is at the center of AR/VR design and implementation across sectors. Relevant agencies and other government bodies should create opportunities for multistakeholder efforts that integrate technical expertise with underrepresented perspectives from key stakeholder communities.

Fortunately, there are multiple efforts already underway to identify and mitigate challenges for equity and inclusion in AR/VR that policymakers and industry can draw from, such as:

- **The Cyber XR Coalition**, an organization launched by the XR Safety Initiative to develop guidance for equity and inclusion in immersive experiences.[22]
- **The IEEE Global Initiative on Ethics of Extended Reality**, which informs IEEE Standards Association work around the ethical development of AR/VR technologies.[23]
- **The Partnership on Employment and Accessible Technology (PEAT)**, an organization funded by the U.S. Department of Labor Office of Disability Employment Policy focused on developing policies and practices for accessible emerging technologies in the future of work.[24]
- **The World Wide Web Consortium (W3C)** Accessible Platform Architectures Working Group's XR Accessibility User Requirements working draft.[25]
- **The XR Access Initiative**, a joint initiative led by Cornell Tech, Verizon, and PEAT that researches and advocates for inclusive design approaches for AR/VR technologies.[26]
- **Academic institutions and research centers** including the NYU Ability Project, the Stanford University Virtual Human Interaction Lab, the MIT Center for Advanced Virtuality, and the Makeability Lab.[27]
- **Industry-led projects and initiatives** including Microsoft Research Lab's Ability Team and the XR Association's Developers Guide.[28]

Establish Accessibility Guidelines

Policymakers should strengthen existing efforts to develop standards and guidelines for accessible design in AR/VR. While some existing guidelines for web and digital content may translate into AR/VR applications, the immersive, three-dimensional nature of these technologies leaves significant gaps in accessibility approaches. Technical standards are the most immediate need: without these, there will be no foundation upon which to build accessible experiences. "It's a lot of people sitting in airless rooms working out mark-up languages," noted the XR Access Initiative's Larry Goldberg, "but that's really going to be needed."[29] However, accessible design in AR/VR is far too complex for guidance to be limited to baseline technical standards. A multistakeholder effort should consider the best ways to take advantage of the highly customizable nature of AR/VR applications to optimize these experiences for users with

disabilities or temporary impairments and minimize the need for after-the-fact accommodations or additional hardware.

Enhance User Safety and Privacy

As discussed here, personal safety and security is critical not only for individual users' experiences, but also for more widespread adoption of AR/VR technologies, particularly among potential users who already face risks of discrimination, harassment, and abuse in their daily lives. As disability advocate Lydia X.Z. Brown said, "platforms need to actually monitor for violent, hateful, and harmful content, regardless of who is targeted by it."[30] The Department of Commerce should form a working group to allow civil society, government, and industry actors to collaborate toward best practices for user protections in immersive experiences as well as responses to instances of harassment and abuse, particularly in multi-user experiences that are managed by employers, educators, or public service providers. Because this extends beyond individual social experiences, specific tools and approaches may vary between applications. However, there are cross-cutting elements that a voluntary framework could include, such as:

- Identifying real-world risks and harms that could translate into immersive experiences, and adapting existing practices, such as bystander intervention training, to address these;[31]
- Developing robust codes of conduct that recognize the types of harassment and abuse possible in immersive experiences that may not be present in two-dimensional digital media;
- Establishing baseline, easy-to-use privacy settings and real-time safety tools that users should be able to expect in any immersive experience; and
- Providing guidance on content monitoring and moderation approaches for different types of multi-user immersive experiences (such as social experiences or workplace collaboration).

Present Considerations for Implementing Organizations

Finally, best practices should extend beyond baselines for accessibility, privacy, and safety to provide more specific guidance for government agencies, businesses, and service providers who are considering implementing AR/VR solutions. Agencies that oversee the areas of greatest potential impact should put forward additional guidelines that build on these multi-stakeholder efforts. For example, the Department of Education should work with developers, educators, and stakeholder communities facing education gaps to develop best practices for schools and academic institutions seeking to implement AR/VR for e-learning or other solutions. Similarly, the Department of Labor should develop guidelines for employers considering adopting AR/VR solutions for workforce development to ensure these approaches do not lead to de facto discrimination or raise undue concerns about employee privacy.

CONCLUSION

As AR/VR adoption accelerates across sectors and starts to become mainstream, these technologies present significant opportunities to enhance access to education, healthcare, and jobs for many individuals. But if the public and private sector overlook diverse user needs, AR/VR may not be available to many users who could benefit from the technology. Addressing the equity and inclusion risks and challenges can seem daunting—but as Carlos Gutierrez of the LGBT

Technology Partnership and Institute pointed out, "these are issues that are out there … and if you catch them at the beginning, they're actually pretty easy to correct for."[32] Understanding the issues is the first step; proactively designing and implementing solutions that mitigate them is the ultimate goal. To do this, policymakers and industry actors alike should take a holistic approach to building an AR/VR ecosystem that not only corrects obvious flaws, but also pursues innovative solutions to address equity and inclusion challenges for underserved communities.

Government has an important role to play in this and can pave the way for broader adoption. By dedicating the necessary effort and resources early on, policymakers can ensure that AR/VR innovation continues to thrive and that the potential of these technologies expands to meet the needs of a broad set of users regardless of where, how, and why they participate in this immersive future.

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ENDNOTES

1. ITIF conducted three group interviews and three individual interviews via video in April 2021. In total, 15 stakeholders participated. The first group interview focused on safety and inclusion for vulnerable users; the second focused on disability rights and inclusive design; and the third explored the specific accessibility needs of users with disabilities.
2. April Boyd-Noronha in video interview with the author, April 5, 2021.
3. Cynthia Bennett in video interview with the author, April 15, 2021.
4. Lydia X.Z. Brown in video interview with the author, April 13, 2021.
5. Regine Gilbert in video interview with the author, April 15, 2021.
6. XR Association, "Accessibility & Inclusive Design in Immersive Experiences," *XR Association Developers Guide: An Industry-Wide Collaboration for Better XR*, October 2020, https://xra.org/wp-content/uploads/2020/10/XRA_Developers-Guide_Chapter-3_Web_v3.pdf.
7. Not only is this important for a more inclusive experience; there is evidence that human self-recognition extends to "look-alike" avatars. If some users are able to replicate their appearance while other cannot, this could diminish the experience for a subset of users. See: Mar Gonzalez-Franco et. al, "The Neurological Traces of Look-Alike Avatars," *Frontiers in Human Neuroscience* 10 (2016), https://doi.org/10.3389/fnhum.2016.00392.
8. April Boyd-Noronha in video interview with the author, April 5, 2021.
9. Lydia X.Z. Brown in video interview with the author, April 13, 2021.
10. Jessica Outlaw in video interview with the author, April 9, 2021.
11. Carlos Gutierrez in video interview with the author, April 5, 2021.
12. Martez Mott et. al, "Accessible by Design: An Opportunity for Virtual Reality," Microsoft Research, 2019, https://www.microsoft.com/en-us/research/uploads/prod/2019/08/ismar_mra_workshop_microsoft_final_draft.pdf.
13. Larry Goldberg in video interview with the author, April 15, 2021.
14. Regine Gilbert in video interview with the author, April 15, 2021.
15. April Boyd-Noronha in video interview with the author, April 5, 2021.
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19. Dylan Fox in video interview with the author, April 15, 2021.
20. Larry Goldberg in video interview with the author, April 15, 2021.
21. For a more in-depth discussion of these considerations, see the first report in this series.
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27. "NYU Ability Project," nyu.edu, accessed May 24, 2021, http://ability.nyu.edu; "Virtual Human Interaction Lab," stanford.edu, accessed May 24, 2021, https://vhil.stanford.edu; "The MIT Center for Advanced Virtuality," mit.edu, accessed May 24, 2021, https://virtuality.mit.edu; "The Makeability Lab," washington.edu, accessed May 24, 2021, https://makeabilitylab.cs.washington.edu.
28. "Ability," Microsoft Research, accessed May 24, 2021, https://www.microsoft.com/en-us/research/group/ability; "Research & Best Practices," XR Association, accessed May 24, 2021, https://xra.org/research-best-practices.
29. Larry Goldberg in video interview with the author, April 15, 2021.
30. Lydia X.Z. Brown in video interview with the author, April 13, 2021.
31. See for example: Jessica Outlaw, "Social VR Bystander Intervention—and an Invitation to a Free Training," Medium, June 28, 2018, https://jessica-outlaw.medium.com/social-vr-bystander-intervention-and-an-invitation-a-free-training-5bf38e5616c0.
32. Carlos Gutierrez in video interview with the author, April 5, 2021.