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The Metaverse in 2040

Hype? Hope? Hell? Maybe all three. Experts are split about the likely evolution of a truly immersive 'metaverse.' They expect that augmented- and mixed-reality enhancements will become more useful in people's daily lives. Many worry that current online problems may be magnified if Web3 development is led by those who built today's dominant web platforms

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For this project, Pew Research Center worked with Elon University's Imagining the Internet Center, which helped conceive the research and collect and analyze the data.

How we did this

This report covers results from the 14th "Future of the Internet" canvassing that Pew Research Center and Elon University's Imagining the Internet Center have conducted together to gather expert views about important digital issues. This canvassing of experts was prompted by emerging debates in the early 2020s over the potential evolution and impact of extended reality tools like augmented reality, mixed reality and virtual reality, as well as "the metaverse" or "metaverses." This is a nonscientific canvassing based on a nonrandom sample; this broad array of opinions about where current trends may lead in the next 18 years represents only the points of view of the individuals who responded to the queries.

Pew Research Center and Elon's Imagining the Internet Center sampled from a database of experts to canvass from a wide range of fields, inviting entrepreneurs, professionals and policy people based in government bodies, nonprofits and foundations, technology businesses and think tanks, as well as interested academics and technology innovators. The predictions reported here came in response to a set of questions in an online canvassing conducted between Feb. 6-March 21, 2022. In all, 624 technology innovators and developers, business and policy leaders, researchers and activists responded in some way to the question covered in this report. More on the methodology underlying this canvassing and the participants can be found in the section titled "About this canvassing of experts."

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Terminology

Extended reality (XR) is an umbrella term to cover all of the various forms of computer-altered reality. For some experts and technologists, other terms fall under the XR umbrella:

Virtual reality (VR) completely immerses people in a digital setting. These settings can be created as fully synthetic computer-generated content, they can be made of real-world content (set in actual 360-degree video), or they can be a hybrid of both. Roblox is one of many popular metaverse VR platforms in 2022. Today's fullest home or work VR experiences require individuals to use a head-mounted device and haptic controllers.

Augmented reality (AR) overlays digital information in real-world settings. You are applying AR when you use your phone's camera to translate signs and menus in real time from one language to another, or if you play Pokémon Go. Hundreds of AR applications are available today for use on smartphones. AR keeps the real world central but enhances it with digital details that supplement the environment.

Mixed reality (MR) experiences allow people to interact with and manipulate computer-generated images in the real world, in real time. You use a headset but see and remain immersed in the real world while seeing and interacting with images using your hands – for instance, a 3D architectural floor plan for a new school or 3D schematic for an electric vehicle. At this point in time MR is mostly used in industrial, military and medical training and design.

Mirror worlds are digital creations that mimic the physical and social structures of the real world in a VR setting. Several companies are already working to create such representations of the entire planet. For example, Nvidia's Earth-2 is a digital twin that aims to enhance the capacity for climate modeling. And many mirror worlds are settings for games or businesses. One example is Upland, a virtual-property NFT game where people buy, sell and trade virtual properties mapped to the real world – for instance, a real-world baseball stadium or museum.

The Metaverse in 2040

Hype? Hope? Hell? Maybe all three. Experts are evenly split about the likely evolution of a truly immersive 'metaverse.' They expect that augmented- and mixed-reality enhancements will become more useful in people's daily lives. Many worry that current online problems may be magnified if Web3 development is led by those who built today's dominant web platforms

Interest in the idea of the metaverse leaped in 2021-2022, prompted in part by Facebook's decision to rebrand itself as "Meta." The word was coined by sci-fi author Neal Stephenson in 1992 in his novel "Snow Crash." In today's terms, the metaverse is the realm of computer-generated, networked extended reality, or XR, an acronym that embraces all aspects of augmented reality, mixed reality and virtual reality (AR, MR and VR). At this point in time, the metaverse is generally made up of somewhat- immersive XR spaces in which interactions take place among humans and automated entities. Some are daily interactions with augmented-reality apps that people have on their computers and phones. Some are interactions taking place in more-immersive domains in gaming or fantasy worlds. Some occur in "mirror worlds" that duplicate real-life environments.

While extended-reality gaming and social spaces have been in existence for decades, early 2020s technological advances and societal transformations brought about by the COVID-19 pandemic have pushed the development of the metaverse to the forefront, inspiring tens of billions of dollars in new investments and prompting predictions that the metaverse is "the *future* of the internet" or "the next internet battleground."

Proponents of XR and the development of more-advanced and immersive, 3D, online worlds say its rapid evolution is likely to benefit all aspects of society – education, health care, gaming and entertainment, the arts, social and civic life and other activities. They believe the infusion of more data into people's experiences, progress in artificial intelligence (AI) assistive systems and the creation of entirely new spaces and experiences for tech users could enrich and expand their lives. Of course, as with all digital tech, there are concerns about the health, safety, security, privacy and economic implications of these new spaces. This has spurred a great deal of speculation about what the maturing of XR and the metaverse will look like and what that means for society.

This heightened interest and investment in extended reality prompted Pew Research Center and Elon University's Imagining the Internet Center to ask hundreds of technology experts to share their insights on the topic. In all, 624 technology innovators, developers, business and policy leaders, researchers and activists provided open-ended responses to a question seeking their

predictions about the trajectory and impact of the metaverse by 2040. The results of this nonscientific canvassing:

- **54%** of these experts said that they expect by 2040 the metaverse **WILL** be a much-more-refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally.
- **46%** said that they expect by 2040 the metaverse **WILL NOT** be a much-more-refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally.

These experts were asked to elaborate on their multiple-choice answers in an open-ended question that invited their views about both the positive and negative aspects of the digital world to come. Two broad themes emerged in those written remarks. First, a notable share of these experts argued that the embrace of extended reality in people's daily lives by 2040 will be centered around augmented-reality and mixed-reality tools, not in the more-fully-immersive virtual reality worlds many people define today as being "the metaverse." Second, they warned that these new worlds could dramatically magnify every human trait and tendency – both the bad and the good. They especially focused their concerns on the ability of those in control of these systems to redirect, restrain or thwart human agency and stifle people's ability to self-actualize through exercise of free will, and they worried over the future freedom of humans to expand their native capacities.

The key themes these experts voiced in their written responses are outlined in the three following tables. The first table outlines further details tied to the two broad themes mentioned above. The second describes the five most-mentioned reasons that the metaverse *is likely* to be much more advanced and more broadly adopted by 2040. The third describes the five most-mentioned reasons it *will not* be.

Two meta insights about the future of the metaverse

These themes anchored many experts predictions as they considered the metaverse in 2040:

- **Augmented- and mixed-reality applications will dominate over virtual-reality advances:** Some argued that the most-popular technological enhancements will be tied to augmented reality (AR) and mixed reality (MR), enabled by artificial intelligence (AI) systems. They said people will find those advances particularly appealing because they will expand upon real-world experiences and improve users' daily lives by making reality more understandable and interesting. Most of these experts said they expect that broader adoption of virtual reality (VR) will be limited to enthusiastic but smaller user bases, especially gamers and entertainment seekers and in select business, medical, education and training settings.
- **The next-generation networked-knowledge ecosystem can be built in ways that better serve people than the current web does:** A share of these experts argued that coming tech advances in metaverse technologies will magnify all human activities, including the problems now associated with the current Web 2.0 environment. They said the immersive properties of the metaverse could raise significant threats to human agency and human rights as "surveillance capitalism" expands and authoritarian governments take advantage of these new technologies.

The metaverse will fully emerge as its advocates predict

Half of the expert respondents to this canvassing said extended-reality (XR) applications and the networking needed to facilitate their broad adoption *will* advance significantly by 2040. They expect that extended reality will be much more sophisticated by then thanks to these factors:

- **Profit motives are driving significant investment in advancing these technologies:** The primary force driving investment in technological development has always been the opportunity for people to profit from its success. Expect rapid development of XR because of its massive commercial potential.
- **Compared with today, far more people will find the metaverse useful enough to access it daily:** Those who expect XR to advance significantly by 2040 believe it will be broadly adopted in many realms in addition to its current niches. As with any technology, the use cases include positives *and* negatives.
- **The technology to create an immersive universe is possible by 2040:** Yes, software, hardware, user interfaces and network capability could be advanced enough within the next 18 years to make a much-improved, more broadly adopted metaverse possible.
- **The pandemic gave XR development a big boost:** Experiences during the COVID-19 pandemic have accelerated demand for and investment in new and improved online tools, especially in health, business and educational settings.
- **There are any number of potential positive and delightful uses of XR:** These experts highlighted a wide-ranging number of activities and services that could be offered in metaverse spaces, including rich learning experiences; remote medical procedures; disaster-response flexibility; creation of new kinds of communities; expanded venues for commercial exchanges; a flowering of creativity in the arts and fashion; fully automated encounters with smart agents handling such things as accounting, professional training and mental health counseling; interactions with famous people; playing-field experiences with prominent athletes; and travel to exotic and fun locales (e.g., archeological digs, mountaintops, historic scenes, beaches, museums, far-off galaxies and other-worldly places).

The metaverse will *not* fully emerge in the way today's advocates hope

About half of the expert respondents said advances in full-immersion XR settings will *not* come to widespread use in people's daily lives by 2040. They made these arguments:

- **It will not be seen as useful in daily life:** A portion of these experts pointed out that quite a few immersive augmented and/or virtual spaces already exist and are only attracting niche participants. They contend the considerable majority of people will not see enough life-enhancing use cases in the prospects of fuller XR to want to become more fully immersed.
- **The technology needed to reach a lot more people will not be ready in 2040:** Upgrades in software, hardware, user interfaces and network capability will not be advanced enough to lure mass audiences into fuller immersion by 2040. The gear is likely to remain less than user-friendly, large spaces are required to maneuver in VR, and there will continue to be problems with network latency and bandwidth.
- **People prefer living in layers of 'real' reality:** Most people will continue to find full immersion in VR unappealing – not just due to clunky equipment, high cost or bad connectivity, but because they don't want to be immersed, preferring being mostly absorbed in the real world.
- **Public worries about the impact of surveillance capitalism and abuse by authoritarian regimes will slow or stop adoption:** A number of these experts predict that people will not be willing to invest their time and energy in virtual spaces in which they can be further manipulated and surveilled by corporate and/or authoritarian interests.
- **There are any number of threatening and harmful uses of XR:** These experts noted a number of problems that may worsen or arise in metaverse spaces, including reductions in autonomy and people's ability to control their lives; worsening digital divides; amplified discrimination; new forms of harassment, bullying and hate; new menaces to public safety, especially around sexual violence and exploitation; more avenues for misinformation (especially tied to clever fakes); deeper levels of addiction to metaverse activities; distractions that dissociate people from real life and induce loneliness (or worse); new threats to users' personal data; and further commercialization and further monetization of basic human activities.

Source: Nonscientific canvassing of select experts conducted Feb. 11–March 21, 2022.
"The Metaverse in 2040"

PEW RESEARCH CENTER and ELON UNIVERSITY'S IMAGINING THE INTERNET CENTER, 2022

This is a nonscientific canvassing, based on a nonrandom sample. The results represent only the opinions of the individuals who responded to the queries and are not projectable to any other population.

Some of the most sweeping answers written by these respondents took the long view. These experts wrote that "virtual" spaces have for millennia arisen in the human imagination and that it doesn't take special technological features or gadgetry to create vivid places beyond "real life." At the same time, some argued that even the most far-out versions of virtual reality will still anchor in basic human sensory "interfaces" of eyes, ears, taste, smell, motion, balance and speech.

Still, none of these experts doubt major changes are nigh in the way reality is supplemented by technology or even reimagined in tech-enabled ways. As XR pioneer **Avi Bar-Zeev**, a co-creator of Google Earth, HoloLens and more, wrote, "VR fundamentally strips away the most common

constraints of reality: location and travel, physics, even sometimes *time,* where hours can often seem like minutes, and we can travel to the historical past or imagined futures."

Many were not sure what the timeline for all this change will be, but did their best to imagine where the evolution of today's XR tech trends might take society. Some of the answers reflecting that thought:

Laurence Lannom, vice president at the Corporation for National Research Initiatives, offered an compact prediction, writing, "The metaverse will, at its core, be a collection of new and extended technologies. It is easy to imagine that both the best and the worst aspects of our online lives will be extended by being able to tap into a more-complete immersive experience, by being *inside* a digital space instead of *looking at* one from the outside. At the good end of the continuum are things like the ability of people to interact with others as though they were all in the same physical space without having spent hours burning dinosaur bones to get there; practicing difficult physical tasks (e.g., surgery) on virtual entities; and elevated educational and research opportunities of all kinds as we learn to leverage the built-in advantages of the new environments. The other end is also not hard to imagine – easier addiction to all-absorbing games and fantasy experiences resulting in increased isolation for many; further breakdown of social cohesion as the virtual offers an easy alternative to the hard task of learning to live with each other; and increased political turmoil as the prophets of fear and grievance acquire the ability to command rallies with millions of attendees."

Edward Baig, freelance columnist and longtime technology reporter for USA Today, wrote, "Even the smartest folks today have difficulty articulating the metaverse so that regular people understand it beyond it being this vague thing emerging out of augmented reality, virtual reality, 3D and mixed reality. Of course, measured in tech years, 2040 is a lifetime away and, when you factor in the sheer magnitude of the financial and intellectual investments already being plowed into the metaverse, how could this thing possibly not morph into something likely to have a profound impact on our everyday lives? Whatever it is that draws all of us into the metaverse, it must provide – or at least promise to provide – experiences and benefits that are otherwise impractical if not impossible to achieve in (for lack of a better way of putting it) the real world."

Elizabeth Hyman, CEO for the XR Association, which was founded by Meta, Google, HTC Vive, Microsoft and Sony Interactive Entertainment to convene stakeholders for the development and adoption of XR, shared a number of vital use cases already proven as useful in the XR realm: "Virtual, augmented and mixed reality are the gateway to phenomenal applications in medicine, education, manufacturing, retail, workforce training and more, and it is the gateway to deeply social and immersive interactions – the metaverse. Each day we're taking strides to make the technology better and ensure that the opportunities are limitless – because they are. The XR

industry is focused on responsible innovation and it has built a strong repository of resources that lay the foundation for the industry's continued growth. While widespread adoption does take time and challenges will no doubt arise, we believe XR technology will become the next major computing platform. Already, colleges and universities are teaching students in the metaverse. Human Resources professionals at companies like Walmart, SAP, Delta and many others are using the tool to train workers – some of the fastest-growing job categories in the U.S. are in industries that are rapidly adopting XR technologies. Uses of XR include warehousing and inventory management, product engineering and design, immersive job training and upskilling and virtual health care patient monitoring. Particularly in the health care setting, we're seeing XR use with children. For example, the Children's Hospital Colorado is using XR to help to change the pediatric hospital experience for the better – for instance, for distraction and pain management reducing the need for anesthesia and physical therapy."

Daniel D. Bryant, Wales-based VR educator, co-founder of Educators in VR and a leader in the Virtual World Society, predicted, "By 2040 the internet that you now access on a screen will be a *place* you can enter, visit and explore. Currently we are looking in through windows (literally), but we are soon going to be starting to climb *through* the windows and into the internet. The word web*site* implies a location. Currently this is mostly in 2D. What if these sites are in 3D and you can get in and interact directly, rather than with a keyboard and a mouse? Think how creative people already get with creating and monetizing content on the 2D internet. Now add a third dimension to this and you have just created what Charlie Fink has referred to as the 'largest wealth-and-value-creation experience humankind has ever witnessed.' I can't imagine the momentum heading anywhere else. When young people can truly get their heads and hands into the 'metaverse,' just stand back and watch in wonder. And that is even before AI [artificial intelligence] gets into the mix. AI will soon be able to generate virtual worlds and useful and very convincing AI bots to populate it. It's a wild ride already. Better get strapped in."

Jon Radoff, author of the Building the Metaverse blog and CEO of Beamable, a metaverse consultancy, predicted the influence of gameplay in the evolution of XR. "The metaverse will be important for at least half a billion people in 2040 because it is already important for several billion," he said, referring to a general estimate of the number of people who have used popular game and social spaces, not the number of daily users. "The metaverse *exists*. The most-common definitions of the 'metaverse' are: 1) an embodied virtual-reality experience; 2) a Web3 framework for economic interoperability; 3) a creative platform for experiences (e.g., Roblox). Some current versions may be a hybrid of these. I think all of these 'product-centric' definitions fail to look at the underlying culture and social change. The fundamental shift is toward thinking of virtual property and virtual identity as 'real' and/or important. One can trace the origin of the metaverse back to Dungeons & Dragons before it was digitized and look at it as an imaginary, creative space of social

interaction and storytelling. Everything since then is simply technologies that have digitized, dematerialized and democratized access to this category of experience."

About half of the respondents to this canvassing do not expect the VR aspect of the XR realm to be significantly more popular by 2040. **Kevin Werbach**, professor of legal studies and business ethics at the University of Pennsylvania and author of "The Blockchain and the New Architecture of Trust," commented, "There is not a straight evolutionary path forward in maturity and importance for this collection of technologies. Virtual worlds and immersive online spaces will continue to develop in significance, but 500 million people won't be living in 'the metaverse' in any more meaningful way in 2040 than 2022. Perhaps immersive games, social spaces and work tools will merge into a coherent industry sector at that point, which perhaps we'll still call 'metaverse.'"

Eric Burger, who recently worked in the White House Office of Science and Technology Policy and as the chief technology officer at the Federal Communications Commission, now on the computer science faculty at Georgetown University, responded, "The metaverse will pan out like remote-controlled self-driving cars or roadable aircraft: almost here for decades yet *structurally unlikely for decades*. The use cases for fully immersive experiences have a small niche that, for economic reasons, is unlikely to grow into a global phenomenon for decades to come."

Jerry Michalski, respected technology consultant and founder of Sociate.com and ReX, predicted, "An XR metaverse will be more like 3D TV than the web. It will be more expensive, uncomfortable and disorienting, even as it is less informative and connective. XR is transformative in specific domains and cumbersome in general. I don't see how 20 years of development will fix that."

Micheal Kleeman, a senior fellow at the University of California, San Diego, who previously worked for Boston Consulting and Sprint, responded, "Unless we see a large-scale desire to escape from reality, the virtual space will not add much to human experience. The virtual world does not satisfy real interpersonal dynamics, it is expensive in terms of bandwidth unless you are just gaming and it adds little to experiential value."

Many people pointed to Facebook's corporate pivot to name itself Meta as a catalyst for the uptick in metaverse buzz over the past year. **Ethan Zuckerman**, director of the Initiative on Digital Public Infrastructure at the University of Massachusetts, Amherst, wrote, "Smart people have spent lots of time on different approaches to building immersive, 3D, collaborative online spaces using a wide range of technologies. Some have achieved more success than others, but none have expanded beyond audiences of 1 million or so users. Those users can be extremely passionate and are willing to learn the complexities of interacting in a virtual world. Some of them are willing to put in the work of learning to build and create in these environments, but thus far we've not seen

evidence that mainstream users see a good reason to jump through these hoops. Facebook became Meta for two simple and obvious reasons. First, its brand as a social media platform has been badly muddied by years of mismanagement and irresponsibility. If it could be associated with anything other than angry dialogs online, it would benefit. Second, Facebook wants to own the entire stack from hardware to content, much as Apple does. It has a good hardware product in Oculus [a VR headset] and thus is positioned to argue that VR is the future. But does anyone really want VR to be the future? Those of us who've been down this road before remember Second Life declaring that its metaverse would be the future and we should all rush in to buy a piece of it. That community never achieved mainstream success and has hovered at 1 million users (overall, most were not daily users). Yes, the tech's better now. But in 2040 I expect VR to be popular for gaming and some simulations. It will not catch on for routine office work, standard online interaction and so on."

Jacquelyn Ford Morie, VR pioneer and chief scientist at All These Worlds, co-editor of "The Handbook of Research on the Global Impacts and Roles of Immersive Media," argued there is much to be accomplished before fully--immersive tech will be viewed as worthy of broad adoption. "To be so successful by 2040," she said, "it must be many things to many people, enrich or make better their everyday lives. It must go beyond games and entertainment to provide what each and every person needs. The first, and the biggest, step will be to instantiate and regulate the metaverse as a public benefit/utility, so the greatest number of people can access and benefit from it. It must offer value to its participants and not simply treat them as money sources. If it has to make tons of money for companies and the top 10%, it is doomed to be niche-driven and not a true evolution of humanity."

A notable share of these expert respondents said they expect that *augmented reality* applications will be far more widely used in people's daily lives than immersive VR, which they expect will remain a niche realm. **Louis Rosenberg**, is CEO of Unanimous AI. His doctoral work at Stanford University resulted in the virtual fixtures system for the U.S. Air Force – an immersive augmented-reality system built in 1992. He predicted: "By 2035 people will laugh at images of the 2020s that show people walking down the street staring down at a phone, necks bent, thinking it looks awkward and primitive. The metaverse will evolve in two directions at once – the virtual metaverse (fully simulated worlds) and the augmented metaverse (layers of rich virtual content overlaid upon the real world with precise spatial registration). The virtual metaverse will increase in popularity but will always be restricted to short-duration applications – mostly for gaming, socializing, shopping and entertainment, and it will have powerful business and education uses as well. The augmented metaverse, on the other hand, will *replace mobile phones* as our primary gateway to digital content. The transition from mobile phones to AR hardware will begin the middle of the 2020s and will be complete by 2035, possibly sooner. It will fundamentally change society, altering our world into a merged reality of real and virtual. People will use AR eyewear

from the moment they wake up to the moment they go to sleep, much like they keep mobile phones with them today. Blockchain will be used to assign ownership of virtual objects within the metaverse. There are many other potential uses, but it's too early to know if those will happen or not. But assigning ownership is a natural fit. To see a vision of the augmented metaverse at the end of this decade, you can check out my fun narrative, 'Metaverse 2030.'"

Many respondents who expect the AR/VR metaverse to be well developed by 2040 warned that this will significantly magnify societal challenges already present in the digital sphere. **Justin Reich**, associate professor of digital media at MIT and director of the Teaching Systems Lab, expressed a view shared by respondents who expect big tech companies will further exploit users, writing, "The term metaverse was coined to describe a corporate, dystopian hellscape where a completely financialized world is stripped of any culture and value. Advocates of the metaverse are currently trying to bring that vision into reality in the hopes of creating new digital surfaces that can be covered in new advertising and made as addictive as possible. As the physical world encounters saturation of existing advertising surfaces and data collection, augmented reality is the new frontier of surveillance capitalism. If it does come to fruition, it will be as terrible as social media is today. Questions that I've not seen journalists ask of Mark Zuckerberg or other folks at Meta: 'How many hours a day are *you* currently spending in the metaverse?' 'How many hours a day do you encourage your children to spend in the metaverse?' My hunch is that the typical Meta employee spends very little time in the metaverse, because it's terrible. And they don't want their children there, because it's terrible."

Davi Ottenheimer, vice president for trust and digital ethics at Inrupt, a company applying the new Solid data protocol (a method for building decentralized social applications that was created by web inventor Tim Berners-Lee), responded, "We should declare metaverse to only be a success if it augments the human in a decentralized human-centric model of data ownership. It is currently in danger of being co-opted into overly centralized platforms and constraints, a regression to slavery models in the guise of a proprietary 'digital twin' to be abused by giant companies looking to operate selfishly and above the law and deny social good. Those caught up in this abuse of rights, like industrial-era workers suffering the daily grind of soulless factory jobs and homes and vehicles, will long for an escape from the intentionally limiting artifice of metaverse. The utopianism and mysticism that drive cultural waves of 'escape' during times of technological upheaval and displacement are here again. There is a fundamental difference between the highly controversial technological augmentation and the politically driven escapism that metaverse development will predictably fall into."

Keram Malicki-Sanchez, a prominent expert and activist who runs conferences about VR, AR and XR and is founding president of the Constant Change Media Group, advised, "There is no way to put the genie back in the bottle of immersive technologies. There is no future without 3D

realities as part of it. Will it be called the 'metaverse'? God, I hope not if that means the MAANG companies – Meta (formerly Facebook) Amazon, Apple, Netflix and Google – appropriate and commandeer it to funnel us into a homogeneous, highly trackable somatosensory collection of walled gardens. An alternative path for these technologies is that they will be built using open-source solutions, improved and expanded holistically, organically by a global community who will create an estuary for systems that allow people to seamlessly transition between 3D worlds where they can embody whatever they want and share whatever experiences they choose. These are also media that can communicate new perspectives and afford us new angles of insight via dimensional contexts. They can provide scaffolding to test our analytical reasoning and processes to potentially escape our cognitive biases, develop greater plasticity, or even test new forms of embodiment. We must always take account of how these new media can and will be manipulated and weaponized and consider the rights of our future selves as we become subsumed in data. In addition, there are important digital divides to consider here. These cannot be worlds accessible only to the privileged. VR needs to be built so that anyone should feel they have the tools and access available to them."

Sean McGregor, technical lead for the IBM Watson AI XPRIZE and machine learning architect at Syntiant, observed, "With every great (and terrible) technological revolution comes great (and terrible) revolutions of social systems. Without a healthy sense of skepticism for adopting software for our new reality and working collectively against our worst imaginings, we will fail to realize social benefits exceeding the costs. The transition will be very difficult and potentially dangerous, but so, too, have been most human advancements."

Toby Shulruff, senior technology safety specialist at the National Network to End Domestic Violence, predicted, "The 'online' will increasingly extend into daily life through interfaces with our cities, homes and bodies. The varieties of both self-expression and connection across distance will expand, and this means that we urgently need to reconfigure how we establish and maintain trust in others, in information, and perhaps even in ourselves. Online life so far has mirrored and accelerated real-life trends, and – absent a major shift in priorities and design – this will be true with XR as well. The rules of the game have so far been written by the very few for the very many. Like other technologies, XR does not solve human problems like bias, fear or violence. It accelerates and amplifies what is already present in society. Therefore, we stand to see an exacerbation of isolation, echo chambers and a dissociation from our bodies and communities. We are already seeing sexual violence from earlier online spaces and real life crossing into more-immersive XR environments. This is likely to extend into and intersect with other targeted violence, or even mass violence or terrorism. There is a real possibility that those who are 'plugged in' will become increasingly untethered from the world around them. Future waves of pandemic disease and the effects of climate change will allow those with means to spend more time in virtual worlds. Will we become more willing to let conditions worsen around us because we can escape to

an alternate reality? Meanwhile, those on the other side of the digital divide will struggle to access resources, connections and opportunities. As we go from 'always on' to 'always in,' the constant immersion may cause physical, psychological, emotional and spiritual effects including stress reactions, headaches, disturbed sleep and detachment. Paradoxically, while virtual worlds can be an escape from our bodies and our limitations, many users describe an intensification of sensation, emotion and response from virtual experiences. Another concern is that the more-immersive environment will expand surveillance by governments and corporations, and even within families. The boundaries between our work lives and our personal lives, between the public and the private, will continue to dissolve. Coercive trends in technology design such as dark patterns will drive users to make choices they might not otherwise make. Technology this complex defies precise predictions, but we can find hints from previous examples. If we don't shift course, we will weave our failures of empathy and justice into the very fabric of XR, as we have in other digital technologies."

Among the additional intriguing predictions from those canvassed were:

- **Avi Bar-Zeev** said digital systems will perform ever-more-sophisticated analyses of how people think and feel about people and other elements of their lives, their private political and spiritual thoughts, their emotional triggers. "We've turned people into data mines and no longer truly free-thinking individuals."
- **Glynn Rogers** predicted virtual extraterrestrial travel based on imagery constructed from a multitude of spacecraft sensors, "in which virtual craft can be flown, driven or sailed through environments in which humans could exist only with the most extraordinary aids." And **Gary Arlen** noted that alternative cyber environments will allow people to virtually go *inside* humans, animals or machines.
- **Jim Spohrer** noted that "digital twins" will often function as people's alter egos in multiple worlds. And **Melissa Sassi** noted that having a digital twin in health care will be incredibly powerful when it comes to predictive modeling of diseases and sharing patient data across healthcare providers. She wrote, "One example I have seen inspiring this work is BioTwin, an early stage health tech startup that's created a virtual replica geared toward detecting and preventing health care ailments before they occur."
- **Barry Chudakov** said he expects that immersive mirror-world environments may raise enough psychological issues that "psychiatrists and counselors will be called in to help people cope with multiple-self syndrome."
- **Stephen Downes** predicted that in 2040 it will not be possible for most people to distinguish between avatars representing humans and artificial intelligences, adding that there will be "convincing impersonations and worse."

- **Jonathan Kolber** said he expects that the "demand for all manner of physical objects will drastically diminish" as people move into digital spaces to live more of their lives and the need for real objects shrinks.
- **Marc Rotenberg** said gaming and other life experiences will be far more immersive by 2040, with participants joining their favorite sports stars in online competitions or sharing the concert stage with the avatars of famous musicians.
- **David Porush** predicted immersive reality will produce unexpected consequences for human intimacy and connection and "new opportunities for global unity and tribal discord, for totalizing control and individual freedoms, and for the effective expression of love *and* hate."
- **Rahul Saxena** said he expects a "Super-Metaverse" of tech enhancements that help people augment their work, for instance using imaging and actuators to perform surgeries. But some will choose to live in a "Fantasy-Metaverse" that "prefers gullible consumption over critical thinking," and he warned that "the shifts to the Fantasy-Metaverse will be like the unleashing of an opium super-epidemic."
- **Sam Adams** said anonymity applied through XR will establish far more settings in which people trust in transactions with unknown entities, leaving behind many norms of reputation and branding and allowing parties of "bad reputation (e.g., narco syndicates, mafia, terrorists) to easily conduct 'legitimate' business which income supports their antisocial agendas without the transactions being tarred with their true purpose."
- **Alexander B. Howard** said he expects people to interact with augmented-reality layers in any given physical location, viewing the annotations and glyphs others have left, with background systems pulling up information about the people, places and objects. He also warned that it is possible that a "metaverse could empower authoritarians to track, control and coerce billions of humans in silicon prisons ringed by invisible barbed wire, governed by opaque algorithmic regulation and vast artificial intelligences."
- **Gina Neff** called for a redrafting of fundamental social contracts about trust and democracy, noting that powerful narratives in the metaverse will combine new ways of experiencing social connection with new forms of "trustless trust" from the hundreds of little contracts and exchanges people are asked to enter into every day.
- **Jaak Tepandi** predicted that new species may evolve out of the integration of humans and artificial systems, saying "examples of important components in the development of such a species include genetic engineering (including CRISPR), artificial intelligence, cryptocurrency, metaverse and others."
- **Warren Yoder** encouraged that humanity scrutinize its overall transition, writing: "Postmodernity interrogated modern power and knowledge. It was useful, back then. Now meta-modernity recognizes the existence of multiple modes of the real and prompts one's imagination to take bits and pieces from useful practices wherever we find them."

In the next section, we highlight the remarks of a diverse set of experts who gave some of the most wide-ranging or incisive responses to our request for them to describe what XR and the metaverse might look like by 2040. Following it, we offer a number of longer and more discursive essays written by participants. And that is followed with additional sections covering respondents' comments organized under the sets of themes set out in the tables above.

The remarks made by the respondents to this canvassing reflect their personal positions and are not the positions of their employers. The descriptions of their leadership roles help identify their background and the locus of their expertise. Some responses are lightly edited for style and readability.

1. A sampling of overarching views on the metaverse

The following incisive and comprehensive responses to our questions about the future of the metaverse represent some of the big ideas shared by a small selection of the hundreds of thought leaders who participated in this canvassing.

'We have always been living in a quasi-multiverse'

Sam Lehman-Wilzig, professor of communication at Bar-Ilan University, Israel, and author of "Virtuality and Humanity," commented, "As soon as the latest virtualizing technologies (AR, VR, MR, etc.) become mature and economically accessible for the masses, humankind will adopt it without many qualms. Take a look at human history. We have always been living in a quasi-metaverse, thus the current and near-future iteration is merely old wine in new bottles. Let me explain by sharing a very short synopsis. Virtuality has been with us as homo sapiens throughout our entire history, by and large expanding over the centuries and millennia. Such virtualizing could not have existed for so long among so many people were it not for its numerous benefits.

"One can note at least seven beneficial (even critical) functions: 1) Survival (e.g., camouflage from predators). 2) Escape from boredom (imagination to go beyond the humdrum of life). 3) Efficiency (thinking creatively 'out of the box,' i.e., how to improve life technologically, economically, etc.). 4) Curiosity (why the world is as it is demands abstract thinking). 5) Theory of mind (putting ourselves mentally in another's shoes to reduce social conflict). 6) Future planning (thinking beyond the here and now). 7) Relieving existential dread (seeking the meaning of life; what remains after our death?).

"Indeed, our excellence in mentally 'virtualizing' is what separates us from the rest of the animal kingdom. This virtuality has been (and continues to be) expressed in many areas of day-to-day life and intellectual fields of endeavor: religion and supernatural belief; physics, astronomy and cosmology; philosophy; math; literature and the arts; economics; nationhood, government and war; communications – to note only a few example areas. Why would this be so?

"The universality of human virtuality is a function of our psychological makeup. We perceive our environment in highly 'virtual' fashion (extremely limited perception of the real world) and do not think very clearly or rationally about our immediate and extended world (distorted cognition, as Daniel Kahneman and Amos Tversky have shown). Indeed, many humans have always sought to further distort perception through mind-altering substances. The latest 'fake news' epidemic (disinformation, 'truthiness,' etc.) is merely an addition to such 'virtual reality' (lowercase v.r.) that has existed probably forever: camouflage, deception, propaganda, fakery, superstitious beliefs, conspiratorial thinking and so on."

'The real world will be completely covered with intelligent data, media and interactive information'

Mike Liebhold, distinguished fellow, retired, at the Institute for the Future, "The term 'metaverse' is simply a convenient meme and as ephemeral as the 'Information Superhighway,' 'cyberspace,' 'ubiquitous computing,' 'pervasive computing,' 'Internet of Things (IoT),' 'Web 2.0,' 'the cloud' and 'Web3.' Despite skepticism of the current hype, most of the implied technologies and experiences will have a lasting impact and will become widely useful by 2040.

"VR/AR/XR are really just one medium. The only difference is the degree of transparency and opacity of pixels. By 2040, many vendors will offer low-cost headsets, eyewear and contact lenses with full mixed-reality capabilities. Service providers will offer vast arrays of services and applications supporting a full spectrum of human experiences. Initially, locally-connected experiences will be richer, denser and more interactive because of the required computing, storage, low latency and high bandwidth. Mobile experiences will, over time, improve considerably as hardware, gigabit+ networks and edge-served computing and data become more pervasive.

"Just as humans now have access to vast libraries of human knowledge immediately accessible online, in the future, every object, place and person will be attached to discoverable, rich, visible, linked information, media, models and computation and conversational agents. The real world will be completely covered with intelligent data, media and interactive information, experiences and entertainment. Every node in the workflows of human activities will be amplified by ubiquitous embedded machine intelligence, able to provide conversational support for orchestration and choreography of systems that are too complex for limited organic human cognition without the assistance of machine intelligences.

"Unfortunately, without comprehensive efforts in developing net literacies in the general population for cognitive immunity and in developing security and privacy best practices, it is unlikely that humans will yet have overcome all of the current problems of fragmented attention, distraction, digital security, privacy and persuasive fake media, so these phenomena will still exist in possibly frightening and powerful new forms."

'The metaverse is already set to be a highly polarized "place"'

Sonia Livingstone, OBE, professor of social psychology at the London School of Economics and special adviser to the House of Lords' Select Committee on Communications, said, "The experience of recent decades has taught us that digital innovations – now including the metaverse – are increasingly refined and effective for a sizable proportion of the population, sufficient to drive business and ensure continued innovation and improvement. At the same time, we know that the outcomes for a substantial minority will be problematic – exclusionary, discriminatory,

hostile, exploitative and even dangerous. The metaverse is already set to be a highly polarized 'place.' Some are developing creative forms of expression, looking forward to new forms of participation, and new ways of doing business. All will find their data exploited in the process, and dimensions of life that were once public will become monetized, and in some ways, mainstreamed and degraded. All will experience a digital world in which the casualties – to the public sphere, to our private lives, and to a minority of 'vulnerable groups' – will be disregarded in the rush to privilege the already-privileged, and any protest at what is lost, or what's going wrong, will be ignored as 'collateral damage.'"

The potential: Socioeconomic benefits *and* threats to the social order

Glynn Rogers, a complex systems and networks researcher expert in information security and privacy, commented, "The fully functioning metaverse will be the result of a confluence of further advances in multiple streams of virtual reality development, most of which already exist. Examples are:

- Immersive multiplayer games in which opposing groups can develop strategy, construct resources and coordinate activities.
- Text- and video-based social media in which the social 'rules of engagement' evolve to reduce the current lawless space to a more-regulated, humane and stable social environment.
- Virtual travel, particularly extraterrestrial travel based on imagery constructed from a multitude of spacecraft sensors, in which virtual craft can be flown, driven or sailed through environments in which humans could exist only with the most extraordinary aids.
- Remote working, which the COVID pandemic has forced many people to experience often with quite positive reactions, at least in the more-advanced, information-based economies.
- Educational and training settings in which, for example, VR laboratories enable multi-participant experiments to be performed via simulation that would be expensive or impossible to perform in reality.

"The integration of these developments into the metaverse is unlikely to occur by a top-down process of system design but will most likely be episodic, driven by technical innovation and commercial opportunity. While this has the potential to maximise socioeconomic benefit, it can also pose a major threat to social order because of the danger of antisocial and, indeed, criminal exploitation. Note these points:

- The broad scope of the metaverse suggests the need for a multidisciplinary international task force to oversee the regulation of the implementation and operation of the metaverse, perhaps under the auspices of the United Nations. Why?

- Activities to this point in social media have demonstrated how the internet can be used to propagate false information, misleading political messaging and conspiracy theories in response to contemporary events.
- Because of its immersive characteristics, the metaverse has the potential to vastly exacerbate these problems to the point where social cohesion is threatened, suggesting the need for effective regulation of its development. However, because regulation is in the hands of individual nation-states whereas the metaverse is global, regulation will provide a very difficult challenge, perhaps a greater challenge than the regulation of the international finance industry, which has not so far been an overwhelming success."

There will be a new class of apps that will bring real-world experiences into virtual spaces

Akah Harvey, director of engineering at Seven GPS, Cameroon, Central Africa, commented, "There will be a new class of applications designed for the same experiences we currently have in the real world. Some will exploit human fantasies to a whole new level. Humanity is going to carry the same positive and negative traits we currently exhibit in the real world into the virtual space. Sadly, this includes (but is not limited to) bullying, cybercrime, money laundering, sextortion, pornography, rape, violence and wars. However, we are also going to see some exciting new things in education, learning, research and development, and effective and revealing simulations of what's possible in well-defined time and space constraints."

It's the 'next logical iteration of the internet'; long-term, it could be 'truly mind-blowing'

Oliver Busch, a director of agencies and ecosystem in Central Europe for Meta, working to build a bridge for marketers toward the evolving metaverse, commented, "The metaverse – a 360-degree version of the internet to 'walk into' and interact with contents or to 'invite out' digital contents to our physical space – will be just the next logical iteration of the internet. The development of the metaverse has already passed the tipping point and is happening in so many ways every day.

"Use cases of 360-degree digital contents in AR and VR for businesses or private usage reach far beyond the thriving gaming scene and the fast-growing adoption of VR devices. Evolving AR devices and the possibility to add valuable contents to our environment will boost the magic of the metaverse beyond VR. Over the last two decades, internet users came to prefer seeing text with pictures over just text and then to preferring seeing video over just seeing photos.

"I absolutely can't imagine a future where people would skip the option to interact with internet contents in the most realistic 3D and, instead, just stay with 2D. To see the future, we need to differentiate short-term hype from a sustainable trend. Short-time focused speculation and the public relations stunts of digital brand presences do exist, but the truly mind-blowing dimension

of metaverse-like gaming experiences allows one to view the long-term potential of 3D digital AR/VR contents for everyone on the planet, in any area of life and business."

'My uncertainty about the metaverse is not whether we will have "something" by 2040, but *what* character it will have'

David Clark, pioneer Internet Hall of Fame member and senior research scientist at MIT's Computer Science and Artificial Intelligence Laboratory, commented, "The origin of the term 'metaverse' is the 1992 science fiction novel 'Snow Crash' by Neal Stephenson. We should respect the ability of the science fiction writer to envision a future (however dystopian, of course). We should also reflect on the fact that computer scientists have been dreaming since that time about what it would actually take to achieve that future.

"It is often the case that new applications are envisioned well before their time and lurk until the network performance and reach are sufficient to allow the app to enter the mainstream. We invented VoIP, voice over Internet protocol, in about 1978, and video teleconferencing in the 1980s. VR, AR, etc., have been lurking for some time. Is now their time? I see two relevant questions. First, will the Internet have sufficient performance to support a 'metaverse,' whatever that is, and second, what will the technical underpinnings of that metaverse be?

"As to the first question, the Internet will certainly have the throughput to sustain a shared experience embedded in a joint visual environment. The fundamental barrier to remote, high-interactivity on the Internet is latency, and latency will not improve, because the Internet is moving data today at almost the speed of light, and the speed of light is a constant. If multiple participants in a metaverse are in the same metro area (for example) it may be possible to get the latency down to the point where tight real-time interaction can happen with reasonable quality, but interaction (say) across the country will always have about 100 milliseconds of round-trip delay, and that means (again, for example) that we will never be able to create live music with widely distributed performers. One hundred milliseconds is just too much delay for synchronized music. There is a large body of research on Quality of Experience, and I suspect that work will provide some insights about what sorts of interaction will be possible in a metaverse.

"As to the second question, I think the three critical considerations are: Where the standards will come from? How open will the system be? Who controls it? My uncertainty about the metaverse is not whether we will have 'something' by 2040, but what character it will have. While the Internet (and early apps like email) were decentralized and based on open standards, most of our applications today are designed by and under the control of a private-sector, for-profit firm. That outcome has strengths (rapid evolution, better control of quality of experience, better regulation of abuse, and so on) and great limitations. One outcome might be that there are competing

metaverses, just as we have competing social media platforms today, with no way to take any of the attributes of a participant out of one metaverse into another. The market might tip toward one provider that gains monopoly control of the metaverse. Will it be a 'free' experience, in which the visual space is crowded with billboards? One example of a 'low-fidelity' metaverse is Second Life, which attracted a great deal of attention as an alternative experiential space. But it never quite got the traction that caused the world to tip toward it, despite a great deal of initial enthusiasm. Between now and 2040 we have the time to try and perhaps fail several times. But should we leave the shape of the metaverse we might all find ourselves in to a single private-sector firm with motivation to build a closed system?"

The metaverse will be designed to be addictive and 'make people more susceptible to manipulation and less aware of reality'

Steve Hanna, a distinguished engineer at Infineon Technologies expert on Internet of Things security, responded, "The broader adoption of immersive technology by 2040 will make people more susceptible to manipulation and less aware of reality. Companies will figure out ways to break down barriers to adoption and increase the pleasure that people gain from the experience.

"Human behavior is rather predictable. Among our other traits, we enjoy interacting with other human beings or realistic simulacra. Companies and investors are well aware of this. They design their offerings to be highly addictive. They constantly study human behavior and test changes to their systems to maximize engagement. As VR and other immersive technologies are refined, they will surely become increasingly compelling. Thus, young people (who have few barriers to adopting new technology) will spend more and more time in fully immersive, manipulative environments. We already seen this with immersive gaming environments.

"I have serious concerns about the impacts of this trend for society and individuals. Already, most people obtain their news and worldview primarily through media. Although we might expect that governments would step in to address these issues, most countries have prevailing philosophies that are authoritarian or libertarian. The former will embrace VR as a way to control the population. The latter will permit companies to promote VR and permit people to embrace it. Some people and groups will reject the virtual reality trend, but they will be outliers. I realize that this prediction is dystopian, but I think it is likely unless companies and policymakers and researchers rapidly develop a deeper understanding of the personal and societal development implications of VR and create alternative models."

The metaverse has little to offer in furthering enduring human values

Batya Friedman, professor of human-computer interaction at the University of Washington, wrote, "How, if at all, do the anticipated characteristics, structures and interactions of an imagined

metaverse align with the sort of societies we would like to build and live in? What sort of human beings we would like to be, and how we would like to live in relation to others – humans, nonhumans, and the planet? Personally, I find the characterization of the metaverse to be impoverished. In life, our time and attention are our most precious resources. A metaverse-like environment by and large usurps those.

"A thought experiment: Consider the resources being allocated to developing the metaverse – in terms of people's time, computation, energy to do the computing and all the other materiality involved. These resources are ongoing – to sustain, maintain and further the metaverse. Consider, also, the time and attention of the people who are engaged in the metaverse. Their time and attention are ongoing. Now, imagine those resources allocated differently. People spend time planting trees in their neighborhoods. Parents spend time playing with their toddlers. Teenagers spend time developing themselves as artists, engineers, runners, caregivers. Food is grown, harvested, cooked and eaten. Lips smile, eyes twinkle. We are fundamentally embodied creatures. Our well-being is grounded in such. Which future would you build?

"Yes, some limited metaverse-like activities can enrich our lives. But, on balance, this is far less than what is being envisioned here. If enduring human values of dignity; emotional, psychological and physical well-being; care; play; and community guide our choices – of what we build, of where and how we choose to live our lives, of who we wish to be and what societies we wish to enable – the metaverse has little to offer. Better for us to spend our resources – our time and attention and beings – elsewhere."

'The metaverse will mostly be a relatively mundane experience'

Alf Rehn, professor of innovation, design and management at the University of Southern Denmark, responded, "Whilst it is certainly true that the metaverse will be popular and immersive in 2040, we should not assume this means that we'll be spending our lives in a Technicolor universe full of anime avatars. Rather, the metaverse will mostly be a relatively mundane experience. Just like the internet, much of it will be things we dip in and out of, rather than the place we truly live in. We will use our metaverse-connected glasses to check up on a message or watch a funny video on our commute, and may, whilst walking around the city, use them to check the menu of a place that looks inviting. The metaverse will be much like our current smartphones, important tools for work and play, but not something most people will lose themselves in. Yes, there will be some who 'go native' in the metaverse and start seeing their avatar there as more real than their material selves, but that is already true of some trolls and other netizens. The more-immersive parts will create great possibilities for art and information – imagine a documentary that puts you right in the middle of a war or in the audience at a concert – but for much of what human beings do in their lives, it will be an evolution rather than a revolution.

"Excel isn't going to be any more exciting in the metaverse, and when working on a report or a novel, the last thing a person needs is a bustling vista of cyberpunk surrounding them. Sure, having a famous person's avatar as your personal trainer might make exercise a bit more fun, and there will be conversations and even dates in the metaverse, but much of the time we will just adopt it as one more way of getting things done – and to amuse ourselves. After all, we're still listening to the radio – we just call it a podcast these days."

'The metaverse could be a nice place to visit, but most of us wouldn't want (or need) to live there'

Micah Altman, social and information scientist at MIT's Center for Research in Equitable and Open Scholarship, responded, "It is highly uncertain whether a unified, fully-immersive 'metaverse' will become an important aspect of general daily life for a substantial fraction of the world's global population by 2020. Virtual reality has been predicted to be 'the technology of the next 20 years' for over half a century, dating all the way back to 1962 and Morton Helig's pioneering multimodal Sensorama. VR and the metaverse may continue to be 'the technology of the next decade' for another 50 years. The reasons that weigh against the widespread global adoption of fully-immersive general-purpose virtual worlds (and even more heavily against a single global 'metaverse') are not primarily technical, but psychological, sociological, political and economic.

"Advances in technology may be good for producing the metaverse – but what is the metaverse good for? The core proposition of the metaverse is to provide a unified immersive audiovisual environment. Such environments are certainly good for some things – for example, they can be helpful in promoting certain emotional states, such as awe. More generally, as virtual reality researcher Jeremy Bailenson contends, there are four conditions under which immersive experiences are of high value: when the corresponding experiences they emulate are *rare, impossible, dangerous or expensive*. There are many situations that satisfy these conditions, but they are not the norm – for most human interactions and tasks, being immersed in *reality* is likely to work out better objectively and subjectively. The metaverse could be a nice place to visit, but most of us wouldn't want (or need) to live there."

'The idea that it will become something so novel that we can call it "the metaverse" is just marketing hype'

Cory Doctorow, activist journalist and author of "How to Destroy Surveillance Capitalism," wrote, "Digitization will increase, and user-interfaces will become more intimate (for example, haptic, visual and audio feedback), but we will not have anything we would call 'the metaverse' any more than we currently live in 'the internetverse' or once inhabited 'the telephoneverse.' People already spend a lot of time socializing in virtual worlds, they already use screens and other user-interface elements to help augment reality (for example, walking through a strange city with Google Maps on your phone; it tells you to go straight for 10 blocks and then turn left – you put it in your pocket and when it buzzes the next maneuver, you turn without consulting it). This will continue (assuming civilizational continuity), but the idea that it will become something so novel that we can call it 'the metaverse' is just marketing hype. The future composts the past and technology is accretive, not supplantive. In 2040, examples of all the systems we have now will still be in critical service, wrapped in layers of imperfect abstraction that will often have to be stripped away to directly manipulate them (the way you can do a lot with an ATM without having to touch a bank's COBOL back-end, but at a certain point, you've got to find a COBOL programmer). The metaverse as we understand it today is the result of Facebook's desperate bid to stop hemorrhaging users, engineers and reputation; combined with blockchainism's idea that all humanity's collective action problems can be resolved by stapling on asset speculation and financial incentives."

'We'll have a lot of meta but not yet much verse' by 2040

Doc Searls, internet pioneer and co-founder of Customer Commons, wrote, "While the number of people occupying immersive virtual spaces may exceed half a billion by 2040, what we'll have is a lot of meta but not yet much verse. Some things require enormous compute scale and power. Online immersive worlds are among those things. So, we should start by recognizing that immersive online environments can only be created and maintained by giant companies with giant data centers: the likes of today's Amazon, Apple, Facebook, Google, Microsoft and Samsung, some of which are already deeply invested in the field. This also means the 'free market' for VR and AR hardware, software and services will be 'your choice of captor' – just like we have today with PlayStation vs. Xbox game platforms and iOS vs. Android phone platforms. You will have no more freedom and independence than what those companies support and allow on their separate platforms. Privacy will also be a promise rather than an affordance each of us can bring wherever we go in our immersive worlds. No clothing to conceal our naked selves, no private spaces with doors, locks, shades or shutters that the host platform can't see inside. They may say they won't look, but we cannot have full confidence that they won't, or that their funding sources won't.

"This is how black boxes work. And there is little that regulators can do about it other than 'forbid violations' and prosecute suspected violators on occasions when they might be detected. Still, VR and AR have many obvious and useful purposes in verticals that will surely be well-served by 2040. Those include entertainment (including movies, games, and online sports), health care (e.g., remote surgery), industrial and military. Will there be enough of all that to push the number of users in 'fully immersive' digital spaces past half a billion people? Probably. But will occupying those spaces be a 'well-functioning aspect of daily life?' No: not if those spaces are isolated in corporate silos with no real personal privacy and no more agency than corporate overlords permit. Will we eventually have immersive environments as free and open as the Internet has been by design for the duration? Possibly. But only if we have open standards to build them on, open code to build them with, and privacy tech of our own, such as we have with clothing and shelter in the natural world. We have almost none of those so far in the online immersive space. WebXR and OpenXR have promise on the standards front, but they are very early efforts."

'Freedom, love and happiness are found only in real life'

Marc Rotenberg, founder and president of the Center for AI and Digital Policy, wrote, "VR techniques will be become more widely available in 2040 across a variety of fields, including medicine, public safety, and unfortunately, warfare. But these will be special-purpose applications, context dependent, where human skills are augmented by VR. By 2040, gaming will also be far more immersive, with participants joining the favorite sports stars in online competitions or sharing the concert stage with the avatars of famous musicians. But the metaverse vision of moving community to the online world will not be realized. Many of the current social problems are both too easily amplified and too difficult to monitor. The energy demands will be extraordinary during a period of critical concern about climate changes and the specific requirements of large model computing. Indeed, the 'Matrix' movies offered a profound warning about the problem of the metaverse – we would inhabit a world controlled by others, powered by the energy in our bodies. Take the red pill. Freedom, love and happiness are found only in real life."

The Neal Stephenson idea of the metaverse was set in a dystopia people tried to escape

Christian Huitema, a privacy consultant, 40-year veteran of the software and internet industries and former director of the Internet Architecture Board, wrote, "I do not see a single metaverse taking over the world within the next 20 years. The metaverse was imagined a long time ago – we should remember that Neal Stephenson's 1992 book 'Snow Crash' was set in a dystopian world, a real world so awful that people were driven to escape it and move into a virtual video game in their free time. Will the world be so awful in 20 years that people reward escapism? And will that escaping require building a parallel world, rather than a multiplicity of gaming universes? I certainly hope that the worst dystopias won't come to pass, but I also very much doubt that a

single parallel metaverse would be the solution. The idea of a single metaverse as dystopian continuation of social networks would be a continuation of the worst aspects of Facebook: a centralized system, controlled by a single corporation, dominating the Internet through network effects and massive scale. Postulating such domination implies that society will allow it. We already know for a fact that the Chinese government will not let that happen. They will make sure that a national champion emerges and that they can control it. A somewhat similar reaction is happening in Europe, with European governments progressively blocking the harvesting of private information that finances Facebook and other surveillance capitalists. It is too early to say, of course, but it could lead to the arrival in Europe of multiple competing networks, something we already see with the growth of Telegram."

Two big problems need to be solved: Creating enough bandwidth and privacy protections

Giacomo Mazzone, global project director for the United Nations Office for Disaster Risk Reduction, wrote, "In the 1990s I experienced the enthusiasm for the first virtual reality experiments of Jaron Lanier. In the first decade of this century, I observed with attention the widely-publicized VR experiment known as Second Life. Today, I am skeptical as I observe the latest wave of optimism about the future of the metaverse. There are still two main problems to be solved – these are the same ones that stifled the previous waves: 1) The availability of the enormous bandwidth needed to create a satisfactory environment for a lifelike experience. 2) The gigantic problems posed to personal privacy and to control over personal data by such an environment. A third problem – often not taken in consideration – is the fracture that may come to divide those remaining in the real world and the others that have moved most of their life experience into a meta-world. At the end of the day both communities shall have to come together somewhere in a shared place, because they live in the same country, within the same democracy, the same planet. The reconciliation of the two worlds could be highly problematic. Sci-fi movies of the past could illustrate the risk of this dichotomy. In the Wachowskis' 'Matrix' movie trilogy nearly all of society has moved into the metaverse. Nobody has ever imagined a situation in which only part of the global population – maybe a half a billion people – has mostly moved into a 'brave new world' and all others have not. Then the situation will look more like that one described in John Boorman's 'Zardoz.' In neither of these two dystopian stories does humankind seem to experience a happy ending."

The real purpose of the metaverse is to quantize and monetize more aspects of life

Douglas Rushkoff, digital theorist and host of the NPR One podcast "Team Human," responded, "The only true purpose of the metaverse or the 'decentralized' Web3 blockchains administrating it is to create more 'surface area' for the markets. The purpose is to quantize and monetize more aspects of our world and experience. In the metaverse, these words I'm typing, and the air I'm breathing, are all intellectual property. So, if we do manage to make it another 20 years,

it will be because we have – like the Israelites escaping Egypt – escaped from the needs of the market. Instead of imprisoning ourselves in virtual simulations in order to feed more money to the wealthiest elites, we will have the joy and privilege of touching other human beings in the real world, looking at the sun, swimming in clean water and reclaiming the planet for nature. It's very hard to consider the future of a particular networking interface in isolation, particularly when much larger issues, from climate change, mass migration, de-speciation, geopolitical strife, among others, are still unknowns. The ability for a billion people to spend significant time in the metaverse by 2040 will depend on our ability to find new energy sources for the servers, and water for users.

"If we are able to tackle climate change, massively reduce our carbon footprint and energy consumption, and avoid global political catastrophe, my guess is that it will be because we have somehow extracted ourselves from capitalism's requirement for exponential growth. In other words, we will have somehow extricated ourselves from surrendering all human and other life to the abstract needs of a poorly programmed balance sheet and decided that the sustainability of our planet and some of its species is even more important than the price of stocks or wealth of the top 80 families in the world. And if we have gotten there, then the idea that we want or need a metaverse at all will be called into question."

There are at least three versions of the metaverse that different people envision

Ayden Férdeline, a public-interest technologist based in Berlin, wrote, "There are multiple futures being predicted for the metaverse. To some, the metaverse is a place to escape from reality, where we don't have to use our real names. To others, it means just the opposite: It is a place to bring the virtual world into reality. A third major definition is linked with the Web3 movement: These people expect or at least hope that everything online in the future will be decentralized, that we will have an open and decentralized metaverse where no single entity has control over individuals' behavior, assets and data, transferring the power to the public and away from corporate and government interests and possibly enabling a world that is governed in a more democratic manner. The broadest possible definition of the metaverse is that it is just the next iteration of the Internet, except that it is no longer just the artifacts of people who are online, but it also includes the people themselves. It will take the entirety of the next 20 years for us to build the metaverse into what enthusiasts are hoping for today. As we build out the metaverse, I hope we consider very carefully the privacy and security implications of how this technology could be exploited. During the early evolution of the World Wide Web security was an afterthought. Bad actors have exploited loopholes. It is likely that most of the metaverse will be intrinsically linked to our real-world identities, and we won't be able to see all of the applications, devices and other users that we are interacting with or being surveilled by. We will need to develop a way to filter out all of these harms as we pull content from a space-alized, future Internet. One solution here might

be what Richard Whitt of the GLIA Foundation (which is working for a trustworthy open Web) has proposed asking us to pick a trusted intermediary: a library, newspaper or consumer-protection agency to develop and maintain a 'filter' that scans our metaverse interactions and has a duty of care and a duty of loyalty to uphold our interests. Other solutions will likely emerge, but turning to fiduciary law rather than reinventing the wheel strikes me as a good way of addressing various forms of wrongdoing by others at our expense."

'It is no coincidence that the very first forays into virtual reality have been marred by sexual harassment'

Mary Anne Franks, president of the Cyber Civil Rights Initiative, a nationally and internationally recognized expert on the intersection of civil rights and technology, said, "It's quite likely that many daily activities will take place in the 'metaverse' by 2040, given the resources being poured into extended reality technologies by billion-dollar companies ruthlessly focused on profit potential. And if past performance is the best indicator of future performance, this means that the state of our discourse, our security, our privacy and our democracy will have dramatically devolved rather than evolved.

"For the past 20 years, the tech industry has been given free rein to subordinate every social value to the drive for 'engagement,' with predictably dystopian results; if they continue to enjoy this impunity, the next 20 years will only further entrench this state of affairs. There will no doubt be some beneficial impacts of the shift to extended reality: Virtual- and augmented-reality technology offer tremendous opportunities for education, physical therapy and psychological treatment. But those opportunities will pale in comparison to the increased opportunities for harassment, surveillance, sexual exploitation and misinformation. It is no coincidence that the very first forays into virtual reality have been marred by sexual harassment (see the experiences of beta testers for Meta's VR social platform), or that increasingly sophisticated digital-manipulation tools have been directed at the sexual exploitation of women (e.g., 'deepfake' porn sites and 'nudification' apps) and the escalation of political tensions, and yet major companies in the extended reality space continue to treat safety and privacy considerations only as an afterthought, if at all.

"One reason for this is that these companies continue to be dominated by a narrow class of individuals – white, wealthy and male – who have still not internalized the lesson that what works well for privileged groups can be catastrophic for vulnerable ones, and that inattention to this fact will ultimately threaten general welfare. Another reason is that the tech industry has been given no incentive to care about the negative consequences of its 'move-fast-and-break-things' mentality. As long as Section 230 of the U.S. Communications Decency Act of 1996 continues to be interpreted to insulate the tech industry from the long-standing principles of collective responsibility – preemptively absolving them from liability for entirely foreseeable injuries caused

reckless or negligent practices – it will continue to churn out increasingly invasive and immersive products with no regard for the danger they pose to society."

Pitches for the metaverse 'fall on a spectrum from startup hustle to stock inflation to Ponzi scheme'

Janet Murray, noted scholar of digital media, influential interaction designer and the author of "Hamlet on the Holodeck: The Future of Narrative in Cyberspace," wrote, "The current push is greed-driven and based on magical thinking. Magic Leap should be a warning case for the current hype. The appeal to Silicon Valley moguls is obvious – own the platform, own the data, own the access to users. The appeal to actual users is not at all clear. In 2040 there will be discrete VR and AR applications. It is unlikely there will be a single platform. More-convenient videoconferencing is more likely to be more appealing to users than avatar-based interactions outside of games and game-like social spaces. The current link of XR to the cryptocurrency hype and NFT huckstering and nonsense about 'blockchain' suggests a Venn diagram of overlapping vaporware. Like the blockchain-crypto-NFT hype, the metaverse hype is light on actual use cases, and various pitches fall on a spectrum from startup hustle to stock inflation to Ponzi scheme."

Alternative idea: A 'hyperverse' where people can share using 'tools for thought'

Stowe Boyd, consulting futurist expert in technological evolution and the future of work, said, "We could consider the metaverse idea as selling us the mallification of our experience of the world. The recent interest in it is a technoid fantasy, somewhat like the obsession with migrating to space. Both share an underlying desire to leave the simmering concerns of social and environmental 'space' for an imagined community (a la Benedict Anderson), one that rejects nationalism or shared concerns about the state of the planet and its inhabitants. While I believe that some elements of the metaversic vision – like augmented reality adding a new dimension to internet-based social interaction – will be successful, the larger notion of 'living in the metaverse' will have no greater appeal than spending long periods of time at a virtual mall. And just like a mall, we'd be inundated by brands, like Tom Cruise in the film 'Minority Report.' At the same time, there is hope for a web-centered alternative, a hyperverse, since we have abundant computing infrastructure and myriad devices for people to layer on and share their observations and annotations on the web and also in a place-based manner, as well. We saw a glimmering of that with Third Voice in the late 1990s, and in today's tools like Hypothes.is. The interest in so-called 'tools for thought' – Notion, Roam and Obsidian – could be a part of that, as well."

Only gamers want to live in the metaverse for more than five minutes at a time

Paul Jones, professor emeritus at the School of Information and Library Science at the University of North Carolina, said, "I feel like Rocky (the flying squirrel) watching Bullwinkle

trying one more time to pull a rabbit out of his hat while he's asking 'Again?' My growing disaffection with immersive 3D began with the cyclic fads in theaters – 'House of Wax,' 'Creature from the Black Lagoon,' then Warhol's 'Frankenstein' and 'Dracula.' It continued more recently in 'Avatar' and 'Martian.' Can it be that [these 3D technologies find their best use] in horror and science fiction? Will that be the same in 2040? By now, I'm jaded about immersive VR whether it's helmets, full rooms, glasses, goggles or sticking your phone on the end of my nose. I have seen one entire floor of a new campus building dedicated to a variety of supposedly 'immersive' VR that was out of date before the concrete dried – all three varieties of VR in the design. While the 'immersiveness' of VR has been improved in each iteration it is not yet improved enough for mass use or use for a long period of time. People other than gamers are ready to walk away from immersive VR in less than five minutes at a try. This has not changed much despite efforts to streamline and lighten the weight of the devices and increase the number of pixels presented. However, the use cases for augmented reality (AR) are strong. We are already using AR of a form in our cars – the screens used in Teslas are a good example – and we are learning how to make the AR experience both safe and reliable without losing ourselves to immersion. Short version: The metaverse will be more Augmented than Immersive. Meat-based living will have a dash of meta in it but meta will not be a replacement for embodied living."

Current proposals for the metaverse are 'a concept searching for a market'

Andre Brock, associate professor of literature, media and communication at Georgia Tech and adviser to the Center for Critical Race Digital Studies, said, "AT&T developed the picturephone in the 1960s and the videophone in the 1990s. Neither initiative was commercially successful despite enormous amounts of hype. While communicative devices, networks and our technical literacies have moved far beyond those primitive videophone terminals, the metaverse as argued for by Facebook/Meta is still a 'concept looking for a market.' By my count, this is the third iteration of a 'graphics-intensive, computer-generated' multiuser virtual environment, counting ActiveWorlds and Second Life. Both of those spaces still exist, but our ahistorical and ephemeral media (driven by venture capital and tech industry hype) barely acknowledge that metaverses have been tried before. This isn't even counting the virtual worlds such as Habbo Hotel and Club Penguin, or massively multiplayer online games such as EVE Online, World of Warcraft and EverQuest. Every iteration of a multiuser virtual environment – including the present speculative offering by Facebook/Meta – requires users to purchase expensive equipment, expensive broadband connections and have disposable income. Existing inequities around computing and connectivity will be exacerbated by this new initiative – minority groups are never the ideal user for tech nor finance. Much of the present fervor over the term is driven by Facebook/Meta's commanding market position as the largest social network, leading to speculation that this lock-in will easily convert users from the largely text-driven Facebook platform to a yet-untested platform at scale with demanding hardware and software requirements. History suggests a different outcome."

IEEE report encourages ways to build XR ethically for best social outcomes

John C. Havens, executive director of the Institute of Electrical and Electronics Engineers (IEEE) Global Initiative on Ethics of Autonomous and Intelligent Systems, and **Monique Morrow**, senior distinguished architect for emerging technologies at Syniverse, led a team of IEEE experts in producing a paper and program titled 'Ethically Aligned Design' that includes a chapter on the ethics of Extended Reality. They wrote, "Aspects of that work can provide a deep and highly resourced focus on answers to your extended reality question. In it we make the following important points:

> 'The growing prevalence of augmented and virtual environments is set to extend our collective human cognizance. Our sense of physical identity, time and agency will become subject to entirely new paradigms where the gateways to these experiences might be controlled by interests other than citizens. This raises a host of ethical and philosophical questions about the collection, control and exploitation of user data within these ecosystems. As these capabilities move from external headsets into much more subtle, integrated sensory enhancements and embedded or implanted devices the stakes can become perilous. In order to avoid negative consequences in XR systems enhanced by autonomous and intelligent systems (A/IS), society must proactively seek solutions, set standards and adopt methods that can enhance access, innovation and governance to assure human well-being. By adopting a lens of pragmatic introspection, society can envision a positive outcome for all the inspiring and immersive realities humanity will encounter in the near future.'

"The rest of this important 29-page report goes into great detail, with separate chapters outlining important issues tied to the future of social interactions, mental health, education and training, the arts and privacy, access and control. We note that it is critical to promote widespread education about how the unique nature of XR may affect social interactions, including avoiding widespread negative societal consequences. As the report points out, there are two major forces at play in sculpting the 'reality' each individual encounters in their uses of interactive media: the commercial imperative to deliver services that earn profits and the public's desire to use technology to facilitate their needs. Over the past decade the user has become the product in online environments. Thus, the coming XR world may also look like today's current gated communities that are programmed and controlled by commercial interests. The following are a few of our many recommendations (for full details please read the report):

- An integrated XR-awareness framework for technology developers and end-users should be co-created by policymakers and manufacturers within a social consensus-based framework.

Such an awareness framework would be deployed by entities that create the technologies, with a goal of standardizing education and literacy regarding products.

- Ethical design should be a standard part of the conversation from the very beginning of any project creating public-facing XR products. Organizations working on immersive technologies should create a multidisciplinary approach, involving social scientists and humanities researchers in technological product development in order to help identify ethical concerns from the earliest iterations.
- All technology developers, regardless of their position in the product ecosystem, have a responsibility to provide clear disclosure and explanations for users regarding the augmented, virtual, mediated or multi-mediated experiences in which users will find themselves immersed. Such awareness initiatives should involve social scientists, humanities researchers, marketers and practitioners – including emotional intelligence or positive psychology – in addition to policymakers and manufacturers.
- Users of any virtual realm should first be routed to a tutorial in which they learn how to rapidly exit the virtual experience at any time they choose to do so, and they are thoroughly informed about the nature of its algorithmic tracking and mediation. Users' personal data should not be used without their prior consent as part of this experience.
- Users should have clear assurances that their virtual and physical identities can and will be protected within virtual worlds. This applies to accidental collection of data by XR systems to better customize the experiences and the technology. Informed consent and existing best practices for user data need to be updated to incorporate specific vulnerability issues of users within XR environments."

'An effective story to raise venture capital for people running out of plausible tech to sell'

David Golumbia, associate professor of digital studies at Virginia Commonwealth University and author of "The Politics of Bitcoin," wrote, "The metaverse is a completely undefined concept being pushed by Meta and venture capitalists to secure ongoing funding for their projects. There is nothing there. We have already seen the major downsides with VR and even AR tech, and unfortunately the folks promoting the metaverse starkly deny what almost everyone else sees: The more attractive virtual experiences are, the less most people want much to do with them, especially for any length of time. Digital tech entrepreneurs are running out of ways to swindle the public into buying their gear, whose destructive affordances are becoming more apparent every day. Their reliance on old science fiction narratives, including ones already shown to be much more interesting as fiction than as fact, is starting to be a 'tell,' as is – especially – the intertwining of the old VR story with the newfangled blockchain story. VR makes a tiny bit of occasional sense without blockchain. NFTs and blockchain make zero sense. Put together, it becomes an effective story to raise venture capital for people who are running out of plausible technology to sell. But most reasonable people – even those deluded by cryptocurrencies and NFTs – just look at this

latest publicity push with complete incomprehension. There is nothing there. Less than nothing, in fact."

'The functionalities created in the virtual world will enhance the effect of isolation from the real world'

Luis German Rodriguez Leal, teacher and researcher at the Universidad Central de Venezuela and consultant on technology for development, said, "It is quite possible that the metaverse could be used to propagate new forms of individual and collective slavery. The metaverse is one more step in the evolution of the bubble created around each user of technological platforms in order to stimulate and often manipulate their behavior – with or without their own consent.

"Only users of these systems who have the necessary digital literacy will be able to remain free from the ever-increasing onslaught of the technological avalanche that promotes the metaverse. Unfortunately for humanity, there are very few highly literate users. This translates into a worrying growth and expansion of modern slavery. The virtualized reality expressed in the metaverse will tend to be established as a reference, just as in the present the so-called 'influencers' are taken as such with no other apparent criterion than their number of followers and the consumption profile of that audience.

"The functionalities created in the virtual world will enhance the effect of isolation from the real world and the limits between one and the other will become increasingly confusing for unsuspecting user. Those in the vast majority are, by far, the least educated and are highly unlikely to question the alternatives that will exist in the proposed metaverse.

"Let's remember that each one of these environments will be fashioned to appeal to individuals' specific characteristics in their user profile that will make each consider that this is the universe they want. Blockchain-based products will strengthen the security and privacy of each person's preferences as individuals, but at the same time, they will make users disregard the underlying objectives of the algorithms that regulate the operation of these platforms."

'Humans still need direct connections, physical presence and touch'

Kelly Quinn, clinical associate professor of communication at the University of Illinois-Chicago, responded, "The pandemic crystallized for many the very real capabilities of digital tools for interaction and transactions across time and distance. Yet while we will continue to evolve our capacities for a metaverse, our experiences today demonstrate the very real advantage of physical proximity and sociality. Due to sheer necessity, we have developed more quickly and efficiently across many fronts – businesses today conduct transactions virtually in ways that were once thought impractical; remote learning is now mainstream for many students (alas, to the demise of

the occasional snow day); and telehealth consultations are an everyday reality. But these opportunities do not accomplish their goals with the same efficiency and energy of in-person interaction, and the practical realities and limitations of living in virtual spaces are apparent.

- Businesses that rely on mentoring models find that the scheduled and formal nature of Zoom management leaves something to be desired in training and development of future managers.
- Teachers find that very valuable aspects of peer learning that naturally take place in a classroom do not occur in online classrooms, and that the ability to motivate young students across time and space is limited.
- Even medical practitioners find that it is difficult to fully appraise illness and disease in virtual settings, and that the ability to deliver ongoing treatments (which often rely on a closer assessment of the patient) is still limited.

"Humans still need direct connections, physical presence and touch – these are important cues for understanding an imperfect world. People generally put their best selves forward in digital settings; the consequence of this is the assumption that such perfection is reality. Humans still need connections, physical presence and touch – these are important cues for understanding in an imperfect world. The recognition that people and the self are *not* perfect is one important reason that the metaverse will not replace our need to interact in person."

'If fractametaverses emerge, they'll be like cable channels: specialized, amplifying and entrenching inequality'

Susan Crawford, a professor at Harvard Law School and former special assistant in the Obama White House for science, technology and innovation policy, commented, "A truly interesting, vibrant metaverse would require a generosity of spirt that I'm not confident will emerge over the next few years. It was the simplicity and ease of adoption of the internet protocol TCP/IP, backed by the energetic efforts and resources of the U.S. government, that forced into being the global internet.

"Meta's view of the metaverse is that it's all about *them* – their business plan, their identity, their tie-ins, their incentives. That's not something that all parts of U.S. society, much less a global community, will be interested in (literally) buying into. And if fractametaverses emerge, they'll be like cable channels: specialized, amplifying and entrenching inequality and bundled by some aggregators looking to charge a lot. My dream is for the internet to be accessible to more people at reasonable cost and to enable presence at a distance – that's the metaverse we should aspire to."

'The willingness *and* ability of people to invent new rituals, meanings, symbols and habitus are slow to evolve'

Riel Miller, head of foresight at UNESCO, Paris, wrote, "The holodeck as an opportunity to simulate life is not a new idea. As with today's reluctant and coercive push into virtual meetings, the willingness *and* ability of people to invent new rituals, meanings, symbols and habitus are slow to evolve. Like any frontier, the conditions for open access, the fluidity of birth, death, entry and exit determine what is done with the affordances that are available. Should our imaginations remain atrophied and our insistence on denying our symbiosis with our tools continue, then the metaverse will remain 'marginal' even if the allocation of time and money is relatively high."

Deeper immersion will produce unexpected consequences, opportunities and threats

David Porush, writer, longtime professor at Rensselaer Polytechnic Institute and author of "The Soft Machine: Cybernetic Fiction," wrote, "It will evolve the experiential and sensory. It will continue the trajectory of producing greater fidelity, speed, reach, sensation and bandwidth for exchanging subjectivities (technologically mediated telepathy, as it were).

- It will produce unexpected consequences for human intimacy and connection.
- It will produce new opportunities for global unity and tribal discord, for totalizing control and individual freedoms, and for the effective expression of both love and hate.
- It will provide vast new opportunities for buying and selling and advertising and big data/big commerce feedback loops between desire and fulfillment and the willing sacrifice of privacy for convenient ways to scratch our itches.
- It will produce new kinds of cyber-art.
- In short, it will move the needle not at all towards the redemptive, visionary and inflated claims for changing human morals. That's always already been the vaporware of media revolutions. For that, a different kind of message is needed."

'How will our data be used against us in the metaverse by 2040?'

Lee Warren McKnight, professor of entrepreneurship and innovation at Syracuse University's School of Information Studies, responded, "Given the estimated 3 billion gamers worldwide by 2023, reaching half a billion metaverse-immersed by 2040 is probably a low estimate. However, first – to state the obvious – the current metaverse hype and confusion (and venture capitalists riding trends and pumping scads of money into a lot of dumb metaverse-associated ideas) are largely driven by Facebook's very successful 'wag the dog' PR play to get people talking about the metaverse instead of about their data privacy-invasive business model and serial legal-and-ethical-violator, repeat-offender status. Which leads us to the larger looming issue: How will our data be used against us in the metaverse by 2040?

"A major negative of our immersive future is that privacy violation by design by platform companies like Facebook (Meta) will be supercharged. Their business models rely upon selling

user data to advertisers and/or to business-intelligence/political-intelligence outfits like Cambridge Analytica that use it to manipulate the public – for instance influencing their buying behavior or nudging them into obsessive-extremist interests and disinformation campaigns. What has happened to this point in that regard is all child's play compared to the truly dystopian 'Blade Runner 3.0' imaginable in 2040 when people are much more immersed in digital worlds. When they are not just relaxing playing games or interacting/sharing with friends and family and random strangers and data-gathering bots on social media. When they spend more time and invest more of themselves when the metaverse is also the workplace/the future of work. The blurring of psychic and physical boundaries could be very ugly.

"Already, the growth in the percentage of young people of college age with mental health issues, the rise in suicides and drug addiction are driven by a range of complex economic, social and political factors, not least being the pandemic. Facebook's – excuse me – Meta's own research data has revealed that time spent in not-yet-more-immersive social media is a major cause of serious mental stress and illness. By 2040, assuming the trendline and market/business model of data security and privacy invasion by design carries on into the metaverse, we will all be living in a much sicker world. And the sickness-causing-by-design metaverse will be at least partially to blame."

Today's environment will be amplified and expanded once the metaverse takes off

Mario Morino, chairman of the Morino Institute and co-founder at Venture Philanthropy Partners, commented, "Look at the gains and horrors in today's environment and amplify and expand this in projecting to 2040. My expectation is that it will become a natural habitat in which to work, learn, share experiences, be entertained and to entertain, and to have 'lived digital experience.' It will be another level of immersion, building upon previous plateaus of the Internet: email, Web 2.0, gaming, cell/smartphone, social media, AI/ML [machine learning], etc. However, the power of community in the metaverse (collective activity) will bring vast new gains and even more threatening risks to society. There will be a lack of editorial and information mores and protocols, lack of ability to counter mis- and disinformation (from text to deepfakes), too few gatekeepers for checks and balances, and the 'lone ranger' digital player will have even more disproportionate power arising from increased externality."

Every new tool advances horizons *and* inflicts harms

Frank Kaufmann, president of the Twelve Gates Foundation, said, "This shift will take place when an increasing number of 'apps' and life-convenience tools offer users 'two options': 'conventional' or 'immersive.' A smaller number of apps and tools will be offered only as 'immersive,' but this will be for an elite – the 'in-the-know' types, like early crypto traders. It will function as a sort of cultish status symbol. Most people will still not feel comfortable having tools

and apps that require a steep learning curve or clumsy hardware to do simple things. All this will steadily and increasingly change. 'Immersive' life will be made more user-friendly by the natural function of corporate greed. And as the meta becomes more user friendly its adoption will spread via word-of-mouth tutorials (the guy next to you at the bar shows you it's not really that difficult), gradually more people try it, and the world falls unthinkingly into increasing use and addiction to metaverse functions and life. Of course, every tool and every invention from the beginning of time has emerged to enhance the horizons of human capacity and human creativity. However, every tool and every invention from the beginning of time has also enhanced the capacity to more efficiently and more sweepingly inflict harm on other human beings and on nature.

- It will increase human separation into new categories.
- It will intensify dystopic inequalities of 'haves' and 'have nots.'
- It will further desensitize people, putting them further out of touch with their true selves (their divinity and humanity).
- It will make doing harm 'less real.'
- It will make careless, mindless users easier targets for control and manipulation.

"For most people it will have little or no impact on how we think about our world and ourselves. The emergence and slow market expansion of this technology will have no impact on people's abundant capacity for living in non-reflective ways, and no effort to intuit our relationship and purpose with nature. If anything, it will further diminish general consciousness into indignity, self-diminishing distractions, and obsessive addiction to acquisition and the type of 'learning-curve addiction' that typically drives gamers."

If it follows the path paved by the web and Web 2.0, 'Web3 will deepen inequalities'

Aymar Jean Christian, associate professor of communication studies at Northwestern University and adviser to the Center for Critical Race Digital Studies, wrote, "Technological advancement is only one component of social change. Cultural, political and economic factors are equally if not more important to how Web3 will develop. If it follows the same path as the original web and Web 2.0 – with unregulated corporations and investors allowed to own as much digital property as possible, where users lack the public support and regulation for the ownership of data, devices and property – Web3 may deepen the power inequalities we see today. These inequalities are raced, gendered, nationally-bound (e.g., Western/U.S.-centric) and they replicate power dynamics that predate digital technologies (colonialism, white supremacy, heteropatriarchy, etc.). Web3 has the potential to shift power dynamics, but only if those driving the technological change are willing to make it so."

The unknown territory: 'How can you tell a machine from a person?'

Garth Graham, longtime leader of Telecommunities Canada, said, "We are moving into unknown territory with respect to how our relationships and connections shape our identity. This is of concern. I would like to share a passage written by Stephen Marche in 'The Imitation of Consciousness: On the Present and Future of Natural Language Processing' published June 23, 2021: 'What is shocking about the artificial intelligence of natural language processing is not that we've created new consciousnesses, but that we've created machines we can't tell apart from consciousnesses. The question isn't going to be "Can machines think?" The question isn't even going to be "How can you create a machine that imitates a person?" The question is going to be: "How can you tell a machine from a person?"'"

How will governments respond to the multinational nature of the metaverse?

Mark Jamison, an American Enterprise Institute scholar who previously served as manager of regulatory policy at Sprint, commented, "The direction of the metaverse will depend upon how governments react. The metaverse has the potential to be an online society with its own cultures, economies and governance systems that relate to those of the offline world, but that are optimized according to the interests of the users and developers. Such an evolution would enhance humankind by freeing us from some of the constraints of the immutable laws of physics and our DNA, but not without some painful realizations of the importance of these immutable laws and losses of long-term benefits of time spent in the offline world. It is likely that some offline governments will sense that important activities are happening beyond their reach and respond by trying to create laws to regulate the metaverse. This will be hampered by the multinational nature of the metaverse, but offline governments are powerful forces and may have the ability to restrict some societies as they try to develop in the metaverse."

2. Expert essays on metaverse possibilities

The experts' answers to our questions about the future of the metaverse that are reported in this section are somewhat longer than those in the previous section, and they often have a more panoramic perspective.

'It will be even more difficult to separate the "real world" from the manifold mirror worlds we will be engaged in and – yes – addicted to'

Sam Adams, artificial general intelligence researcher at Metacognitive Technology, previously a distinguished engineer with IBM, commented, "Cognitive immersion can occur anytime a mind focuses intensely on something to the exclusion of everything else. Musicians experience it, as do athletes, artists, assembly line workers, mothers giving birth, authors and computer programmers. In all cases it requires a focal point as well as the engagement of some number of senses and muscles. The stronger the focus, the broader the engagement of the senses, the lower the latency between muscle twitch and sensory response, the easier it becomes to slip into that state of immersion. As a college student in 1980, I found myself fully immersed in the original adventure game, 'The Colossal Cave.' The interface was minimal, the visual and auditory distractions many, but I was entirely oblivious to them as I wandered in the cave and puzzled over the various challenges, ignoring the hunger and exhaustion from lack of sleep for as long as I could. Simply put, it was immersive and addicting.

"With the development of XR technology and content over the next 20 years, I expect this experience of cognitive immersion to be commonly available on demand to anyone with access to the bandwidth and sensor/effector interface equipment. As with the original PC wave, then the desktop/Internet/browser wave and the mobile Internet wave, the XR wave will be driven by device access, bandwidth and content. I fully expect device access to be a non-issue, as XR by 2030 will be delivered to the human senses via ubiquitous wearable devices, probably in eyeglass format. Broadband beyond 5G and low-Earth-orbit satellites like StarLink will provide the low-latency bandwidth required to trigger full immersion of the senses.

"This leaves the content, which will largely be a predictable mix of passive (music and movies) and active (social, gaming, sports) offerings. But the rest of the metaverse ecosystem, the massive cloud computing centers with their daily exabyte data feeds and the trillions of Internet of Things (IoT) devices will usher in a kind of content we have only hinted at in today's XR experience: David Gelernter's 'Mirror Worlds.' And just as it is nearly impossible to engage in modern life and society without hours of daily Internet interaction today, it will be even more difficult to separate the 'real world' from the manifold mirror worlds we will be engaged in and – yes – addicted to.

"Positives include broader life experiences and the development and maintenance of personal relationships, especially with those we will never likely meet 'in the flesh.' Remote work and, especially, collaborative remote work will be greatly enhanced.

"Negatives may sound like a broken record, but less and less of life will be spent in-the-flesh-present with other humans, breathing the same air, feeling the physical closeness of companions and crowds. A larger segment of the population will choose to live as solely digitally as possible, with their physical existence and needs being minimally met so to allow maximum time 'in the 'verse.' Early examples of this are the 'sleep, eat, game, repeat' crowd, who have no ambition outside spending more time 'in-game.'

"Changing the world? It will amplify the existing cross-border unification and hyper-balkanization of society that we have been experiencing with the global mobile internet for the past 10 years. Changing our lives? For the connected, more time away from real life, but this will also create a desire to unplug, at least for retreats and vacations. Look for 'Faraday Retreats' that use technology to digitally isolate guests from the 'verse. Extremes will include Faraday communities (anti-digital communes) where people chose to live their lives in 'the real world,' without being jacked into the 'verse.

"But in the end, people are still people. Until the highly unlikely full-brain interface that no longer requires the physical senses, experiences will still be modulated by the human interface: eyes, ears, touch, taste, smell, motion, speech, etc. Blockchain will fade into the core of the internet to provide anonymous but irrefutable authentication and transactions, including the securing of content (like the fledgling Web3). But its anonymity when applied through XR will create a different kind of trust, where you can trust the transaction but never really know the other party. Transactions-only trust leaves behind many of the societal notions of reputation and branding and allows for parties of currently illegal/bad-reputation (e.g., narco syndicates, mafia, terrorists) to easily conduct 'legitimate' business which income supports their antisocial agendas without the transactions being tarred with their true purpose."

The future environment for most is likely to be 'a kind of everyday mixed-reality system that allows for both physical and digital worlds to overlap'

Jamais Cascio, distinguished fellow at the Institute for the Future, responded, "By 2040, the technologies that fall under the 'metaverse' umbrella will very likely be in ubiquitous use, even if the term 'metaverse' has fallen out of use. Fully-immersive virtual environments distinct from the physical environment will likely be occasional-use tools, as we see today with games. More commonly, we're likely to be using a kind of everyday mixed-reality system that allows for both the physical and the digital worlds to overlap.

"There are multiple reasons why a full-immersion non-physical environment will be used in a more-limited fashion, but primary among these is the sensory limitation. While visuals and sound may be reproduced at better-than-real clarity, touch, balance, smell/taste and other bodily senses that are outside of sight and hearing do not get the same kind of immersion. (For the sake of this discussion, I'm not talking about direct neural interface – the technology is plausible in this timeframe but has impacts and cautions that go well beyond the 'metaverse' conversation.)

"I believe that we'll confirm that bodily sensation is necessary for a truly immersive experience and that being disconnected from the body for extended periods will lead to both physical and mental health issues. Conversely, mixed (blended, augmented) reality technologies that allow experiencing physical and digital sensory inputs simultaneously will likely be far more widely used. This can even include experiences where all visual and audio input is digital – but working in concert with the real-world environment (such as virtual decoration and imagery for clothing, rooms, faces, etc.).

"Toned-down versions of this technology can be extraordinarily useful for both work and personal enjoyment. We already have narrowly-focused iterations of this technology in use; this 2040 version would be much richer and more environment-aware (e.g., will not require beacons indicating the size of a space, as with current VR technology).

"There are two significant concerns that arise from this kind of technology. The first is more blatant, the second is more subtle but it is ultimately a bigger problem. Mixed reality, by definition, allows for the imposition of digital imagery over physical reality. The potential for abuse is clear, from censorship to non-consenting pornography. The technologies needed to police such abuses are even more complex than trying to block harmful images and text from Facebook, and would likely be similarly ineffective. The more subtle problem would also apply, at least to some degree, to all forms of metaverse technology: enclosure, in the classical economics sense.

"Things that in 'real' reality are free to see (architecture, clothing design, street art) can in a metaverse system be paywalled off, such that only people with the right token can see the 'true' shape of the building or the full details of the dress. The nightmare iteration of this is that essentially everything has to be paid for to experience – it's a world where everything is an NFT.

"We shouldn't let legitimate concerns like this force us to set the technologies aside entirely. The ability to see the world at greater depth (look closely at the plant and see its taxonomic description, or how it circulates water, or its life cycle, or its total carbon captured), to allow for creative people to intermix the surreal with the physical (giants wandering off in the distance, or clothing that leaves an echo of itself in its wake, or tattoos that offer commentary on what the wearer is doing), and even to clear away visual clutter (and you *know* that ad-blockers will be the

first thing many people install) can be a source of delight. But having to subscribe to reality? No, thank you."

'We're rushing headlong into it without all the safety measures that we need'

Avi Bar-Zeev, an XR pioneer who played important roles in developing and creating the technology of HoloLens, Google Earth and Second Life and has worked with Microsoft, Google, Apple, Amazon, Disney VR and more, agreed to share several segments of his writing and talks about the metaverse as his contribution to this report.

In a November 2021 talk at Augmented World Expo, Bar-Zeev, predicted:

"AR is going to be bigger than 'the metaverse,' not by volume but by ubiquity and user experience. The fact that we will be wearing our AR glasses for potentially 18 hours a day makes it more personal to us. The same interfaces that work for us in the real world will work for us in the virtual world, so we will be applying these same ideas across any reality, across any world. The fact is that we want to interact with stuff that is personal. So, if the metaverse is essentially the next generation of the internet, and XR hardware is essentially the browser and we are the browsers, then AR-like user experiences may be the most common user interface.

"This is why AR goes beyond what people talk about today when they talk about the metaverse. Really, there will be states of presence and co-presence. I propose 'coreality' as the best way to describe the collection of spaces where we can be present or co-present. We are working to form the XR Guild in order to come up with a set of principles for XR developers that they can own and use to get better results for humanity."

In a February 2022 interview with Spatial Reality, Bar-Zeev said:

"My biggest worry about all this is that we're rushing headlong into it without all the safety measures that we need. There is no regulating force in this new world, other than for-profit companies with their own territories. There is no force coming in to say, 'Here are the ways we should behave, and here's what we do with the small percentage of people who misbehave.' And unfortunately, one bad actor can cause grief to thousands or millions of people. It's a really important thing to get it right before we all rush in and say we're going to live there. It's nowhere near ready for us to live there. There are no rules. Everybody is just rushing in to grab whatever pickaxe and gold they can find on the ground. … What is the harm of moving slowly? What's the downside of actually being careful? It might cost us a little more money upfront. But the cost of

doing it wrong, the cost of making a mistake, the cost of hurting people or leaving people out? That's tremendous …

"Privacy is critical. And the biggest threat to privacy, honestly, is the ad-driven business model. It's not that the ads by themselves are evil. Ads often are just giving us information or creative expressions, and they're largely protected by the First Amendment. The problem is the way that our personal information is being used to deliver ads. What I'm arguing for, and other more-prominent people are arguing for, is that we need to regulate the business model, not the expression of the ads themselves.

"When XR has eye tracking and emotional analysis, the computer is going to better understand how we think and feel about everything in our environment. It's going to know more about how we feel about people in our lives. It's going to know how we feel about political issues. It's going to be able to know about our emotional triggers. Whatever our hot-button triggers are, the companies will know how to get us into a much-less-rational state, which is the perfect state for making us susceptible to all sorts of influences. By optimizing the system, driving it for the maximum extraction of ad revenue, we've turned people into data mines and no longer truly free-thinking individuals. Ultimately, if we take it to its extreme, we lose our autonomy, we lose our ability to think for ourselves because the systems are pushing our buttons for profit.

"The best computing interface of the future is the one that knows us so intimately that it can help us get our work done. If companies continue to exploit us, then we're going to have to just come down and say, 'No, we can't do that. It's too dangerous.' Let's be cautious and human-centered about these things. Let's act on the negatives we see today. We can't ignore them and just hope things will get better over time. Taking action is the only way we're going to steer this stuff toward the best outcomes."

And in a column he wrote for uxdesign.cc Bar-Zeev predicted:

"Imagine 10-20 years from now. We'll each have a pair of contact lenses that can create AR and VR as well as we want (except maybe for touch, taste and smell). By then, the words 'AR,' 'VR' and 'meta' will likely be relegated to academic writing and old-timey company branding in favor of something more hip, now and organic. Open your eyes and you'll see 3D holograms in the real world perfectly mixed with real objects and people. Close your eyes (or otherwise elide the natural light) and you can be virtually anyplace else. Audio must also mix perfectly. But AR and VR are only two points on a spectrum. If you start with AR and add enough virtual stuff to distract you from reality, you're effectively in VR.

"If you add digitized 3D 'twins' or otherwise live camera feeds of your real-world environment into VR, you're essentially back in AR again, or at least a simulation of it. VR fundamentally strips away the most common constraints of reality: location and travel, physics, even sometimes *time,* where hours can often seem like minutes, and we can travel to the historical past or imagined futures. We can also pretend to be someone else in VR (or perhaps more of our truer selves?) to temporarily remove the constraints of our births: sex, appearance, even changing aspects of our personality. We can gain 'superpowers' inside these worlds too, like flying, invisibility and content creation. Eventually, everyone will just call them 'abilities.'

"On the way to that ubiquity, power imbalances invariably lead to social strife. Without the normal constraints of reality or other ways to defend ourselves, we are more vulnerable to other people's powers, personalities and agendas. If we increase our individual power beyond prose and memes today toward experiences with effective superpowers, we also turn up the volume on the negative expressions as well. This is not an arms race that anyone can 'win.' Even in a virtual world of *one*, with no multiplayer capability, we have to consider the owners of the space as unseen, god-like entities who may want to influence our thoughts and actions in positive or negative ways. And some will.

"What AR really does is provide a new way to see and interact with the real world and the people in it. It can improve the signal-to-noise ratio of our daily life by filtering out what we don't need to see and enhancing what's most relevant and impactful to us, individually, contextually, based on what matters most. …

"Mark Zuckerberg recently touted a desired feature of his company's future AR glasses as being able to carry on *other* conversations while we're talking to someone in person. Let's also figure the glasses can secretly bring up the social media profiles, criminal records and posted vacation photos of the people we meet. These particular features are clearly *anti-social,* even *sociopathic*, giving the wearer much more power over others. If the goal is adding presence and connection, then being distracted by information and social anxiety about the contents of each other's AR displays yields the *opposite result*. However, if the glasses monitor our own individual emotions and let us know when we're getting too emotional or otherwise *less present* (e.g., lost in past memories or worries of the future), then they will provide a tool for us to be *more present*, more grounded and better connected with others around us. *Why don't we ever hear about that as a feature?*

"How we design these experiences will largely determine how this goes. Do we add unhelpful saturating layers to reality, or do we help strip away some noise? People with more money than sense will routinely make bad experiences and occasionally wonder why they don't work. Hopefully we can all learn from these mistakes and do better ourselves. Our hope is that the

marketplace and other social institutions will help get rid of the bad ideas fast enough and help ensure a brighter future for us all. The better path is to find and fund the better designers now, to build that future proactively."

Despite concerns, 'the metaverse will eventually draw us together' as other media have done throughout history

Stephen Downes, expert with the Digital Technologies Research Centre of the National Research Council of Canada, said, "Opportunities for fraud and scams will abound. As well, there is the risk of a non-traceable shadow economy developing. It will be hard for people to grasp the idea that something could be both digital and 'real' and, despite the reassurances, it will be very hard not to believe that they could simply cease to exist. The danger here is that people will think of very real things – like, say, digital currency debts – as non-real, and suffer harmful consequences. Complicating matters will be the fact that digital objects may also embody artificial intelligence.

"By 2040 (probably much sooner), it will not be possible for most people to distinguish between avatars representing humans and AIs. The proliferation of AIs will enable actors with more resources to simulate a much greater presence online (just as we have seen with social media bots). A lot of these will be laughable (there *will* be the metaverse equivalent of the Nigerian prince), but there will also be serious cases of impersonation and worse. It is perhaps too early to demand specific legislation, but it is not too early to develop frameworks describing what will be acceptable and unacceptable uses of the metaverse both legally and commercially.

"Having said all that, despite the risks, we will not be able to resist developing, entering and using the metaverse. It will be very difficult to enjoy flat-screen media entertainment after watching an immersive movie or sporting event. Today's games are not yet more compelling in VR, but as the interface improves play will be much more fluid and natural, making traditional gameplay on a screen with controller or keyboard seem awkward. Just as it's hard to get up from the television or pull the plug on a video-gaming marathon, it will be difficult to put down the controller. Psychologists will undoubtedly talk about dissociation disorders afflicting people after long VR sessions.

"Having said all that, the metaverse will eventually draw us together. Just as radio and television created the common experience, just as social media created shared memes, we are going to find we share our world more deeply and meaningfully with people (and ideas, and representations) we could not have imagined before plugging in. being closer to each other isn't always pleasant (as we've certainly learned!) but being closer leads to deeper dialogue, greater understanding, and more empathy. No, this is not universal – the divisions in our global society will also be magnified.

We will need to ensure that these divisions are not incentivized and monetized, as they are in some social media today, because the experience will be that much more personal, the hurt caused by these divisions is that much greater. More, because digital resources are not scarce in the way that physical resources are scarce, there will be more opportunity for people in less-advantaged positions and societies, providing they can gain access to the network.

"We saw manufacturing develop worldwide with the development of a global supply chain infrastructure. People worldwide can today offer digital services thanks to the global internet. A person does not need to own a factory or a farm to earn wealth in a digital world. This depends, though, on a shared digital infrastructure. If the inhabitants of the metaverse are merely tenants, then most likely they will be excluded from any prosperity the metaverse may create.

"Decentralization is the great promise of the metaverse, especially some of the enabling technologies such as blockchain networks and self-sovereign identity. In a truly decentralized system each of us might enjoy more autonomy to design our own lives and our own worlds. If we are indeed moving toward a world of less regulation and oversight, it will have to be a very different from today's world. Personal autonomy and self-governance can thrive only in a world where authoritarianism and coercion are difficult, and where people are protected from the ill effects of inequity and exclusion.

"Without mechanisms to ensure reasonable levels of personal freedom and prosperity, we can enter a dystopian world very quickly. Without regulation, not only governments, but corporations, schools, gangs and even individuals can use their freedoms to oppress others. The rise of the metaverse will lead to a renewed discussion of rights. This discussion will be partially focused on diversity, equity and inclusion, reflecting the current dialogue flowing from events in the physical world, but will it also reflect the requirement to enable people to participate fully in a digital society? Issues such as access, consent, transparency and openness, ownership and association, among others, will shape the great debates of the 2020s and 2030s."

The biggest impact will tie to the question: What does it mean to be human?

Chris Labash, associate professor of communication and innovation at Carnegie Mellon University, wrote, "Remember that part in 'The Matrix' where Agent Smith and Neo are fighting in the subway and the train is bearing down on them and Smith says, 'Do you hear that sound, Mr. Anderson? That is the sound of inevitability.' That's the metaverse today and the likelihood of it being real, ubiquitous and normalized by 2040. Right now, I have a student research team creating 'An Investor's Guide to the Metaverse.' Right now, I have a student doing an independent study on creating and managing products in the metaverse. Right now, a friend of mine has just

launched an NFT Asset Management company. [Here are] my top five [questions about the metaverse], starting with the most important:

5.0 - The most important question about the metaverse is about its fundamental ontological impact on what it means to be 'human.' Will it make us more civil? Will it represent an opportunity for 'augmented humanity?' What happens when AI-enabled 'entities' can be part of the metaverse? Every great leap in technology is inextricably interwoven with fundamental human questions. As we move forward, the questions get harder, the answers more challenging to put into practice.

4.0 - Apropos of the above, what about diversity, equity and inclusion? The metaverse offers a great opportunity for specific groups to establish safe spaces where they can share experiences, desires and dreams and then have the tools to actualize them. It can also, as we've already seen, be a dark alleyway where the most horrible elements of our global society do most-horrible things, often with no consequences. It could potentially level the playing field both economically and socially for those sidelined in the physical world. And note that I say 'physical' versus 'real' world. The metaverse being digital doesn't make it any less real; in fact, by 2040, it may be considered by many people to be as real or even more real a space than 'physical' space. The blurring line between the physical universe and the metaverse is potentially very empowering. I taught on the Second Life platform years ago and it was interesting that people with physical disabilities made their avatars reflect those disabilities, rather than be a 'perfect' character.

3.0 - Similarly, will the metaverse drive social participation or social isolation? Both are likely. One potential problem is the possibility of over-participation. In the early days of Nintendo 64, traders on Wall Street were staying home to play 'GoldenEye' rather than showing up for work. The metaverse will be even more addictive. The metaverse can also be a safe space for the painfully shy or introverted to interact with others on their own timetable and terms. The obvious minus: right now 37% of 12- to 17-year-olds have been bullied online, 30% more than once, and more than 50% of LGBTQ+ young people have been bullied. The metaverse can exacerbate this and/or help mitigate it.

2.0 - What will be the role of government? When it comes to how real the metaverse will be on a global scale, consider the possibilities. As I write this, Russia's invasion of Ukraine has intensified, and the show of support for Ukraine is both global and unprecedented. Fast-forward to 2040: If such a conflict took place in the world of an interconnected metaverse, imagine the power of seeing millions of digital people dressed in blue and yellow all gathered in a vast open space in a profound show of support for Ukraine. Now couple that visual support with digital sanctions – economic and otherwise; with the sharing of blockchain-verified real-time information that goes beyond a government's control, with the sharing of real-time crowdsourced information about

Russian troop deployment, supply and logistic issues, with the humanitarian needs of Ukraine and fundraising and other efforts to get help to those in need … and you begin to see both the power and the possibility of a world where the metaverse has become an elemental part of everyday life, intertwined with physical reality, that allows for immediate action and reaction. We will also see 'digital alliances' emerging just as we are seeing in the response to Russia's invasion: pan-government groups that span finance, media and the social sector that can bring enormous pressure to bear. We will also likely see the rise of 'digital states.' If Facebook were a country its population right now would outnumber that of China. The metaverse will be far bigger (and more participative) than Facebook. That's a lot of power.

1.0 - Finally, one of the most basic questions that people will have is 'Can I trust it?' Participation in the metaverse requires trust, trust requires governance, governance requires accountability and accountability requires redress. How, in an entity that belongs to no one, can any of that be achieved and achieved consistently? Will people not just participate but *continually* participate in the metaverse? One potentially strong attribute is that people will turn to the metaverse for 'trusted' communication; misinformation, disinformation and state- or group-sponsored information terrorism could be mitigated by the real-time public verification that a blockchain-powered metaverse allows.

"There are so many other areas for discussion: How will the metaverse's infrastructure be used to make business, government and everything else faster, more efficient and more accessible? Will there be the metaverse equivalent of bilateral trade, which research suggests reduces conflict? What are the microverses that will comprise the metaverse? Will it be a technical oligarchy or truly democratized? What will the economics of it be? And maybe most interestingly, What's the future? What's beyond meta? What will it help us become? I'm excited to find out. See you in 2040."

A vision of what a great metaverse – or great metaverses – could be

David Weinberger, senior researcher at Harvard's Berkman Center for Internet and Society, wrote, "Let's assume that that the metaverse will be like the web in that it does not consist of a single, wholly owned place, but rather is composed of many, many, many linked metaverses. There is reason to think that metaverses are highly likely to become the primary way we participate on the Internet. The Internet has pretty consistently tended toward richer media, so metaverses seem like a 'natural' next step.

"This assumes that access to affordable bandwidth and low-cost VR/AR devices will increase, and the like. And that, in turn, will further increase the digital divide. We should therefore be, from the start, designing metaverse protocols that will scale from full-sensory user experiences to

accessibility on low-end 2D devices. This should not require add-ons or third-party transformers, any more than viewing a webpage on a huge, high-resolution screen or a mobile device does.

"Let's make a further optimistic assumption: metaverses are made deeply interoperable in exactly the way that social media platforms are not but webpages are. You can open a website on virtually any device because webpages and web browsers follow protocols. That's why any proper browser can display any non-broken webpage and even lots of pages that are broken.

"Let's hope that metaverse interoperability means not only that you can display and interact with a metaverse on any metaverse 'browser,' but that metaverses know how to use the information you choose to provide. For example, a metaverse should be able to display your chosen avatar, which you might also use in other metaverses; this would help provide continuity of perceived identity across these spaces. Simply having the same avatar across metaverses – especially if you're in third-person view so you can see yourself in the metaverse – will give us a sense of digital personhood that we don't generally have on the web or Internet. It will also enable others to recognize you, enabling a deeper sense of social connection. Being on a thread with a player named 'Excal143a' is very different from joining a conversation with a person you recognize because of their pink frog head and by their sense of fashion.

"But your avatar is the least of it. You should be able to carry into each individual metaverse what you want that metaverse to know about you. We've long had this dream of each of us controlling what various sites and services can know about us, but perhaps efforts like Tim Berners-Lee's Solid will start to gain a foothold. There's every reason to think that metaverses will take on some of the most important properties of games: an emphasis on engagement, a sense of play, sociality and mods.

1) *Engagement:* Metaverses will compete for our attention by looking great, but also by encouraging exploration and participation. Exploration might manifest itself by leaving much hidden but discoverable. Participation means that we will often be able to build permanent elements in a metaverse, by ourselves or with others. Just look what happens with Minecraft.

2) *Play:* The web has already eroded the wall between the serious and the playful. That is not only usually a false wall, but it keeps people away from explorations we'd all be better off engaging in. Metaverses will perhaps encourage play the way lots of discussion boards enable or encourage collaborative humor.

3) *Sociality:* There are more invitations to connect when your avatar almost literally runs into another. Or if that avatar is a creature with a pink frog head who's carving ellipses in a waterfall. The synchronous and visual nature of metaverses may encourage more social connections,

perhaps with more cross-session persistence. I'm sure we'll also invent new ways to attack and degrade one another.

4) *Mods:* Game makers have learned that mods – customer-created maps, potions, rules, etc. – not only help them retain their users longer, they deepen the users' attachment to the game. Metaverses with mods? Yes please!

"This all might well change our ideas about the role of the real. Full-on metaverses will succeed by putting us into a world with other people in which we encounter, discuss and create things that matter. We can say that none of that is 'real' (something the philosopher David Chalmers disputes in his recent book 'Reality+'), but as we spend more and more time going through metaverses on the Internet, it will become ever more clear that what matters to us transcends both the real and the media we're engaged in.

"Metaverses are going to make it clearer than ever that what's most important to us is not what's real and thus independent of us, but what matters to us together."

Watch for the rise of 'digital twins' and the variety of ways they will be helpful

Melissa Sassi, global head of IBM Hyper Protect Accelerator, wrote in great detail about a number of use cases for extended reality: "There are still significant hurdles to overcome with metaverse applications in real-life scenarios; however, I do expect the technology to continue to evolve and become more refined leading up to 2040.

"I see the rise of the digital twin and personalized ways of bringing AI and ML to life via our digital twins: a new definition of 'in real life.' We will continue to rely on technology to help us become more productive, more efficient and able to virtually be in far corners of the world without physically being there. As the digital world continues to intertwine with the physical world, these lines will continue to blur for all of us to the point at which I am not even sure we can say 'in real life' anymore. Real life will have become our digital life and vice-versa.

"Use Case #1: Health care - Significant efforts today are put toward treating symptoms as opposed to achieving prevention, and we all recognize the challenges with sharing patient records across doctors and health care networks. Having a digital twin in health care could be incredibly powerful when it comes to predictive modeling and sharing data across health care providers and entities, where the patient is put more in the driver's seat in regard to preventative care and bringing your own record to medical doctors and other health care representatives responsible for care. One example I have seen inspiring this work is BioTwin, an early stage health tech startup that's

created a virtual replica geared toward detecting and preventing health care ailments before they occur. This is a budding space to watch when it comes to health care innovation, disruption and putting more information in the hands of the people to drive good health care and well-being, which is one of the UN's Sustainable Development Goals.

"Use Case #2: Education - Having digital twins gives rise to better opportunities for those learning to become health care professionals or medical doctors for practicing in virtual environments. Tiny mistakes and major adverse effects that occur during surgery or other types of medical treatment can be decreased by providing learners with virtually simulated environments and twins to practice with no risk to human life. AR, MR and VR plus the personalization of AI and ML will give other boosts in people's education journey, for instance in practicing professional development or soft skills, including public speaking, problem solving, critical thinking, teamwork and collaboration, and many other skills of the future. Many ed-tech platforms today focus on certification factors and talking heads; imagine a scenario where people can interact as digital twins in different scenarios to practice real-life skills. According to the World Economic Forum, we are in a workforce crisis, with 87% of companies worldwide expecting skills gaps, as noted by Boston Consulting Group. Employers today say supervisory staff and front-line workers lack future-ready skills. Having a digital twin provides significant opportunities for learning practically and being immersed in the learning journey. Advances can also give rise to the digital-twin educator in K-12, higher education and other settings where teaching can happen in different ways from the past, especially in scenarios where we are learning in digital formats. COVID-19 has taught the education sector that relying on in-person instruction is not always possible, which has given rise to significant increases in e-learning investment within the venture capital community.

"Use Case #3: Digital and entrepreneurial thinking - The same conceptualization can be applied to learning digital skills or entrepreneurial thinking. According to the World Economic Forum, the lack of digital skills among their people cost 14 G20 countries $11.5 trillion in GDP growth. It also reported that by 2030 U.S. talent shortages and a skills gap could cost its economy $8.5 trillion. Learning and development leaders see skilling, upskilling and reskilling as strategic priorities, further demonstrating the need for new business models, technology applications, content and curriculum and practical ways of demonstrating that workers have gained these skills that can be applied in the workplace. Bringing the metaverse into this realm could have significant impacts. The World Economic Forum's 'Reskilling Revolution' program aims to provide 1 billion people with better education, skills and jobs by 2030. There is no reason this cannot happen via augmented reality.

"Use Case #4: Entertainment and gaming - Gaming will continue to evolve as a space with more interactivity and more engagement with the digital world. The metaverse also has applications for concerts where digital-only concerts are also a consideration. With hundreds of millions of users,

Epic Games, the creator of Fortnite, and other game developers have significant opportunities for intertwining gaming and entertainment with the metaverse. Epic produced a live virtual show in its Fortnight game starring EDM producer Marshmello. More than 10 million people 'attended' the concert. It followed later with a virtual concert starring Travis Scott that drew an audience of 12.3 million people. As of 2021 Fortnite was played by 40% of children between the ages of 10 and 17, according to National Research Group. But the rise of virtual entertainment is not just for children and youth. During the pandemic, the annual adult gathering known as Burning Man went virtual as well. I would say the vote is still out on whether the feeling, sentiment, experience and memories of real-life entertainment can be replicated via metaverse applications. I am not convinced that the metaverse replaces how one feels being on the Playa in Blackrock City, Nevada.

"Use Case #5: Social life - While we already are experiencing and enjoying digital opportunities to 'see' others in far corners of the earth through video conferencing and virtual events today, I am 100% certain that these virtual events, even if done in AR/VR/MR, do not replicate the 'in-real-life' experience. I recently had an opportunity to go back onto the in-person conference scene after the long stretch of COVID-19-induced isolation, and no virtual event in the last two years could replicate that feeling of talking with real people, in real life, and enjoying what the physical world has to offer. Who knows? Perhaps future innovations in the metaverse space will change my mind, but for now, keep my 'in real life' social interaction at the top of the list of things I am after vs. metaverse interactions. I would say the vote is still out on whether the feeling, sentiment, experience and memories of real-life entertainment can be replicated via metaverse applications.

"Use Case #6: Culture, the arts and travel - Extended-reality applications will create significant opportunities for making cultural experiences and the arts available to all. These experiences can be set in any chronology. Via digital replicas you can witness and participate in how life was lived in years past in any setting or experience those settings' contemporary cultures. It's a great way of learning about the world, although there is no doubt that the 'in-real-life' feeling of really standing there at the Grand Canyon, the Eiffel Tower, Times Square, the Pyramids of Giza, the French Riviera, Angkor Wat or any other faraway land cannot be duplicated. I would rather lie on the beach in the Caribbean with a drink in my hand, visit Museo del Prado in Madrid Spain, sail on a Catamaran in Costa Rica or see the Great Wall of China with my own eyes and experience the 'in-real-life' impact of people, language, food and everything that has to offer. Innovations are unlikely to completely replace the depth of our traditional means of connecting with culture, the arts and travel."

The worst online problems could intensify; then add interpersonal dissociation

Daniel S. Schiff, a Ph.D. candidate who studies the governance and social and ethical implications of AI at the School of Public Policy at Georgia Tech, said, "The existence of a metaverse renews questions about misinformation, protection of privacy, targeted advertising, disparate treatment of subgroups, coercion, harassment, bullying, labor and sexual exploitation, and more. VR theoretically makes many of these and other social and ethical issues raised by the internet and social media even more stark given the enhanced experience associated with immersive audiovisual content. Harassment and bullying could become more traumatizing, while protecting privacy would be even more essential given increased access to data about an individual's digital location, emotional state, or behavior. The early experiences of sexual harassment in virtual spaces indeed point to a dire need for proactive governance and regulation, especially to protect vulnerable groups and children. Further issues surround psychological well-being. Indeed, just as digital technologies and social media have altered people's cognitive patterns, attention spans, systems of reward, and mental health, so too can VR/AR alter and even exploit these phenomena, likely to a greater degree. Careful research and governance will be needed stay ahead of these and other associated harms, especially if they are indeed more stark in phenomenologically enhanced VR settings.

"A further set of questions surrounds notions of identity and interpersonal relations and behavior. In particular, will individuals be likely to substitute alternative digital personas for their real-world personalities, and will such behavior allow for creative expression and development or instead psychological dissonance, harmful artificiality, and social and self-alienation? That is, will increasingly immersive environments allow for more genuine expression of the self and deepening of relationships, or simply for more immersive forms of self and social displacement, deception and so on? Of particular concern is that acts of sexual or physical violence or criminal activity may find a home in the metaverse.

"A further issue in VR/AR ethics associated with modern philosophy surrounds the Nozickian 'experience machine,' most prominently portrayed in popular culture through the film 'The Matrix.' The cautionary tale here is that individuals who embrace the metaverse may dissociate from society and real-world relationships and obligations, for example, by deprioritizing school work, marriage, job-hunting and child-raising. These kinds of disengagement have been explored in the context of the adoption of television and the internet, with some real indications of social harm.

"Needless to say, to the extent that these risks are realized rather than overblown, they can spell major societal challenges in the form of insufficient educational achievement, fractured labor markets, lack of stable family or community life, structural demographic problems, crime, loneliness, poor health, political instability and additional social and psychological pathologies.

"Ultimately, a metaverse presents the opportunity to revolutionize expression and creativity, create new venues for social connection and exploration, enhance commerce and entertainment, and even increase access to underserved populations. Whether adoption is slow or fast, the possibilities are expansive if the risks are carefully managed. To manifest the best version of the metaverse, then, technologists, policymakers, researchers and the public will need to work actively to envision possibilities and minimize harms."

Services will grow and digital gaps will widen, too

Robert M. Mason, professor emeritus at the University of Washington whose research focuses on the culture and ethics of knowledge management, commented, "By 2040 the metaverse *will* be a much more refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally. The global population in 2040 is estimated to be over 9 billion, so this statement posits that about 5.5% of the global population would be affected by a more refined and well-functioning metaverse.

"Without parsing all the nuances or quibbling about definitions, I expect the relevant technologies will continue to improve, with image resolution and improved sensory stimuli enabling increasingly immersive virtual encounters. For those living in 2040, the metaverse can provide an expanding range of physical/social encounters and intense experiences.

"Having lived through a few iterations of technologies that have great potential to enhance our access to knowledge and provide a wider scope of virtual experiences, I have become less enamored with the technologies themselves and more intrigued with questions of 1) how these technologies are assembled into systems and services that provide experiential opportunities for users and 2) who the users are.

"What experiences will be available to users and what will motivate producers to provide these experiences? These three categories will help shape the future metaverse:

- What services are available?
- Who has access to these services?
- What (government) regulations are enacted?

"If we review what producers provided with earlier versions of the 'virtual' or Internet-connected world, we arguably could begin with France's Minitel. Developed and operated by the French administration for telecommunications to increase citizens' use of the phone service and to lower the cost of printing telephone directories, Minitel provided popular and successful. Although based on a rudimentary text-only terminal (provided free to phone subscribers), Minitel provided

a glimpse into the Internet-powered future of connectivity and online services and offers some insight into the tension between regulation and open access for developers (a forerunner of net neutrality).

"With all the beneficial and cost-effective services that Minitel provided, the French government seemed almost embarrassed to report on the high volume and high revenue provided by games and chat rooms, particularly the *messageries roses* (adult chat rooms). Despite concerns about minors' access to these sex sites, France PTT decided not to prohibit them, leaving access control to parents. Men were more likely to be users of these sites than women, prompting many of the sites to hire men to impersonate women to maintain high call/chat volume. Consequently, these chat rooms expanded, even to the point of overloading and crashing the Minitel system.

"Observers of today's Internet and other online services disagree on estimates of the financial impact of gaming and entertainment (including pornography and 'pink' interactive services), but all agree that the volume is high and revenues substantially more than $100 billion. Virtual reality and augmented reality (VR and AR) games in 2019 comprised less than 10% of this total but were growing.

"Assuming a Western (U.S.) capitalistic (or even oligarchic) economic environment for the continued evolutionary development of the metaverse, I anticipate that the profit motive, perhaps lightly controlled by government regulation, will shape, if not dictate, the types of services available and the accessibility of these services.

"As I write these notes today, almost 60% of the global population are active Internet users. However, Internet activity is not equally distributed; the World Bank estimates that Internet use ranges from over 90% in most economically advanced countries to less than 10% in countries with emerging economies.

"If history and current services are guides to how services will evolve in the metaverse, I would expect that gaming and entertainment (including pornography and 'pink' services) to be early adopters of the technological capabilities associated with the metaverse. Innovative developers are likely to drawn to the wide range of economic and manipulative opportunities in the metaverse, including scams and swindles. The past success of sex-based websites and Internet services would attract developers for metaverse platforms that offer similar services. I expect such services to be a significant, though not necessarily the dominant, driver of developer innovation and user adoption in the emerging metaverse.

"The opportunity for metaverse engagement is likely to continue to be uneven. Absent any government-based services designed to engage all households, the technology accessibility gap will continue to grow and increase the social inequality of metaverse engagement.

"In summary, I anticipate that the metaverse, supported and enabled with increasingly richer visualizations and experiences, will provide only a modest (if any) increase in the range of human behaviors, yet it can and will leverage the impact of the values embedded in the engagement opportunities in the evolved environment. The metaverse will empower developers to create services that appeal to both the higher and lower aspects of human nature through gaming, entertainment and social engagement. These engagement opportunities will be available unevenly, with citizens in the more affluent societies having greater access to a wider range of such services."

'This could increase our loneliness and lead to more polarization'

Maja Vujovic, owner/director of Compass Communications in Belgrade, Serbia, wrote, "If we take just the two most-discussed activities we've experienced *en masse* during the pandemic of COVID-19 – remote education and remote work – and imagine them within the metaverse, we can readily see that the drawbacks of those unhappy experiences would get resolved in this new and improved setting. Instead of staring at the Muppet-theater-like gallery of passive faces, who cannot do any work while they talk one at a time, individual workers and students could be at their workstations at home, quietly do their work and only occasionally talk to their colleagues' and their bosses' avatars on their screens. They could have almost exactly the same experience as they would have on location at a workplace, or in a school setting – for real. And that could easily include the small talk at the water cooler or accidental encounters in the canteen – occasionally priceless opportunities for exchanging ideas and information.

"Throughout that teleported experience in a seemingly joint office or classroom, they could comfortably and effectively be doing whatever activity that brought them together in the first place, without the infamous virtual meeting fatigue. This would go beyond making just our 2D experiences more immersive. This would be a very effective and productive upgrade of a 3D experience that occupies the most hours of our days. The same logic and the same technology could also be used for attending any number of group activities, such as exhibitions, entertainment shows, public debates, trade shows and conferences, trials, etc. This would add a lot of depth to the expression 'hybrid work.'

"There is no doubt this would become the beloved option for anyone who would be given a choice to fully participate in an essential collective activity without the discomfort of commuting, polluting, shaving or applying makeup, packing kids' lunches, etc. But the downsides would be considerable, too. There would be a drop in the foot traffic in urban areas, which would bring a

reduction in commerce, casual shopping, impromptu meals and coffee breaks, cab rides, public transportation demand and most likely even tourism.

“Critically, this could considerably increase our loneliness. It could work fine for already established families, which would be able to structure their time better. But it would reduce the opportunities for people to meet, get to know each other, become romantically involved and start families. It would likely help us get in touch and develop relationships with people from other parts of the world with whom we have something in common or with whom we think alike. But this would be at the expense of the everyday contacts with our immediate neighbours, people in our communities, our colleagues, etc. This would lead to more polarization, not less.

“It is very likely that we will use the potential of these technologies to delegate ourselves into situations we would rather avoid, such as a job interview at a distant location, a parent-teacher meeting that conflicts with our work hours and so on. Dating applications will have a field day with this technology, as will teaching, sales and any other sector where presentation is key.

“The change in our daily lives will not be a grand one. We will use these tools the way we use a thesaurus in a word-processing program or a spreadsheet to track our expenses. They will be tools only and we will not be any smarter or kinder than without them. They will save us time and offer more convenience, an additional layer of entertainment, more variety in our day-to-day existence. But we will not mistake them for a distinct layer of reality, nor will we get confused about our identity. If really superb avatars get developed and we get to customize them ourselves (a whole economy would develop around that alone) we will at the most treat those avatars the way we treat pets – as very close beings that we love dearly, but that we can keep in their place most of the time.

“The blockchain and smart contracts will likely have a role of a new paradigm, new phase in technology. On a large scale, we will substitute most of what we use today – social media, interest groups, databases of all sorts (expenses, gift lists, playlists, etc.) as well as any seminal interactions, and we will port them all into the blockchain. We will use blockchain to tackle the biggest problem that the metaverse will exacerbate and turn into our main priority: the question of trust. Blockchain-backed provenance will become the only solid source of truth that we will have to combat misinformation, fake news, identity theft and other transgressions of that kind.

“Behind this grand gamut of new possibilities at the tips of our fingers will be tight teams of overworked production people. Tech-savvy creatives will hurriedly be perfecting the shimmers, the twinkles and the smoothness of our virtual clothing, hair and skin. They will perennially run against tight deadlines and put up with exigent bosses, in their insufficiently paid jobs. So not much will change in our social contract, alas.”

A whole new range of social challenges will arise

Michael M.J. Fischer, professor of anthropology and science and technology studies at MIT and lecturer in the department of global health and social medicine at Harvard Medical School, said, "As defined here, the metaverse is computer-generated, networked-extended, reality spaces (XR, including VR, AR, MR). All these are already extant, so it is not much of a stretch that these (and perhaps also holograms) will continue to be refined, extended and made interactive by 2040. In addition, it is likely that progress will continue to be made in many fields, such as haptic feedback-enabled prostheses (i.e., biomechanical, neuro-electronic interfaced, cyborg) along the lines of those being developed in Hugh Herr's lab at MIT.

These will become rich spaces for artistic speculative and material-environment play:

- More-efficient, accessible and user-customizable storage spaces for information (aiding chemical, pharmacological, archival and environmental search and retrieval)
- Gaming environments for scenario planning and resilience planning
- New architecture – materials, textures, 3D shape transformations, energy flows and recirculation, green technologies
- Transport – self-driving vehicles are already in use in high-throughput ports
- Socially-livable urban spaces

"Among the advantages or new affordances might be more-flexible attitudes in regard to the worlds we live in and make for ourselves, and an expanded ability to live with and switch among various cognitive, affective and aesthetic modalities. No doubt these will also stimulate new forms of math and physics and deeper understandings of biological processes.

"The worries are that these can easily become aids to intensified surveillance societies, concentrated corporate structures and anti-user control (also known as 'anti-democratic' in conventional parlance), including anti-privacy and anti-tolerance of diversity, tinkering and eccentricities. The technological developments being rolled out in China in Xingjiang to control and 'reeducate' the Uyghurs are the most obvious disturbing red warning lights, especially since much of that technology is Silicon Valley-developed, parts of which are being introduced also in our neoliberal societies under management-speak, techno-optimistic sales tactics [driven by] the needs for capital to develop technologies and sales at the cost of abandoning societal values.

"More attention needs to be given to: 1) social implications of complex systems to social responsibility and social justice concerns; 2) multiple social arrangements that are not normalized into coercive, algorithmic reductiveness driven by efficiency models; and 3) increasingly

problematic mental health issues being reported globally as due to a rise in individuals' feeling isolated and alienated – including increases in suicides.

"These social issues cannot be accommodated under the rubric of 'ethics' which is a) based on outmoded individualist models of usually rational behaviorism (social responsibility is a better alternative descriptive except that it has been coopted by greenwashing-style corporate social responsibility scams), and b) is all too often bureaucratized into to-do checklists that are easily evaded. Particularly, more attention needs to be given to the freeing, creativity-stimulating and psychodynamically interactive features of play, memory, traumatic experiences and the cultural resources of very different languages, cultural experiences and ways of attending to the world."

'Education is where the greatest and most valuable shifts may come'

Nigel M. Cameron, president emeritus of the Center for Policy on Emerging Technologies in Washington, D.C., wrote, "It's a truism that tech changes tend to be slower than expected but also more fundamental in their impacts. I suspect this case will bear that out. 2040 seems a long way off, though 2004 seems as if it was just yesterday. Much has happened since then, though Second Life proved to be a cul-de-sac, MOOCs [massive open online courses] remained outside the mainstream of education despite the COVID-19 fillip to all things distant, and the allegedly liberating power of technologies and their corporate purveyors are currently held in much more suspicion than they were in 2004 – by governments and people alike.

"I'm anticipating a steady migration online of all manner of economic activity, though the nonce word 'metaverse' suggesting a basic recasting does not appeal to me. My book on robots and jobs from five years back already looks pretty dated (we really were on the cusp of self-driving cars, before we weren't). While the direction of travel of AI development is one-way, that may not be the case for take-up of its possibilities, partly as COVID-19 has potently reminded us of much that is uniquely special about the non-metaverse, partly as cybersecurity issues remain wide open and as advances in cyber-physical systems raise levels of risk to potentially existential heights.

Keynes' vision of widespread 'technological unemployment' is a non-trivial possibility; it was Bill Gates who opined some years back that governments would be pleading with companies to employ people, not machines. Certainly, tax subsystems will adjust – both to preserve employment and of course to capture value added – and it may be social movements will grant ever-more-enhanced value to human interaction and notions of human service. When I spoke at the Champalimaud Foundation's 10th anniversary conference on The World in 100 Years, I said I hoped when the Foundation celebrates its 110th anniversary our descendants will still wish to fly to Lisbon and party in-person in the Jeronimos Monastery. It may be that the next 18 years will pretty much

decide the direction we'll be taking long after, as we discover whether we can gain real benefit from the metaverse while keeping our focus on a *human* future.

"My sense is that education is where the greatest and most valuable shifts may come, even though online teaching is still often little more than a 19th-century correspondence course. The complete failure of COVID-19 to drive creative and widescale immersive MOOC-type educational provision at all ages has been rather remarkable, though certainly at secondary and college levels were it to succeed it would likely cut the number of teachers needed by a factor of, say, 100 (and expose every child to the very best of them)."

'The demand for all manner of physical objects will drastically diminish'

Jonathan Kolber, author of "A Celebration Society," wrote, "What most people don't understand about virtual reality is that a fully immersive VR experience, with zero latency (subjectively), will be functionally equivalent to physical reality for most purposes. While we are far from that experience as of yet, all of the enabling technologies are either entering commercialization or emerging from laboratories. To whatever extent these technologies prove insufficient or limited by comparison to 'real' physical reality, the commercial pressures to refine them in the direction of full immersion will be immense and will grow as use cases for VR grow.

"One profound implication of this anticipated development by 2040 is that the demand for all manner of physical objects will drastically diminish. The reason is that, in almost all cases, what people want is the experiences that are enabled by an object rather than the object itself. While unique artworks have cachet, even that can be digitized, as evidenced by NFTs. By way of example, once people can experience idealized living environments which can be customized and modified almost instantly from vast 'libraries' of digital components with AI curation, there will be much less pressure for the oft-cited 'location, location, location' that seemingly drives real estate prices ever higher. It will likewise become much easier to 'own' a set of immersive digital representations of cars than the physical cars, which require expensive maintenance, storage space and are subject to breakdowns and are not easily modifiable. People who spend large parts of every day immersed in virtual worlds may only require basic necessities from the 'real' physical environment: modest housing, adequate if bland nutrition and preventive health care. Since the health care can also be provided via the VR environment, in most cases via automated monitoring of vitals and occasional human consultation, there will be little need for most people to physically travel anywhere.

"The reduction in requirements for manufactured physical objects will utterly transform and eventually render obsolete the economy. I therefore expect life on Earth post-2040 to become largely a playground and place of voluntary mutual service, with the best examples of such service lavishly celebrated. In this world, the human inhabitants will have our basic needs met by robots

and the AIs that control those robots, with few humans having to 'work' as currently understood. (The reasoning behind this statement is extensive, and a primary topic of my book.)

"Nevertheless, I do expect a trickle of people to begin migrating to the first O'Neill-style space world in the late 21st century, due to the unique physical experiences possible there which, to my knowledge, cannot be replicated in VR – and the paradisiacal environments they can create. Once the first has been built – and either the space elevator or SSTO spaceplanes for transport – I expect an exponential increase in spaceworlds, with both habitation and tourism bringing vast numbers of people to them in the 22nd century and beyond.

"As with any transformative technology, fully-immersive VR will have both angelic and demonic uses. The demonic uses could include intrusive surveillance and control at a level that even George Orwell could not imagine, and I expect totalitarian states to embrace this power. Likewise, hackers may be able to take control of a user's experiences, even to the extent of convincing the user that their VR experience *IS reality*, tricking them into emptying financial accounts, etc.

"These problems lack easy answers but, if we can shift the conversation in the direction of systems of sustainable technological abundance, based upon forthcoming effectively unlimited supplies of energy, raw materials and organizing intelligence (i.e., software), these threats and pressures will significantly abate, and the 'angelic' possibilities are far more likely to flourish."

'An even deeper immersion into "social media," which means a further centralization of our culture, and the increasing power of the technological elite'

Russ White, infrastructure architect and internet pioneer, commented, "Whether the metaverse will play a major role in the lives of a large portion of the world's population by 2040 largely hinges on social and cultural realities rather than technical ones (although there is a technical component). There are two positive aspects of the 'metaverse.' First, it promises, like Web3, a return to the individual-creator origins of the Internet. Second, it promises disruption, which means the current large players may well be dethroned and replaced with a more decentralized group of smaller players. For the dream of the metaverse to come to life, however, we must all live in the same 'world.' The metaverse, like social media, requires a network effect. People want to talk to people; for that to happen, we must be on the same platform. Platforms are expensive and complex and rely on the infrastructure of the Internet to reach everyone. The money and technical expertise required to build the platform(s) on which the metaverse must run are in the hands of a small group of people – the same people who have built and control the current neurodigital media landscape.

"The most likely result, then, is that the metaverse turns out to be an even deeper immersion into 'social media,' which means a further centralization of our culture, and the increasing power of the technological elite. These trends, however, may have run their course. There may be a backlash against the technological elite forming. We may be currently living through the high tide of an authoritarian moment. It might be that the current globalist regime can hang onto power, but it doesn't look promising right now. Since the metaverse is a project of this technological elite, so it's hard to judge its future. It might be that the global economy has reached a sort of tipping point, and we cannot restore the ideas of widespread ownership and decentralized control. The difficulty of building and maintaining these technologies is also a factor.

"There is an illusion of control by the 'smartest and brightest' in our current culture. From the COVID-19 pandemic to building the platforms that run our daily lives, people have largely turned control over to experts – people with specialized training and experience. The failure of these experts, however, to keep their promises in a purely technical way is becoming obvious to large segments of the population. In the technology world, specifically, security and privacy are becoming huge issues. The personal information of hundreds of millions of people is exposed every year. DDoS [distributed denial of service attacks] are on the rise. Cars are being bricked because of mistakes in a radio broadcast. Large providers are experiencing multiday outages. Each time there is a large-scale outage, each time people's privacy is violated, each time a prediction about the future (on which policy is based) fails, the confidence in 'the elite' slips a little.

"Will trust erode to the point that large masses of people reject the metaverse outright? It seems like the more likely situation is the metaverse catches on with some classes of people, but not with the large mass of humanity. The metaverse will have an impact – much like the gamer's world does today – on some significant portion of the population. But it won't be used by 'everyone' in 2040. Its influence will be limited – closer to the parallel universe of Twitter and Facebook than 'the real world en masse.'"

The metaverses will be stationary, separate, task-related and simulated

Glenn Edens, Internet Hall of Fame member and professor of practice at the School of Global Management at Arizona State University, wrote, "The metaverse in prototype form has existed for a while now, first as 3D spaces mapped onto 2D spaces (Second Life, Minecraft, Roblox, myriad blockbuster games, etc.) and now moving to simulations of immersive spaces using 3D projection. Although, at present these 3D spaces are implemented very crudely using head-and-body-position tracking, localized displays (head-mounted stereoscopic such as Oculus, HTC, etc.) or glasses (Google Glass, Microsoft HoloLens, etc.), or room-based projections (Avalon Holographic, Looking Glass, etc.) – it's all very crude. These implementations all limit the metaverse to specialized viewing spaces and highly constructed experiences, not entirely unlike a home theater

system or even a good hi-fidelity stereo system where you have to 'sit in the right place' to get the full effect. (Of course, wireless headphones and spatial audio are a solution in the audio-only realm.) Looking at the historically slow progress of this field, we should ask four questions:

- Will the metaverse be portable (i.e., mobile) or relatively stationary?
- Will the metaverse be a separate space in our lives or integrated into it?
- Will the metaverse be pervasive or task-related?
- Will the metaverse experiences really be social, with all the nuances, or will it be a crude simulation, slightly better than online today?

"My bet is by 2040 we'll be stationary (you'll have to 'sit in the right place'), it will be a separate space one intentionally visits, it will be task-related, and it will still be a simulation of true social interaction, only slightly better than Zoom is today, for example. You will 'go in' for work or play or health care or socializing and you will 'come out' when you are done or need a break.

"The first challenge to implementing the 2040 vision is to create a set of viewing tools that are comfortable and natural to wear, that allow freedom of movement and enhance activities rather than require a dedication to the activities (i.e., if one is passionate about their VR gaming, they are willing to put up with the discomfort and clunkiness of a head-mounted display). This is proving to be a technical challenge, so far.

"The next challenge to implement the 2040 vision is tackling standards, architecture and governance (the three pillars of any platform). Just how will these unfold? The Internet is compelling since no one company owns it – TCP/IP, UDP, DNS, etc. – are standards, along with standard physical equipment created to implement those standards (routers, switches, multiplexors, etc.), that allow billions of devices to interconnect and appear to work together.

"If, when and how will we get to a set of standards, architecture and governance to create a single metaverse is key, or will we have thousands of individual metaverses, or should it be metaversi :-)? Of course, today we all understand the Internet is a geographically fragmented global network with significant local control, however it still appears largely as a global agora.

"Technically, the viewing hardware that will drive the experience is the problem. Let's be honest, for the average person the user interfaces we have today are horrific. I am certain we will have the software platforms, authoring tools, algorithms, computation resources, storage and communications bandwidth necessary to create viable metaverse experiences. I'd predict that many (if not most) visitors to the metaverse will see the 3D world mapped to a 2D device (Second Life got a lot right, it was just way too early).

"Our current metaverse situation reminds of the early years, long ago, when bulletin boards (remember Fido?), Tymshare, The Well, Prodigy, CompuServe and America Online were individual, unique and competing visions of an online world ultimately subsumed by an improved set of standards, architecture and governance that is now called 'the Internet.' The safe bet is that individual economically-driven enterprises offering competing capabilities, experiences and visions of the future will continue to be the structure of the metaverse in 2040.

"The economic and technology forces favor task-driven multiple metaverses, enabled by continuing improvement in software, communications, computing and viewing equipment. These multi-metaverses will be run by many commercial enterprises, non-profits, educational institutions, research labs, government institutions and, hopefully, grass roots activists and citizens. You will decide what you want to do, where you will sit (or stand) and which metaverse to visit. The metaverse will be additive to our present-day online and computing experiences rather than replacing them.

"So, my best-guess answers to the primary questions are:

- **Will the metaverse be portable or relatively stationary?** Stationary – it will not be as pervasive as mobile devices and the web are today.
- **Will the metaverse be a separate space in our lives or integrated into it?** Separate – it will be an intentional decision to 'enter' and to 'leave.'
- **Will the metaverse be pervasive or task-related?** Task-related.
- **Will the metaverse experiences really be social, with all the nuances, or will it be a simulation of social experiences, slightly better than online today?** It will be a simulation, which will fall short of true presence or prana.

"Immersive experiences and environments have benefits: They can be more engaging; they can increase comprehension and communications; they can more effectively share complex information and details; they can compress time and space, reducing the effort of travel; they can improve task efficiencies (such as maintenance of complex equipment); they might improve education and health care outcomes; and they might increase access and diffusion of knowledge and experience. All of these factors should have real economic and societal benefits.

"The big question in my mind is as follows: Are these metaverse investments and engineering to create virtual spaces and mirror worlds a New World, or are they just the next evolution of user-interface and user-experience design? If it turns out to be just the latter, a lot of investors might be disappointed."

‘We need signposts, guardrails and rulebooks for distinguishing the metaverse from the biological universe’

Maggie Jackson, award-winning journalist and author of “Distracted: Reclaiming Our Focus in a World of Lost Attention,” said, “In thinking about the role that the metaverse might play in the future of humanity, we must separate the question of ‘what can we create?’ from the question of how our creations, now and in future, will influence humanity. We must ask, in other words, ‘What do we want from the metaverse?’ This is a caution that tech critics from Langdon Winner to Wendall Berry have wisely offered for decades. The choices we make today in terms of what kind of virtual/digital worlds we create and inhabit are critical. The very survival of humanity is at stake. My concerns are multifold. Despite falling far short of any kind of truly realistic simulation of life itself, the digital world already is taken for ‘real.’ Whether we are dealing with a caregiver robot or allowing ourselves to be transported by VR, humans are very willing to treat almost any digital experience as real. Any further improvements in the realism of the metaverse will make this more so.

“It’s important to keep in mind that however ‘real’ we deem the metaverse to be, it will not constitute the totality of our reality. At least for a long while, the physical, biological, nondigital reality remains and should be cherished. It would be a huge mistake to seek to subsume ‘non-virtual experience’ within ‘meta-experience.’ Nondigital realities are slower, more messy, more demanding, and so offer us exactly the kind of experiences and skills that are needed for deliberation, creativity, contemplation. If we invest ourselves too fully in a metaverse that seems to answer all our needs at the push of a button, that rewards instant gratification, that allows an easy escape from the difficulty of non-virtual life, we are narrowing ourselves in the moment and over time.

“At a time of great flux and increasingly complex systems-wide crises, we need more than ever to invest in the side of ourselves that can work with uncertainty, not fear it; that can push past the first, often-mistaken impression of a person or a problem; that can admit that we don’t fully know and can’t fully control the world, especially at a click. This is why, as we move forward in creating any metaverse, it is crucial that companies, citizens, inventors and users alike demand transparency in this realm on multiple levels. Both children and adults must know what is digital and what is not when entering the metaverse; this sounds like an obvious point, but it will be more crucial in coming years. One of the most heartening measures being seriously considered in ethical AI circles is this kind of transparency for caregiver and other assistive robots. We need signposts, guardrails and rulebooks for distinguishing the metaverse from the biological universe, and we need them quickly.”

A mirror world that will change our perception of place, space, time, presentation of ourselves and connection to reality

Barry Chudakov, founder and principal at Sertain Research, wrote, "Calling the metaverse 'the future of the internet' or 'the next internet battleground' is to miss (or dismiss) the logic of mirror worlds, recently promoted as the metaverse. Thinking that the metaverse will be another internet is like thinking the internet would be another kind of television. It's understandable that we might use a current reference to frame the future, but that frame is misleading. The metaverse is a worldwide mirror – a mirror world – which you will walk into with some version of yourself; a made-up world that purportedly is a replica of the real world. That mirror may be accurate or distorting, deliberately manipulated or scrupulously precise. And by 2040, looking into – and entering – that mirror will significantly change us and our perceptions. Writer Jia Tolentino called social media a *trick mirror*; imagine how much trickier a metaverse mirror will be where, in Kevin Kelly's words, 'everything will have a paired twin … all things and places will be machine-readable, subject to the power of algorithms.'

"David Gelernter, writing in his 1991 book, 'Mirror Worlds':

> '*People build microcosms to find topsight*. … The simplest way to get it … is to recreate a big scene in little. Then I can soar above it—tower over it; literally *see* the big picture.… Microcosms are satisfying because they give you the sense of comprehending *the whole thing* or understanding how the parts fit together and what it all means.'

"Today, investors and tech pundits are excited about the financial returns of this new technology incarnation. But the metaverse – whether as currently envisioned by Facebook/Meta, or as an evolution of mirror worlds – will be more than a branding bonanza, a new-world land grab. As Gelernter wrote years ago, the deeper, much more important value of the metaverse microcosm is how it helps us to understand – and hopefully improve – the world we live in; understand some aspect, or many aspects, of the pieces and parts the mirror world shows us; how they fit together and what that means.

"So, the first thing we need to consider is what a metaverse truly is; then the breadth and depth of the change a metaverse brings to us, our consciousness, our physical world. Indeed, advanced, immersive, 3D, online worlds have the potential to benefit all aspects of society, from education, health care and government to gaming, entertainment and the arts – positively affecting all social and civic life. If – and this *if* could not loom larger – if we examine, grapple with, come to understand and then regularly monitor the logic of the metaverse and our adapting to (entraining with) that logic.

"In the history of art, the advent of mirrors fundamentally changed painting, as David Hockney and others have described. Why? Because this seemingly benign technological advance led painters to more exactly *replicate* the world the mirror enabled them to see. In other words, looking in the mirror changed how they saw; and that changed how they thought. Replicating the world, presenting and re-presenting the world, seems to be as fundamental a human enterprise as building cities or making art. The metaverse represents an ultimate expression of that will to replicate.

"Replication changes how we see, and so what we tell ourselves about the world. For millennia humans told stories of how the world was: how it began (Genesis), how it would end (Revelation). And in our private lives, many of us did the best we could with what (little) we knew. Then came the Enlightenment, the rise of science and technology. What emerged, albeit slowly, was objective reality. Prior to the Enlightenment, objective reality was an undiscovered land. We take this for granted, at least in free societies, because we can access so many objective resources, from libraries and schools to government resources like the CDC [Centers for Disease Control and Prevention] or the Census Bureau. *We stopped making up the world when we started measuring it*. Via replication, the metaverse – mirror worlds – has the potential to be the finest measuring tool humans have ever created because it will be designed to exactly reproduce reality in multiple dimensions.

"Replication is a complete change of perspective. So, first, among a series of new demands such a remarkable technology as the metaverse makes upon our consciousness we must examine and come to understand *the logic of the metaverse*. The logic of the metaverse is the logic of the mirror, multiplied by the logic of immersion. Since mirror logic entails exaction – the desire to exactly reproduce what the mirror shows – and this exaction is fundamental to seeing the world more accurately, we will see that the product of exaction is facticity, the state of what is really going on. If you see exactly, you are seeing *what is* – and this leads you to see differently, engendering topsight and greater insight. This is a whole new story.

"As a digital representation of any- and everything in the world, the metaverse will be *a camera-ready venue*; everything in the physical world will be captured by innumerable cameras – 'pinpoint electric eyes that can be placed anywhere and everywhere' – to re-create reality. Our consensus physical reality will be translated into the mirror world. As everything and everyone will be on camera 24/7/365, we all become the Kardashians. Our workplace, our homes, public and private spaces will be reflected back to us in the mirror, creating reflection as broadcast. We will all become as transparent as windows. We will wonder: Have I become *a person of interest* to some tracking entity, since anyone, anywhere can see me?

"Such concerns will be countered by new mores and privacy boundaries that will naturally emerge. As the metaverse bulldozes boundaries and mirror-reflection becomes our first-line self-awareness, even the new selfie, the presentation of self – and almost anything else – in everyday life will be a presentation to cameras. For a car-manufacturing company or a shipper of goods and services with numerous warehouse and delivery protocols, the mirror world is a game-changing advance of remarkable dimensions. Mirroring enables and enhances many things, such as supply chain management, production efficiency, assembly line accuracy, etc. While at the human level ubiquitous cameras and mirrors create a host of moral, identity and privacy quandaries.

"Our identities and behaviors and thoughts and actions will adhere – as they always do when we use a new tool – to the logic of the metaverse. How will our identity evolve in the metaverse? Today, following the example of Second Life, a digital representation of ourselves in the metaverse is likely to be an avatar, a cartoon-like replica of ourselves. This self-representation or persona will not remain a cartoon. Selfies will morph in the metaverse to represent us more accurately, more beautifully or handsomely; they will change to become more congruent with our affiliations or view of the world. Do we understand how that self-presentation of our identities in the metaverse will alter our overall presentation of self, given the immersive logic of coming mirror worlds? Do we even understand that we need to know that logic in order not to be used by it as we use the metaverse? Again, Kevin Kelly writing in Wired describing mirror worlds: 'The great paradox is that the only way to understand how AR [or the metaverse] works is to build AR [or the metaverse] and test ourselves in it. It's weirdly recursive: The technology itself is the microscope needed to inspect the effects of the technology.'

"On a personal level the metaverse not only entails watching, surveillance and the thorny ground of self-presentation and self-obsession; it also embraces self-evaluation, the desire to fit in, to conform, to succeed, to be seen and heard. Considering exaction, there is a curious, recursive logic at play when humans use mirrors: the will to exactly represent, reproduce, capture and re-create changes us; when we use mirrors, our use is not passive. In painting, artists like Vermeer changed how we saw the world using a mirror to capture each detail on canvas. Camera and video capture images that not only spur memory, they *become memory*; they are the documentation of our lives, our encounters, our loves, our crimes. This is the logic we take with us as we build and enter the metaverse. When we see ourselves in the mirror – in that mirror world – we take our ambitions, insecurities, self-image and (often-breathless) prejudices with us into the mirror. How will we know what this means if the technology itself is the microscope needed to see the effects of the technology?

"We will rewrite laws and create new laws for infractions and crimes committed in the metaverse; we will debate and set new boundaries as the mirror follows us into our lives, our homes, our bedrooms.

"Of course, this presumes that the metaverse documentarians and builders are as scrupulous and accurate as Ken Burns, Doris Kearns Godwin, Walter Isaacson or Jon Meacham. And what will the soundtrack of the metaverse be? Will we hear the voices of Toni Morrison, Alice Walker, Hannah Arendt or Rebecca West? Because the very nature of immersive environments that purport to mirror reality means that *the mirror must accurately reflect the reality it purportedly represents*. We are currently having trouble sorting information from disinformation, news from propaganda, and we are only a step or two beyond newspapers and magazines. Remember, technologists built Facebook to make it stickier, Instagram to reward scrolling doom. What will happen when technologists build monetizing metaverse environments to make them more inviting, more believable – and then the power structure of the metaverse changes and some entity wants its users to believe untruths and distortions? Who will police this environment? What rules or laws will those digital overseers enforce? What integrities can we assume are guaranteed?

"By branding and promoting the metaverse, Zuckerberg and Meta are hoping to promote the monetizing of the metaverse. Meta wants companies and people, gamers and social media types, to fund development for the metaverse and to use the metaverse as a new venue for business, akin to opening up a splashy new shop in a mall (except malls are now so turn-of-the-century). Monetizing may be a laudable goal. After all, without an economic engine and ongoing support the metaverse would simply be another idea that technologists devised that never got off the ground. But the timing of the metaverse is spookily ironic. As we have despoiled the physical environment of our planet, vanished species and whole biospheres like the Amazon rain forest, polluted our air and oceans, melted our polar ice caps and poisoned our food systems, we build a metaverse which is not only a mirror of the real world, but another world altogether. Is the metaverse an attempt to redo the real world, create an alt world now that we have wrecked the one we inherited? Or can we use it to reinvent the world, see it more clearly, fix what has gone awry and build towards a freer, more equitable, balanced and holistic future?

"Further, when monetizing and market makers get involved, the goals and parameters of experience change. The metaverse will present a look-in-the-mirror challenge to our base assumptions of presence and value. As Kim Stanley Robinson wrote, 'We can't think in anything but economic terms, our ethics must be quantified and rated for the effects that our actions have on GDP. This is said to be the only thing people can agree on.' The metaverse will present its logic and value on its own terms. For example, consider how Decentraland, a metaverse venue, ignores the logic of everyday experience in the real world to promote its footprint – not in typical real-world terms, but via NFTs, a newer blockchain valuation with little or no market-value track record. Tokens.com co-founder and CEO Andrew Kiguel described Decentraland on a TV news broadcast as a different kind of NFT, or nonfungible token. NFTs represent a new way of creating and building value.

“Monetizing the metaverse will prioritize where money can be made. This is an obvious conclusion from looking at global industries, like pharmaceuticals and insurance. There is always a balance between serving customers and returning dividends and profits to shareholders. Initially the metaverse will prioritize land (the digital equivalent of a URL in our current website-based environment); entertainment, where existing brands and personalities and expand their reach and profits by finding new users to entertain; and the horde of followers who will see these trends and want to take their brand into the metaverse to present goods and services in a most modern way. That is given. Today, while anyone can buy virtual land on the Decentraland platform, metaversers have to use a form of digital currency called MANNA, which can be purchased only with bitcoin or ethereum cryptocurrency. Then, like going to a physical real estate office, they can go to the site to see what’s for sale. Parcels have been purchased already, but many are available secondhand. The price fluctuates just like real estate in the physical world.

- Who will monetize – and thereby prioritize – the urgency of climate change as the Amazon rainforest hurtles toward abrupt and irreversible devastation, in the face of the breadth of ocean pollution, vanishing biodiversity, expanding drought, receding shorelines, unmanageable storms and the increasing numbers of climate refugees who cross national borders in search of food and a better life?
- Who will monetize a way to combat misinformation and disinformation, fostered by growing communities of nativism and populism?
- Who will monetize factfulness, the Hans Rosling moniker for a fact-based understanding of basic issues like literacy, poverty, women’s and minority rights, wealth of nations, and the advance or decline of democracy?

“In other words, will the metaverse merely become another gold rush that attracts wealthy investors who want to make more money than they already have? Or is there a way to encourage investment while also creating clarity and focus around a fact-based assessment of the real world while looking to resolve large and pressing global issues that face humankind? After all, in a mirror of the world, like a telescope, we should be able to see and do something positive about things and issues we typically miss or ignore with the naked eye.

“The shift of many online activities into the metaverse, more fully immersive digital spaces and digital life will initially take place as a virtual meeting, for example a telehealth consult today. But it won’t stay there. Once we move more of our meetings and activities to the metaverse, this change will be like base conversion, or changing base in mathematics; like moving from designing the world according to biblical dictates to designing the world in ones and zeroes. This is effectively a new order, a new way of ordering things, environments, presence, identity – a reordering of ourselves.

"Fully immersive digital spaces will supplant social media. We need to consider and game-plan for the difference between immersion and online access. This is a different logic, a different way of showing up. If we show up as ourselves, given behaviors we can see today on TikTok and Instagram and Snap, we will not be content to leave ourselves as we are; we will immerse as an enhanced version of ourselves. Our eyebrows may be darker, our muscles and breasts bigger, our skin tone altered to achieve some social goal of inclusion or exclusivity. So, immersion is not like so-called real life, it is more like the teenagers who watch Tourette syndrome victims on TikTok or YouTube and copy or become more like that behavior. We will adapt to metaverse realities by assuming them as our own, which has attendant benefits.

"Consider also that you will spend an hour, or a series of hours, in an environment that is neither where you live nor where you work; it will be the new meta space where you live or work. You will adapt easily to work there because metaverse software will have been tested with people like you and there will be a consensus of amenities to make you comfortable in the digital plane of the *workaverse*. Yet we are, after all, bodies as the first substrate of our reality. Our sense of the ends of our bodies, our proprioception, will alter significantly as we transition from physical reality to metaverse logic and reality. Thus, the most profound thing I imagine that this shift of online activities into more fully immersive digital spaces will do is confound this proprioception. Where does our physical form end and the world begin? And which body do I want to show up in, anyway? This is not a small consideration. Our bodies and our relationship to our bodies will become more fluid, less rigid.

"As we 'jack into' the metaverse to become present there as ourselves, without the encumbrance or enhancements of our physical form, not only our presentation of self in everyday life will change – our sense of self will expand. We will feel we have multiple selves, and psychiatrists and counselors will be called in to help people cope with multiple-self syndrome.

"Wherever we are *here* will become a transport vehicle to *there*. We have seen this movie before, as gamers donned their headsets and stayed locked at their stations until they needed nourishment, had bathroom breaks, or even died.

"The metaverse, or mirror worlds, will fundamentally change human society by producing alternatives to commonplace reality. There will likely be multiple alts, multiple realities; we may well number them like dimensions in equations: reality^{1}, reality^{2}, etc. Human life has become more multidimensional with various technologies, starting with photography and television. Once the internet arrived, we had another *there* besides working in an office or a field to which we might go or retreat. But it was still two-dimensional, a screen, a picture of something in the real world. The metaverse, once it is fully developed, for many will effectively have the beats and depth of a real world; for some – especially those with a gripe or discontent with conventional reality – this

may be the *realer* world, or at least a reasonable alternative to houses, streets, stores, and buildings where you live and work. Humans have not had, or lived with, alts for long; we do not have traditions and protocols based on alts. We have not collectively, and barely individually, decided how to behave in alternate realities. Coming to that understanding, and then diving into it, will change human society as few things have before.

"First, our sense of place will undergo a profound transformation. In her book 'The Power of Place,' Winifred Gallagher describes how our surroundings shape our thoughts, emotions and actions. Place was once the village, the farm, the town square, the forest or ocean. We took place for granted because it was all we knew; all we could know. The home, the local bar or tavern, the school, the office – these were three-dimensional places, not placeholders; they were our concrete understanding of being *somewhere*.

"Our devices and screens have already changed our sense of place, of being here and there. Here used to be where I am, and there where you are. Now here and there are blended into digital environments, sites, apps, Zoom calls and Microsoft Teams gatherings. The metaverse will accelerate that perception on steroids. Whatever store you might like will have its metaverse locale, as most brands will. The act of going somewhere to try and buy, to see and shop, will be augmented, and to some degree replaced, by metaverse fun zones and shopping experiences. We will gain in terms of time and convenience; we will lose in terms of physical contact and unprogrammed encounters.

"Second, our sense of space will move from linear – point A to point B, so many miles away – to perceptual, to being 'jacked in.' With the metaverse, like wilderness or exotic animal species, place vanishes. With our current devices, it already is being eroded by time. Instantaneous connectivity (Japanese engineers have demonstrated a data transmission rate of 319 Terabits per second (Tb/s) through optical fibers) is a new dimension of time. High-speed connectivity catapults us out of place into the realm of infinite *now-ness*.

"As of this writing there are 5.232 billion Internet users in the world; 171 billion emails are being sent today; 522 million tweets sent today; 8,227 tweets are sent in 1 second and will be sent today each and every second. Being connected on a variety of devices enables us to ignore – even abandon – *place-ness* in favor of *now-ness*. As we do, our awareness of place and our place in it changes. While gaming environments provide alternate locales (we play there in our graphics-fueled imaginations yet *there* exists *here*), *now-ness* neuters place – vaulting us into the limbic realm of connectivity itself. As when gaming enthusiast Chen Rong-yu remained at his gaming console so long he expired, we come to disregard our physical place – even our physicality – to focus intently on being connected and on the experience that connectivity provides. *Here* is the world circumscribed by the metaverse: what comes here, what fits here, what captures my

attention here. *There* (formerly, place) is now an afterthought, a leftover, the remainder of hours when here has exhausted us.

"Third, with place altered, our sense of time will be compressed and distorted. This new time dimension will blithely appropriate artifacts from (any) place to furnish almost any featureless locale with the *appearance of place*. In other words, via the metaverse we will experience connectedness – not place – and that connectedness will exist only in time; place becomes thereby an artifact of connectedness. Speed hurtles us into time. This is not conventional time measured in o'clocks. It is the time of perpetual *here-ness*, endless *now-ness*. Time in that measure *becomes* place – re-places place with a ticking *nowscape* of messages, updates, sounds and swipes.

"Fourth, our presentation of self will undergo profound alternations. As Erving Goffman describes in 'The Presentation of Self in Everyday Life,' we cobble together a performance for the people we encounter and interact with daily. In the metaverse, there will be new cues, new traps and feints. We might be less worried about whether our hair is done right and more concerned with whether we bought the right metaverse outfit for the conference or occasion.

"Akin to Tristan Harris' *amplifiganda* (the newer version of propaganda that amplifies something to make people believe it), the metaverse will amplify our need to be immersed, to be an insider: in a situation, an environment, a conflict, a celebrity's house or a metaverse destination. Without this sense of immersion, we will feel we are not present, we don't fully understand or participate – just as today the internet and video take us inside people's lives, actions and bodies.

"The metaverse will change the daily lives of the connected particularly via our sense of location. Even today, since *there* is now anywhere, *there* is gone, except as a GPS coordinate. *There* is now *here*. Pix of some there on Twitter or Facebook are not *there*. You are never *there* anymore; you are only *here*. Even when you travel there, you morph it into here with one hipster post of how cool there is – but no one is there with you. We all join you here.

"Living *here* changes where we live, and the metaverse will only enhance that change. You see it today as people walk face-in-phone through life. They are not in the grocery store or on the avenue. They are un-placed. They are (soon we all will be?) re-placed. Time, as instant connectivity or metaverse immersion, eats our awareness of place. For most of human history, there was no alternative to place, just as there was no way to instantly connect with millions of others on a digitally networked platform. To be out of place was anathema; our places, both as roles and as physical locations, were fixed, defined by geography, norms and cultural institutions. This highlights how far our present state has removed us from our history: now-ness is blissfully ahistorical.

"The daily lives of the metaversians will become less connected to physical reality. Office buildings, the site of work, will no longer be the sole, or even the principal, place where work gets done. Nor will retail stores and malls be the principal place where goods are shopped, sold and bought. Of course, this happened already with COVID stay-at-home experiences, but the metaverse will accelerate that evolution. Connection used to mean how our social networks and experiences, personal and interpersonal, were tethered; with the advent of the metaverse, connection will simultaneously mean connected to the metaverse land, destinations, and experiences; and at the same time, it will denote diminished intimate, physical connectedness.

"Being connected will mean being immersed. Like the cyborgs in the movie 'Minority Report,' we will all be underwater, submerged in the metaverse substrate. This disconnection from physical reality will be at the heart of a contradiction that, hopefully, we will use to our advantage. As climate change accelerates, the metaverse can focus specifically on areas that need immediate attention or where strategies of containment or enhancement need tweaking. But there is little doubt of the irony: As our outside climate deteriorates, our interior digital world – the metaverse – will be expanding and attracting more capital.

"Immersion brings another distortion. Namely assessing the realness of a situation, a person, a feeling. There is little doubt that with advances in technology, the replication of five-sensory reality will enable being in the metaverse to be a construct as real as the so-called real world. Metaversarians will then wonder: Which do I find more real? Where I am in my physical life, or where I am in the metaverse? This will fill psychiatrists' and other caregivers' offices with confused and confounded patients, as *metaverse syndrome* becomes another kind of PTSD.

"A further distortion will be deliberate. Any mirror world can be manipulated to become distorted. The mirror world, the metaverse, can be intentionally manipulated to show disinformation, misinformation, or outright lies as a means of gaining control, cash, or raw power. As Peter Pomerantsev says in his book, 'This Is Not Propaganda: Adventures in the War Against Reality,' when information is a weapon every opinion is an act of war. For this reason, and for reasons attendant to this one, the metaverse will require a bill of integrities to ensure that what is presented as real is accurate, unbiased, undistorted, not impinged upon by forces that would seek to use the metaverse for nefarious means.

"Presence will be the key to how the daily lives of the connected are accessed, watched, streamed and tracked. With the advent of the metaverse, we will come to ask ourselves the strangest of questions: Where am I present? Cognizance of place demands that we are *present* in it; that we see a given locale as a unique combination of light, air, smells, sounds, people, experiences. Speed, as a dimension of time – imagine: 319 terabits per second – blurs presence. The faster we go, the less aware we are of, the less we actually live in, place. In this way, time severs us from place, making it

irrelevant. Reality is no longer where we are; it is how fast *there* becomes *here*. Already under considerable pressure from rogue dictators who bleed their countries of money and resources, international rule-based order will find itself under increasing pressure as the rules of the previous order meet the realities of the metaverse."

3. Two meta insights about the future of the metaverse

Two overarching themes emerged in respondents' answers as they contemplated the most likely fate of the metaverse and extended reality (XR) by 2040. The first: Augmented reality (AR) and mixed reality (MR) information layers that can be seamlessly implemented in real-world settings will be relatively widely embraced across societies by 2040 as a part of daily life, but all-immersive virtual reality (VR) will likely remain a niche domain mostly used for entertainment, meetings and virtual education and training. The second: Advances in XR seem most likely to be shaped by the well-heeled mega-technology companies that own, design and control today's public spaces of the internet. A share of these experts said they expect that this will amplify the already-difficult problems arising out of digital life circa 2022. They argued that human agency, human rights, personal safety and people's mental well-being are at stake, as metaverse services will further deepen the tracking of people's online activities, monetize their every move, exercise more influence and control over users' lives and employ more algorithmic techniques to stir their emotions and passions. This chapter covers experts' responses related to both of these themes.

Augmented- and mixed-reality applications will dominate over virtual reality advances

A notable share of these experts predicted that AR and MR information layers that can be easily implemented in real-world settings will be more widely embraced across societies by 2040 than VR. They predict that AR and MR tools will continually become more and more important in many millions more people's daily lives at work, home, school, health care settings, shopping and social engagements. Many said they expect that VR worlds will not have the same kind of utility in 2040, gaining ground only in the realms of entertainment, work and education/training. They pointed out that AR apps can be easily and seamlessly integrated into people's everyday lives via mobile devices as complements to and enhancers of the real world, bringing more and more data into people's real-world experiences. In contrast, they noted that today's vision of truly-immersive 3D VR includes use of sophisticated hardware such as goggles or special glasses and handheld haptic and gestural devices, and it requires a full immersion that leaves "the real world" behind.

Dmitri Williams, associate professor of technology and society at the University of Southern California, commented, "As much as I personally like elves and lasers, they are not the future of our daily life. Relationships, sex, friendship, work, commuting and community all are, and those are the things AR overlays will have real impacts on. The potential for AR is much larger than what will be found in fantasy- and entertainment-based platforms and pure VR. AR could augment our daily interactions, which absolutely will have massive social effects – many positive and negative at the same time. I think this is where our attention should be."

Mark R. Miller, a Ph.D. candidate who works in the Virtual Human Interaction Lab at Stanford University whose research examines social interaction and interpersonal communication in augmented and virtual reality, said, "If there is a hope for broad adoption of the metaverse, it is in augmented reality rather than virtual reality, where the border between the worlds is lower and daily use does not imply, as Marc Weiser says, 'excluding desks, offices, other people not wearing goggles and body suits, weather, grass, trees, walks, chance encounters and, in general, the infinite richness of the universe.' The driving factor for the adoption of other social media – the telephone, Facebook – has not been richness and depth but rather greater numbers of easy, low-intensity communications. This contrasts with the idea of the metaverse, which occupies as many senses as possible (fully immersive) and assumes synchronous rather than asynchronous communication."

David J. Krieger, director of the Institute for Communication and Leadership in Lucerne, Switzerland, commented, "What will become influential and integrated into many activities is mixed-reality or augmented-reality applications. Integrating digital information into real-world activities and thus extending reality rather than replacing it with an immersive 'second life' will have many advantages and effects in all areas of life including work, education, health care, etc. The immersive digital spaces of a metaverse sacrifice too much of reality, leave too much out of experience and thus 'cost' more than people will be willing to pay and offer less than they can get with augmented reality. I do not think that immersive digital spaces will become mainstream in any significant area of life, apart from gaming and entertainment, at any time in the near future."

Tim Bray, founder and principal at Textuality Services (previously at Amazon), said, "Why would I insulate myself from the wonders of the real world and the people around me when I can keep that and still have full access to the riches of the online life, carefully curated and layered onto whatever I see around me – or not, at my choice? The VR-flavored metaverse is interesting, but it will have peaked and started declining by 2040 because AR will have a much more profound impact and push VR back into a Twitch gaming niche."

Micah Altman, social and information scientist at MIT's Center for Research in Equitable and Open Scholarship, wrote, "Eyeglasses have been a successful technology since the 14th century. Today, VR gear is still much harder to use than a pair of glasses, perhaps in 20 years the weight, bulk, reliability, battery life, wireless connectivity and even the price may improve enough to make the ease of use of such equipment comparable to eyeglasses. At that point, shouldn't everyone have a pair of magic-tech specs? Highly-usable high-tech glasses may well become very popular in industrialized, well-resourced countries – but not primarily to use the metaverse. Instead, cheap and widespread magic-tech specs would have a lot of uses and benefits in augmenting reality or 'mixing' with it – the uses of these terms are fluid. This can be a great boon for entertainment – (Tamagotchi 11.0), expert work (surgery, auto maintenance) and in daily life (augmented facial-recognition could be great for those of us suffering face-blindness, or vision loss; maybe not-so-

great for those of us concerned with averting a surveillance society). Most of these uses do not require full immersion in a unified audiovisually-immersive virtual metaverse, nor are they improved by it."

Simeon Yates, director of the Centre for Digital Humanities and Social Science at the University of Liverpool, UK, said, "To function very efficiently in our interactions with digital devices we don't need a virtual representation of the world to drive around in. In fact, all prior attempts have failed for this reason (e.g., Second Life). What will likely be far more powerful than a 3D metaverse is the integration of computation into more and more devices – such that the real world is interactive in and of itself. This will be popular and featured physically in artifacts or in virtual overlays – even if the result could be, in some instances, as dystopian as the AR world imagined in Keiichi Matsuda's short film 'Hyper-Reality.' So, will we have some VR environments in 2040? Yes. Will they be all-encompassing? No. It's not like being online dominates all aspects of my life. I go hiking to be in real hills, I cycle to get fit and it's better if I do it in the local national park. I get more done working at home on Zoom, but boy, being on campus feels better. Of course, humans adapt, and kids brought up with VR and the metaverse may in fact love the 'Ready Player One' existence. So, it might become ubiquitous. But I actually think that, like much other tech, it will be the domain of the wealthier/elites if it has great value (access being limited and what goes on there being privileged – both in terms of wealth or 'private-law,' the meaning of privilege) – and/or the domain of those not so fortunate if it is a great route to control or exploitation (VR Mechanical Turk work, VR 'gig economy')."

Steve Sawyer, a professor of information studies at Syracuse University expert in sociotechnical systems, wrote, "The future is about a merged experience of physical and digital. By 2040 we'll have moved into a more-seamless augmented overlay of digital features on real experiences. The metaverse is centered on shifting attention away from physical realities."

Mark Johnson, a technology advisor, administrator and consultant, wrote, "People don't want to transact their daily business in artificial worlds. Instead, real life that is augmented with digital overlays will become increasingly useful; think more-immersive YouTube how-to videos."

Andrew Tutt, an expert in law and author of "An FDA for Algorithms," wrote, "Assuming the technological advances come about, the most likely metaverse to emerge will be a 'blended-reality' metaverse, in which the real world and a digital world are blended in various settings. We already see this to a very limited extent with the technology of today. During COVID, many restaurants replaced physical menus with QR codes that could be used to pull up a menu on a phone and then order from the menu on the phone. This will become even more seamless and virtualized. Every flat surface will have the potential to become a screen, every blank sheet of paper will have the

potential to become a printed document with virtual text overlayed, every empty room will have the potential to become a conference room with people not physically present in the room.

"I do not foresee, at least by 2040, a tremendous appetite for moving large swaths of physical life into a metaverse environment. Rather, I foresee that we will overlay a data-rich virtual world over the real world that augments the real world. Some examples of how this could work: Imagine running into a forgotten acquaintance at a party and being able to immediately and discretely find their name and other important information about them at the touch of a button; or being able to quickly and easily learn the make, model, price, and potentially even the owner of a car by taking a photo; or being able to identify and name a plant growing in a garden next to the street; or being able to virtually visit a museum, distant place or historical site; or being able to collaborate with friends and colleagues on projects across long distances in empty rooms where they are 'virtually' present with you.

"I say all of this as preface because I still regard this as a 'metaverse' and an important one. But it is not the 'shared 3D virtual world' that some envision when they talk about the metaverse. Although I can imagine there will be some such platforms (for example, possibly fully virtualized concert, karaoke or party venues) I think these will be more like what we already see today as discrete experiences within our larger real-world universe. A group of friends from all over the planet might go on a virtual safari together in a videogame in lieu of all traveling together to South Africa for a real-world safari, but that experience will be discrete (like buying a travel package) not integrated into a single unified virtual world."

Paul Brigner, head of U.S. policy and strategic advocacy at Electric Coin Company (which seeks to support technology that provides the public with access to a fair and open currency), responded, "Outside of gaming, my expectation is that AR and MR have the most potential for transformative change in society by 2040. I have doubts about Meta successfully driving the transition; rather, I think it is far more likely that Apple, Google and others will lead."

Kyle Rose, principal architect at Akamai Technologies, said, "Augmented reality? Yes. Virtual reality? No. I doubt people want to live in cyberspace, but I do believe that people will use AR devices to supplement the information they receive from their existing senses."

Richard Miller, CEO and managing director at Telematica, a technology and business strategy consultancy, wrote, "I have no doubts whatsoever that XR (VR, AR and a variety of designed-for-purpose uses of these technologies) will be very much a part of our society's business and consumer life. However, I also believe that the 'fully-immersive,' completely-contained mediation of VR will continue to be disturbing and problematic for end-users and it will, therefore, experience limited success when compared to augmented-reality technologies and services."

Robert Bell, co-founder of the Intelligent Community Forum, predicted, "Augmented reality will be incredibly useful in a huge range of businesses, industrial operations, medicine, science and so on. This will involve wearing a pair of glasses that unobtrusively augments what you see, hear and touch with data *when the user wants it*. There are many dystopian possibilities as well, which many books and films have explored. But there is strong core value to hands-free access to useful data that will, I believe, translate into strong impact."

Pete Cranston, an independent communications networks consultant based in Oxford, UK, wrote, "Mobile phones are where partial immersion is more easily achieved without needing to be fully immersed. Many will find that a more-attractive option."

Andrew Nachison, founder of WeMedia, executive and creative analyst, commented, "I'm not convinced fully virtual experiences will replace 'real' ones for most people. The transformation of 'real' life will be more like what today we call augmented reality – layers of information and interaction overlaid on real-world environments. That implies glasses or some kind of visual device and I have no clue which hardware approaches will become dominant. Even future smartphones could do the job and be transformational. This additional layer of pervasive data will change our experience of the real world. The answers to routine curiosities will be delivered without the need to type or speak a search on Google. Names, birthdays and important notes about friends – or anyone – might float over them. Maps and directions, which are already pretty fantastic, will be embedded in your live, real-world view. Those kinds of information utilities will change our routine experiences, and some of those changes may transform how we interact with each other – like never again forgetting someone's name and background when you bump into them. I can also imagine the malicious and dark aspects of that world. Doxxing, shaming and tracking individuals might become truly terrifying. Yet I do expect 'virtual' will be commonplace."

Grégory Maubon, a longtime independent consultant in the augmented-reality field and digital coordinator and AI project leader at HCS Pharma, said, "In everyday life, AR will be more useful than VR because it will offer us a simple way to find the right information at the right time. I hope we will get usable smart glasses by this time."

James A. Danowski, president at Communication and Technology Sciences, predicted VR interest will not outmatch the appeal of real-world digital overlays, writing, "Although many activities will occur in the play space of VR, the non-play digital world will be dominant. The recent metaverse chatter is due to Facebook's last try to leap over its stagnant user base and the declining importance of social media in people's lives. This is a temporary deviation. The metaverse is a longshot gamble tied to the rise in social distancing due to COVID. There will be work applications in specialized areas for it, but the initial surge in VR will involve platforms recouping their investments in the metaverse and creating the pay-to-play environment with

NFTs. Users are unlikely to persist in the metaverse unless they can make money there in a digital currency. The secondary economic activity could lead to initial growth, but the metaverse will stagnate after the early innovators and adopters have left."

An internet pioneer and longtime network executive wrote, "Most interaction with social media and the Internet today is not immersive, but rather in tandem with or complimentary to real-world interaction. Some people may desire to be in a fully-immersive experience in their homes, but in public both safety and practical concerns strongly suggested that virtual reality participation will instead be augmented reality – if AR catches on to a greater degree at all. Augmented reality is much-touted but presumes interception and modification of at least visual and likely audio input for the user. As experiences with Google Glass and Facebook eyewear have shown, users don't desire such devices to be continually attached to themselves – they value the ability to turn off and put away their mobile devices as much as they value the ability to turn them on. Important lessons are available in the wearable watch area – users will continuously wear the Internet-connected watch but only if it doesn't get in the way of the rest of their real-world life. While refinements in wearable goggles are expected, no one envisions goggles that are so innocuous that the wearer and their friends forget that they are wearing them – yet that's the implied requirement for 'full-immersion' digital life."

The next-generation networked-knowledge ecosystem can be built in ways that better serve people than the current web does

The move into extended reality is a shift from today's Web 2.0 (the social web) to what many are calling Web3 (the XR web-plus). In the early years of the web in the 1990s, before it was commercialized, individuals generally controlled their online interactions. Since the commercialization of online spaces, large technology companies offering centralized platforms were able to monetize the public's input and interactions online. This has raised significant issues tied to privacy, personal security and political ploys to polarize the public, and it has raised concerns due to the prevalence of hate speech, harassment, bias and misinformation. For more than a decade, many internet leaders (including web innovator Tim Berners-Lee) have been trying to find new approaches to "decentralize" online activities once again. Yet, most of what the internet's billions of users do online takes place in centralized spaces under the control of mega companies and authoritarian governments.

A share of the experts who participated in this canvassing said *now* is the time to address these societal issues – before the metaverse is more fully built. They said the more engaging and fully-immersive XR world of the near future will foster rising complexities. They expect that XR spaces built by commercial interests or authoritarian governments will implement AI to exploit individuals in ways that threaten their basic agency and their well-being. They argued there are

problems implicit in allowing the principles of market capitalism and political authoritarianism to be key factors in the design and control of the world's networked-knowledge and communications ecosystem. Some recommended new laws and regulations should protect vulnerable populations from being exploited physically and financially, prevent large tech companies from gaining monopoly power, preserve user privacy, give individuals control of their data and encourage decentralized systems and services.

Gina Neff, professor and director of the Minderoo Centre for Technology and Democracy at the University of Cambridge, predicted, "The dark side of the metaverse is that the types of technologies coming together to make it work as a whole will monetize even more of our social private lives, will create new types of surveillance, chip away at regulatory and state powers for ensuring equity, fairness and protection for citizens and cede more power to the corporations that are already the most powerful ones in human history. Right now we are seeing the redrafting of fundamental social contracts about trust and democracy. Powerful narratives about life in the metaverse combine new ways of experiencing social connection with new forms of 'trustless trust' from the hundreds of little contracts and exchanges that we'll be asked to enter into every day. Where is the public sphere, where is the social center, in a world that we are told we can remake and reconfigure at whim? There will be so many wonderful positives, to be sure."

Brian Haberman, network architect and Internet Society board member, the principal staff research scientist at the Johns Hopkins University Applied Physics Laboratory, predicted, "While the technology to instantiate the metaverse is rapidly emerging, there is little work being done to address the more challenging problems that will hinder widespread adoption of the metaverse. The existing social media platforms clearly demonstrate the challenges to such immersive technologies adopted on a broad scale. Those challenges include complex topics such as trust, attribution, data provenance, identity management and personal information management. Fully-immersive digital life will cause an exacerbation of the current ills of social media platforms (disinformation, bullying, spying, etc.). The underlying XR technologies will evolve in niche markets and make dramatic contributions. Technologies that require massive computational resources will be re-thought, as more industries and users understand their massive environmental impact."

Alexander B. Howard, director of the Digital Democracy Project, wrote, "As with rapidly emerging systems that are currently being used as virtual concentration camps by authoritarians in modern surveillance states, it is possible a metaverse could empower authoritarians to track, control and coerce billions of humans in silicon prisons ringed by invisible barbed wire, governed by opaque algorithmic regulation and vast artificial intelligences. When combined, all of these devices, our activity on them, the sensors in them and the urban environments around us and above us will make up an embodied Internet in which we leave digital exhaust with each action or

movement. As with smartphones and the data collection practices of 2022, people won't need to be wearing goggles, smart glasses or other wearable computers to be affected by adding more Internet-connected cameras, sensors and autonomous devices to public and private spaces. This will put a premium on nations and states enacting data laws that protect children, consumers, citizens and seniors as they move through these sensorized spaces. While dystopian outcomes aren't assured, there is gathering risk that failures in collective action will allow bad actors' exploits (e.g., today's ransomware and spear phishing) to become even more pernicious as more and more human activity is tracked as we navigate a planet overlaid with a metaverse."

A principal architect whose focus is cybersecurity said, "As the metaverse becomes more connected with the real world, it can cause harm to the real world, and I do not believe we currently have the necessary safeguards and the architecture to address that. Given the advances in internet technology (speed, latency, availability) along with the advances in AR/VR and AI/ML [artificial intelligence and machine learning] techniques, it is a natural progression for the virtual world to be advanced to allow us to explore and express our need for communication, need for information and our need for attention. This is likely *not* going to be an all-happy-go-lucky path. We have to evaluate and address the moral and ethical consequences along the way. We need to understand the implications on privacy and security. Currently we are driven more by profits and big corporations which can have a very damaging effect. However, I remain cautiously optimistic that we will be able to evolve this metaverse as a collective that serves the greater good."

Steve Wilson, founder at Lockstep Consulting and a VP and principal analyst at Constellation Research focused on digital identity and privacy, wrote, "The metaverse is probably not something that should be rushed by commercial interests. It should be allowed to evolve ecologically. Social media, digital spaces, digital reach and immediacy can be wondrous. We need to triangulate the best of human organisation and digital technology to synthesise a true VR ecosystem."

James Hochschwender, futures strategist with Expansion Consulting, said, "Misuse of metaverses by companies like Facebook (Meta) could undermine independent thinking and create a form of slavery to that company's economic and cultural ecosystem. It will be the same as we have seen with social media, the bad folks will take advantage of the less astute and will incorporate misinformation to serve their own controlling purposes. It will need global standards, regulation and supervision at a scale that does not yet exist on Earth if it is to avoid being more destructive to society than constructive. Metaverses could take over many people's lives to the extent that they would no longer be living in the physical world but would spend most of their lives entirely in the metaverses of their choosing. That could result in desocialization of large numbers of people and the breakdown of the entire fabric of society."

A co-leader of a major U.S.-government-convened AI policy group said, "I have no doubt the technology will be more immersive and that digital life will continue to encroach upon our physical lives. Will it create more positives or more negatives? Given the evidence that the current internet environment is enabling both global nationalism and a further concentration of wealth at the top, and understanding the added psychological influence and power of being more immersed in a 'metaverse,' it is hard to believe that its positives will outweigh the negatives."

Leah Lievrouw, professor of information studies at UCLA, wrote, "The whole metaverse prospect is being presented in breathless, escapist terms as a novel and entertaining way to avoid or overcome the badness of reality – perhaps to appeal to those feeling worn down and adrift in the context of the COVID-19 pandemic, the resurgence of violent authoritarian and nationalist politics and declining faith in institutions or one another. This promotional tack may reflect the enduring digital utopianism of the extraordinarily wealthy and influential 'tech titans,' investors and walled-garden models that have come to dominate most people's experience and understanding of the internet and its possibilities (from the same folks who are presenting space flight and planetary colonization as the ultimate escape for the select few – oy). It's very interesting to me that at this moment – just as social media, search, online entertainment and the market power of a handful of titanic firms are facing serious public criticism and backlash for the social, political and psychological harms they have produced – the metaverse idea is somewhat cynically being promoted as the 'next' internet and thus the solution to all its current problems. But if the owners and users and infrastructure and devices are all securely entrenched, what they're really offering is more of the same, only more so."

Alex Halavais, associate professor of Data & Society at Arizona State University and past president of the Association of Internet Researchers, wrote, "The negative end of this evolution is already very clear: Meta's attempt to wall the metaverse garden is dangerous. There should be a moonshot effort at building the Wikipedia of metaverses – a platform in which the users have a significant say in how things are built, one that remains solid enough to predictably support interactions. Platforms that infect these spaces with advertising or make them only available to those most able to play are challenges."

Andy Opel, professor of communications at Florida State University, wrote, "While the spectres of corporate control, data mining, privacy fears and predatory capitalism haunt these emerging spaces, just as they continue to haunt much of our daily lives outside the metaverse, the power and potential of these tools is far too profound to reject them because of their corporate entanglements. These digital spaces need to become another front in the ongoing struggle to democratize our media systems, dismantle monopolistic control and close the digital divide. Bell telephone lasted from 1877 to 1983 and was eventually broken up, sparking the explosion of the digital age. Long-distance phone communication changed the world, and immersive media tools

are going to be equally revolutionary in their impacts. We shouldn't wait 100 years to confront, question and demand to change the systems of enclosure and control that shut out audiences and limit creativity and innovation."

A director of applied science whose work focuses on identifying and mitigating problems arising from technological change said, "The largest concern for our future is that the platform companies that have the clout to build these systems, that have not yet shown the ability to responsibly run platforms with much less potential influence on society seem to believe they can responsibly run metaverse platforms. This is almost certainly not true, and much harm will result if this is allowed to occur. Policymakers, other entities in the market and the public need to be proactive to prevent this."

A professor of public policy at a major U.S. technological university said, "The metaverse may be 'more fully immersive' and expertly 'refined' by 2040, but it will be in a way that is designed to extract information and dollars from those who enter. To some, that might be a 'well-functioning aspect of daily life' but it offers enormous unchecked power to those who control it. The promoters of the metaverse are hardly disguising their motives, and at this point there is no constraint on what devices (behavioral, cognitive, even coercive, but certainly not involving truly informed consent) will be used to exploit their innocent participants. There's no reason to expect that legislative or judicial institutions will understand these systems, react to them quickly, or stand up to the financial pressures that will accompany this new way to profit from this fundamental alteration in the way people interact with each other and real reality."

Terri Horton, founder and CEO at FuturePath LLC, said, "Theoretically, the metaverse of the future can enable a more inclusive and safe work environment, support work-life harmony, meaningful work, drive collaboration beyond traditional boundaries and be a catalyst for innovation. However, if it is not carefully crafted, organizations risk creating work environments in the metaverse that exacerbate societal issues and biases that exist in the physical world. Issues of corporate surveillance, access to worker biodata, privacy, data security, mental health impacts, identity, and reputation theft can have overwhelmingly adverse effects on organizations, workers and society. Therefore, these significant vulnerabilities must be addressed as the future of work continues to unfold through 2040."

An expert on the evolution of algorithms predicted, "Most concerning are the geopolitical challenges currently becoming increasingly visible in the ways in which states are increasingly assertive in their control and surveillance of online spaces and populations. Any further immersion into online spaces heightens the potential for the extension of this control and the expansion of alternate forms of currency/exchange creates additional pressures on state systems and control."

Some respondents do not see it to be highly likely that anything can be done about these problems

John Sniadowski, a systems architect based in the United Kingdom, responded, "The opaque nature of massive-scale international corporations such as Google, Meta (Facebook) and Amazon makes it deliberately difficult for governments and politicians to legislate overarching controls to rein in and allow better scrutiny of how they manipulate markets to their often-exclusive benefit and to the detriment of competition and society as a whole. Most of the negative aspects of social media technologies are being used now by governments to create surveillance systems that have no parallel in human history. This is happening without citizen consent or even awareness in many instances. It is driven by international corporations peddling technologies to oppressive governments to improve their corporate market profits to acquit the fiduciary requirements imposed by law to maximise their market values.

"Every technology, from the most simple to the vastly complex, has light and dark uses. The more complex the technology, the greater the potential for nefarious uses in warfare, social discontent and the development of citizen-control systems that are even more opaque than those created by the very corporations that help develop them. This is a huge inhibitor to the development of a fair and equal metaverse that truly enriches the daily lives of citizens and contributes unequally to the dark side use paradigm. As the metaverse is developed and deployed, there will be inevitable distortions and warping of use cases because this is in the interests of oppressive governments and other organizations to bend technologies to their nefarious uses. Legislation will always be in a retrofit defensive mode unable to move fast enough to keep on top of the negative aspects of technology use. The inability of political structures to avoid the soundbite that 'one size fixes all ills' will inevitably drive the metaverse into areas of oppression rather than to the enhancement of the human experience."

There has been some pushback against 2021-2022 moves by venture capitalists and entrepreneurs who have created a "gold rush" by claiming that Web3 will be decentralized and then touting the riches to be found in the metaverse combined with blockchain, cryptocurrencies and non-fungible tokens (NFTs).

Steve Wilson, founder at Lockstep Consulting, explained, "Decentralisation is a catchphrase that needs to be unpacked. Some things can't be easily or usefully decentralised; re-centralisation is a forceful natural state of affairs which is seen time and time again in this space. See the emergence of Airbnb brokers, private blockchains such as Hyperledger and Corda dominating in enterprise, crypto wallet platforms that are hugely popular and antagonistic to ideals – see Moxie Marlinspike's analysis of Web3. To maintain a decentralised state requires energy (work) for all sorts of reasons – thermodynamic, economic, ecological, sociological. Any system that insists on

being decentralised has to have an extraordinarily good rationale to make the work worthwhile and it needs to be very focussed on exactly what is being decentralised in order to make efficient use of the enormous energy expenditure.

"NFTs are illustrative here: The idea of imparting originality on digital artifacts is extremely strategic, almost the holy grail, but the way that NFTs do it is political. Digital signatures curated by a central administrator are much more efficient than NFTs but not so palatable because they tie all participants into an administered scheme. If a metaverse is implemented on a platform, then there will be central administrators behind the green curtain. Ultra-decentralisation in the circumstances is just a party trick. A key piece is going to be digital originality. NFTs deliver originality through crowdsourcing but like cryptocurrency, they don't work in a vacuum, and there is way too much magical thinking around how NFTs can guarantee fairness for makers and authors. We can provide proof of originality in other ways, albeit centrally administered ways, but that's just how digital civilization is going to roll."

Grégory Maubon, a longtime independent consultant in the augmented-reality field and digital coordinator and AI project leader at HCS Pharma, wrote, "I have doubts about promises of seeing decentralization in virtual worlds because we heard the same song at the introduction of the original web and Web 2.0. The evolution of devices will simplify the access to digital immersive worlds. Around 2040 it will be normal to use virtual places as if you are operating in real ones."

Christine Boese, an independent scholar, wrote, "Patterns are repeating. First came the walled gardens of the early Internet: CompuServ, America Online and Prodigy. Then came the biggest tech companies (formerly known as FAANG – an acronym for Facebook, Amazon, Apple, Netflix, Google). These entities own the platform, host the service, control the search results. Some say that Web3 will be a new distributed model, powered by blockchain, NFTs and the power of cryptocurrency mining. They say the ledger makes it distributed, sends it everywhere with perfect fidelity. That's not the pattern I see, however. The engineers who built the early Internet created a distributed infrastructure using packets, uniform resource locators, open-code, shared modular components, crawlable pages. It was Lo-Tek, as science fiction author William Gibson might say, but Lo-Tek with *distributed* power. Sir Tim Berners-Lee released his link protocols into the wild for free (just as Salk released the polio vaccine). Almost immediately, entrepreneurs tried to build centralized, owned bits on top of it, to monetize it. But they couldn't figure out how to put a meter on the frictionless Internet. However, the deep infrastructure of Web3 has monopoly capitalism in its DNA. The blockchain ledger promises opportunities to consolidate wealth and remove it from the oversight of governments and currency regulators. But this consolidation is the opposite of distribution. A true distributed model grows a new or bigger pie. A consolidation model keeps cutting up and trading pieces of the same pie. NFTs promise to honor ownership, fencing the Wild West while letting the bison roam free. You'll just get charged every time the herd wanders over

some invisible fence. Blockchain inventors claim they can distribute these objects while consolidating money for speculators, like betting on stocks or commodity futures. They are also gambling with a high environmental carbon cost for the electricity to create and maintain it. Killing one environment to build another, a virtual black market e-commerce system, hidden from oversight, regulation and taxes? They'll build immersive environments and interactive physical or virtual objects because they're betting values will accrue.

"Due to aggressive promotion, immersive platforms may gain a following, but I don't believe they'll have staying power to keep users in a kind of thrall except through dark UX [user experience] patterns or manipulative AI. Gambling interfaces already do this, but the blockchain system itself is a big casino, a Ponzi bet. Here is why: Blockchain items are distributed with ledgers attached, but the ledgers themselves are not truly nonlinear, distributed things. Rather, their central record can be added to, but not changed. The blockchain ledgers move around like nonlinear, roaming bison, but they don't multiply, clone, branch or merge back. Our roaming blockchain bison gets heavier and heavier, picking up burrs, tumbleweeds, mud from the wallow. We like the permanence of its record, its chain of hyper-extended linearity, preserving a single authoritative record over time.

"But centralization is the opposite of a distributed system. In this world, the past is fixed, recorded. Only the future can change. Revisionist history is not permitted. The recorded past holds all authority – the deep mythos of the blockchain – which is conservative by design. One thing we know, if not from Marshall McLuhan, then from our own experience, is that the medium, its deepest structures and their biases, blind spots and prejudices, shape us as much, if not more, than we shape them. That's why we can't let AI agents run wild, learning our broader culture. The agents learn too well, hold too perfect a mirror to society, and within a short period, they turn fascist, authoritarian, unyielding and abusive. Because that is also who we are. Could a blockchain metaverse carry the day? Yes. Didn't Alexander Hamilton's central bank defeat the distributed democratic ideal proposed by Thomas Jefferson?

"If the builders of Web3 believe a more-immersive Second Life will become compelling because stores and commerce are there, then I have a dead mall to sell them. More likely, they will return us to 1999, full of hope and hype, and then suddenly decide returns haven't reached projected levels, and values will deflate, as pyramid schemes often do."

Paul Brigner, head of U.S. policy and strategic advocacy at Electric Coin Company (which seeks to support technology that provides the public with access to a fair and open currency), responded, "I do not anticipate the move to XR will initially align with a transition to a blockchain-based Web3 ecosystem. Even though many people link XR and Web3, I believe XR is relatively more mature and will become mainstream much sooner via traditional centralized architectures. I see

the positives and negatives of this transition to mirror what we have experienced in the transition to connected lives generally, although perhaps magnified."

Ellery Roberts Biddle, projects director at Ranking Digital Rights, wrote, "Early development of the web and other networked technologies in the late 1990s and early 2000s was cloaked in techno-utopianism, the idea that these technologies would benefit the whole of society by creating a newly open and somehow more level playing field where people would be more free to express ideas, form communities and movements, and build businesses. Most of the people who imagined these benefits were white, male, living in cosmopolitan areas in the industrialized West, and often affiliated with elite universities. Twenty years on, it is not hard to see what actually happened here – this utopianism was indeed little more than a cloak. From these elite circles emerged some of the world's most powerful technology companies that have fundamentally altered the path of the internet and its development and truly made it a place where profits (and algorithms driven by profit incentives) rule the day."

An information science professional said, "The metaverse will not be more fully developed. That would require that people will want to trust more of their lives to big tech companies and to trust big tech companies. It also presumes that people will want to live in a less-tactile world."

Those who fear that corporate and government interests will continue to control the evolution of these systems as they have been the past few decades believe that AI-XR online evolution accentuate or even expand upon current system deficiencies, creating more challenges and limiting human rights and autonomy.

An anonymous respondent shared an excerpt from an essay by journalist Tom Valovic titled "Why We Should Reject Mark Zuckerberg's Dehumanizing Vision of a 'Metaverse'":

"The Internet is now increasingly about social control, technology dependence for profit purposes, surveillance and sometimes cynical corporate manipulation of hearts and minds. … These issues require critical-thinking skills for deciding what kind of world we want to live in since the mass of humanity is not being asked if these invasive technologies are acceptable or desirable. We need to somehow, through the seemingly unstoppable momentum of runaway technology, find a way to return to a way of living that retains the use of limited and intelligent technology where appropriate without allowing it to run roughshod over the core values of humanity we still cherish.

"Facebook's new moniker, Meta, is shorthand for metaverse, a major new technology and culture shift that Big Tech is trying to force feed anyone who uses the Internet. In the words of a friend who works for another Big Tech giant, this new direction is 'terrifying.' … This is a seismic shift. It is planned to become the dominant paradigm for human communications, transitioning our

business, social and cultural life from physical to online environments. … This radical change in how we live our lives is something that no one will get to vote on, as a new and unprecedented kind of technocratic governance begins to replace many of the functions of traditional government and, I believe, even democracy itself. [This is] nothing less than an attempt to fabricate an alternate 'reality' other than the physical one we now inhabit. This new reality can be accessed, of course, only by paying customers who are in a position to afford and understand it. It is a technology designed by elites and for elites and implicitly leaves behind much of humanity in its wake. …

"As more and more corporate control was levied, Internet-based technology began to intrude subtly on our personal spaces in exchange for the Faustian bargain of a new set of technological 'conveniences.' Now Big Tech is aiming to not only extend this intrusion with technologies like Alexa but to make life impossible to live without it … hence the notion of a metaverse. Working in conjunction with elites and Big Tech social engineers, this next big initiative will be even more intrusive and dehumanizing and is being carried out under the rubric of a specious philosophy called transhumanism – a set of values that has declared our own humanity as deficient and in need of technological enhancement."

Llewellyn Kriel, CEO of TopEditor International, a media services company based in Johannesburg, South Africa, said, "As with most aspects of XR, the metaverse is doomed in utero because it fundamentally threatens basic human nature. As long as amoral bots and related unresponsive, antisocial AI define the metaverse, it should be opposed in every way possible. It remains, no matter how camouflaged, sweetened and propagandised, a threat to humankind."

An expert in AI who leads a foundation dedicated to the support and evolution of open-source knowledge commented, "The metaverse, to me, feels like rampant capitalism trying to run even further amok. Cool, but amok. Facebook has already proved you can create a wildly popular social network that is both dystopic and valuable; it should be a walk in the park to seduce a half billion people to switch to the VR. You want to know how it will change lives? What's the point? Well, Facebook has already shown what. It can be both dystopic and valuable. Some people will use it to exploit others. Others, like my wife, will use it for just gabbing with friends the world over. Sure, connecting with friends is seriously cool; meanwhile, there are wars going on, dictators rising, and, oh, did I mention that there is solid evidence that the climate is changing and not for the better?"

Brooke Foucault Welles, associate professor of communication at Northeastern University, said, "I'm concerned that we're already replicating the exclusionary and biased practices that trouble today's social web. Corporations are crowding out or buying up bespoke metaverse platforms. Experiences beloved by women, children, people of color, people with disabilities (and,

really, anyone who is not a cisgender White man) are being dismissed as not 'serious' or 'important' metaverses. And centralized corporate control places an emphasis on expensive equipment and a narrow set of experiences that prioritize competition, consumerism and productivity. This will almost certainly ensure the metaverse(s) of 2040 are not diverse, inclusive or accessible. That's a real shame, because there is so much potential for metaverses to imagine and embody the full range and joy of human experience in ways we have missed in prior technological changes."

Cathy Cavanaugh, chief technology officer at the University of Florida Lastinger Center for Learning, said, "We have learned that when IT companies align with governments and businesses to develop and adopt a technology, consumers at first gain the option of using the new technology and then often lose the option to *quit* using the new technology as it replaces older technology. In 2022, there is enough momentum, excitement and funding behind XR that this adoption and narrowing of choices seems likely. What's unclear is in what spaces and aspects of life the adoption and narrowing is most likely. Certainly, in entertainment, including sport and the arts and media, as well as personal communication and commerce among wealthier consumers within this decade. Whether adoption and narrowing of XR in government, work, research and education reaches tipping points is unclear due to the current expense and complexity of XR technology. As with previous communication technology, XR could increase human presence in remote connection while increasing isolation and general human distance in life. And it could be another example of technology benefiting privileged people while marginalizing people with less wealth."

Andrew Nachison, founder of WeMedia, executive and creative analyst, said, "Will the parallel virtual space people are now calling the metaverse be the nexus of culture, like the internet is now, or just a big subculture, like video gaming is now? I suspect the latter. Given what we know about business and technology, it also seems likely that eventually a handful of corporations will dominate. There may be more than one metaverse, but not too many."

Pete Cranston, an independent communications networks consultant based in Oxford, UK, said, "The promise of social media and other elements of Web 2.0 has at best only partially been realised because of the winner-takes-all nature of capitalism. One geography – the U.S. – had a head start, and the dominance of the English language in the Internet of the early 21st century, along with the development of tools that facilitated hugely profitable business models based on monetising surveillance, meant that a small number of companies would dominate the space delineated by Web 2.0. Chinese Web 2.0 in some senses mirrors the English-speaking world although within huge constraints set by the Chinese state. Chinese web tools, including those associated with immersive digital spaces, will play a much larger part in the next development phase. There are likely to be other location- or nation-based competitors from other parts of the

world, from the other BRICs and possibly Europe. The nature of these immersive spaces will be different, reflecting different cultures."

An expert in complex systems, gaming and collaborative learning commented, "In the 1990s we had multi-user domains (MUDs), text-based virtual worlds built by folks creating them together for fun in online communities. The most famous was LambdaMOO, a blank canvas on which a charismatic founder could build a rich and lively community with all of the action you see in the metaverse – but just in text. Which creative form has more impact, the book or the movie? Why won't the current metaverse expand? In my view the system has to be distributed and federated. There should be communities running on tiny, affordable computers like Raspberry Pis that can connect into a metropolis running on much more powerful computers. Also, developing 3D dynamic content is much more difficult at the moment than writing/programming dynamic content in the 1990s text-based MUD environment. Being 'in the zone' in the text-chat environment back then was so much better than today's 'wave if you can hear me' Zoom-type conversations. The mechanics of Second Life are so distracting. Current players are just thinking about how they can extract value from the place, with little thought about the software infrastructure required. I don't think these problems will be worked out by 2040. Perhaps the 0.1% are trying to reduce the world to a dust bowl to make the metaverse the better alternative."

A professor of digital humanities in one of the most prestigious computer science departments in the U.S. wrote, "The ecological and social costs are staggering. We need to wake up. WAKE UP! Do NOT go further and further into fantasy land. The physical, actual world is a beautiful place. Why is everyone racing to escape it?"

danah boyd, founder and president of the Data & Society Research Institute and principal researcher at Microsoft, commented, "Tl;dr: 'Snow Crash' was a dystopian novel."

It should be noted that on June 21, 2022, Meta, Microsoft, NVIDIA, PlayStation, Sony, Epic Games, Adobe, and dozens of other large, medium and small tech companies joined together with leading open-standards groups including the World Wide Web Consortium, the Open Geospatial Consortium, the Web 3D Consortium and others to announce the founding of the Metaverse Standards Forum, a group designed to ensure interoperability in the metaverse and, ideally, address some of the other concerns experts cited in this canvassing. Two large players, Apple and Google, were not founding members of this group. The aim of the group is to foster consensus-based cooperation to define and align diverse technologies, requiring a constellation of interoperability standards created and maintained by many standards organizations. The announcement did not mention whether standards for ethical design and business practices will be part of its action plan.

The experts who participated in this canvassing wrote hundreds of pages of thought-provoking insights into the potential future of extended reality and how these tools and society might evolve in the next 18 years. They were fairly evenly split as to whether the metaverse will or will not be a much more refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally by 2040.

The next two sections of this report are centered around insights shared by 1) respondents who predict that it is likely the metaverse *will* be quite a bit more widespread and advanced by 2040, and 2) those who say it *will not*. Each of these sections has four subsections tied to common themes arising from these experts' insights.

4. The metaverse will fully emerge as its advocates predict

About half of these expert respondents supported the idea that the metaverse will be a fully-immersive aspect of daily life for many by 2040. Many who expect augmented reality (AR), mixed reality (MR) and virtual reality (VR) to advance substantially predicted those advances will come from a natural evolution of the current innovations that are underway. They noted that humans have always been motivated to push boundaries and explore new experiences, to advance and improve their daily lives and to pursue profit and power. Thus, they said, it is only natural that forays into interactivity will continue to expand and evolve, spurred by tech inventions and ample funding.

Andrew Koch, chief executive officer at the Gardner Institute, wrote, "Talking and writing about the metaverse in 2022 is not unlike what it must have been to discuss 'the internet' in 1978. Back then, the foundational components of that new form of technology were being built, but no one really had a clue what an internet-based reality (virtual or actual) would look like 10, let alone 20, years later. With that as context, and with my knowledge of the metaverse framed and shaped by the cyberspace environment in which the metaverse now exists, I see the metaverse essentially being part of the progression of cyberspace. I don't see the metaverse as being something as innovative or revolutionary as the internet was in the 1970s. Rather, I see it an evolutionary leap. Comparing the future metaverse to cyberspace today is not unlike comparing electronic vehicles to cars propelled by internal-combustion engines – the means of propulsion are vastly different, but the concept and even many of the components are the same. So, at this time, I see the metaverse essentially being part of cyberspace in 2040. Perhaps by then no one will call the metaverse 'the metaverse' – they may just say it is the 'internet' or 'cyberspace.' Admittedly, it will be cyberspace where VR and tools such as heads-up displays shape and inform work, play, shopping, etc. But it will be cyberspace, nonetheless. In other words, meta tools and approaches will become synonymous with the cyber experience by 2040. And no one will call them 'meta' – sorry, Mark Zuckerberg. The metaverse changes to and in cyberspace will bring new and/or elevate the importance of existing pieces of internet infrastructure – including but not limited to distributed-ledger technologies (aka blockchain). This is because virtual reality will require virtual currencies and other forms of accounting and transactional mechanisms. Blockchain or some variant of distributed-ledger technology will be a primary basis for exchange in the metaverse."

Jim Kennedy, senior vice president for strategy at The Associated Press, responded, "It would be a mistake to view the emergence of the metaverse as just an extension of the early forays, like Second Life, or as limited predominantly to the gaming world. If we've learned anything about the internet, it's not where things start, but where they eventually go that truly matters. You can say that about most of the applications or devices that have been introduced through the original web and Web 2.0, and that will undoubtedly be the case in Web3. It may be more useful, and certainly

more exciting, to think of the metaverse not as virtual reality but as a new reality itself. Things created there and things we will choose to do there will be, in a very true sense, real. And in that context it can become a realm for both work and play. Simulations of all sorts, training courses and virtual events are obvious first opportunities to explore. Producing new immersive content for consumers is an enormous opportunity for entertainment, sports and news providers. The limiting factor at first is the equipment needed. Headsets and handsets probably won't get us to widespread adoption. But integration into other devices or presentations that can play in real spaces through next-generation mobile devices or television sets could democratize access pretty quickly. And, of course, the new world will be a place to create new intellectual property that can not only be viewed, but also bought and sold. That's where the blockchain comes in. It may even improve on the physical world by enabling fractional ownership and rights-managed derivative works."

Aymar Jean Christian, associate professor of communication studies at Northwestern University and adviser to the Center for Critical Race Digital Studies, predicted, "The metaverse is an extension of the evolution of the internet, e.g., Web3. Based on blockchain technology, Web3 is the next evolution of the web, allowing for the securing of information/data in a decentralized way. This is the basis for the ability of platforms and individuals to immerse themselves in the internet from any location and makes the decentralized movement of data more secure. This 'immersion' will not only involve the use of VR headsets. Rather, digital communication will be even more present in everyday life as all of our devices will be able to more effectively, securely transmit, store and produce real-time data."

John McNutt, professor emeritus of public policy and administration at the University of Delaware, responded, "To a certain extent, you can see much of it already in our lives today. This will be more a redefinition of how life occurs rather than a technological transformation."

Terri Horton, founder and CEO at FuturePath LLC, hopefully predicted, "We will experience much of how we live in a 3D virtual world in the future. The metaverse will facilitate fundamental shifts in how and where we work, learn, socialize, entertain, travel and engage in daily activities. It will blur the lines between the virtual world and the physical world. While we cannot fully predict the future, there are indicators that the world of work will be extraordinarily transformed by 2040. The impact on both employers and workers will be profound. In the metaverse of the future, workers will not only work remotely but also be able to 'teleport' anywhere in the world and experience work in virtual 3D locations of their choosing. Workers will have the ability to design their avatars and holograms, work, attend meetings and experience interactions with colleagues and clients from around the globe. The VR, AR, MR, AI and other futuristic technologies enabling these interactions will be so advanced that interactions in the metaverse will mimic the physical world, for example, in the context of sight, sound and feeling. Moreover, further in the future

brain-computer interface technologies will eventually enable workers to think about work-related actions and execute, driving high levels of efficiency and productivity. These examples are just small snapshots of how worker experience will be transformed."

Dirk Lueth, co-founder and co-CEO at Upland, one of the largest and most dynamic metaverse platforms mapped to the real world, wrote, "The metaverse will become a part of our everyday lives. We will 'go' there for entertainment, earn a large part of our income by providing different types of services, selling digital and physical items (as both worlds will be blurred), and socializing with others. The metaverse will always be with us as a companion, technology will connect us with it in the right manner/toolset depending on our current state. We might even have implants that will make external devices obsolete."

Daniel Castro, vice president and director of the Center for Data Innovation at the Information Technology and Innovation Foundation, wrote, "There will be no more Zoom fatigue! Immersive digital spaces can create a more 'in-person' experience for people communicating remotely. This will allow for better relationships and healthier communication than people have with today's technology. It will also allow people more control over how they show themselves to the world – through avatars, digital clothes, hairstyles, etc., much of this which people will purchase, creating a thriving virtual economy for creators."

John Robb, owner and principal analyst at The Global Guerrillas Report, covering the intersection of tech, war and politics, predicted, "2040 will feature an AR/VR mix, but it will mostly be AR, with applications applying digital overlays on existing reality. This will roll out as fast as smartphones did, but with many times the impact. It will be central to the work and private life of 3 billion-plus people by 2040. By then a half a billion people will be earning a living from working, selling, etc., in this environment."

Jim Witte, professor of sociology and anthropology and director of the Institute for Immigration Research at George Mason University, responded, "There will be missteps along the way (e.g., Google Glass), but the metaverse is here to stay. The fact that in the metaverse you can experience things that are not possible in your 'first life' presents both its promise *and* its risks. Many people first saw the power of the metaverse in the Second Life online community, but even before that computer scientists were creating VR experiences in labs using expensive specialized hardware and software. In science fiction literature, Neal Stephenson wrote about the metaverse in 'Snow Crash,' and a decade before that in 'Neuromancer,' and one of William Gibson's protagonists, Case, jacks in and out of cyberspace. Gibson's novel 'Pattern Recognition' features a female protagonist, Cayce, and the line between the real and the virtual was fully blurred. It is irrelevant if art is imitating life or life is following art. They are inseparable."

Gary Marchionini, dean of the University of North Carolina-Chapel Hill School of Information and Library Science, responded, "Humans are inherently inclined to maximize the experiences of work and play. These inclinations vary according to physical, psychological, spiritual and economic characteristics. Technologies that made work and play more effective and more fun will attract interest and investment. Metaverse technologies offer enormous varieties of application and personalization ranging from cognitive amplification to emotionally intensive immersions and extreme escapism. The technology will continue to advance and become more accessible to larger segments of the population, and people will surely leverage it to work more intelligently or amuse themselves into oblivion. The effects of this will vary from extremely positive to highly destructive to individuals and society. I worry about dissociation/fragmentation, manipulation and control by powerful interests and waste of human and environmental resources, but I also believe in individuals and the collective organism of Humanity to adapt and find equilibrium over generations."

Gary Arlen, principal at Arlen Communications, responded, "The metaverse will embrace a collection of applications and a convergence of many technologies to create an alternative cyber environment, possibly with variations for entertainment, socialization and enterprise situations. Among the positives is having access to people and situations that would be difficult or impossible in real life, going to places virtually, for example *inside* humans, animals or machines. Among the negatives are isolation; dependence on technology which may be controlled by 'evil-doers' including government or corporate; the expense of access, which may be unaffordable to some people. Inevitably, the convergence of crypto, metaverse XR and other technologies will enable a series of cyber environments that are hard to imagine but are probably not what the promoters are pushing today. If our employers, professional services suppliers, financial sources, government services and others institute and/or require us to use such cyber environments, we'll all probably have to go along to some degree. I expect significant metaverse activity in enterprise categories such as health care/medical, real estate/construction, education, manufacturing, aerospace and retail."

Michael R. Meyer, a Hawaii-based chief information officer with expertise in new technology development, IT infrastructure and change management, said, "Things will get uglier, but the metaverse will come to dominate. It is evolving rapidly, with critical mass being achieved now. The response of the population planetwide to the Ukraine invasion is a large indicator of how fast this is changing. While the Ukrainian crisis may revert to the old-power tools, the potential and power of mass action that is independent of government is now in people's minds. On a more abstract level, the pandemic has made it obvious that for many work roles, jobs are virtual. Despite the desperate efforts of the old physical leaders to reassert control, they will be a bump in the road as humanity moves on."

A professor emeritus of communications wrote, "The incentives likely to shape the nature of a metaverse (digital spaces – as currently defined) in 2040 will be intertwined with the economic, social, political, geographic and transportation disruptions of climate change and tectonic-level shifts in energy demands, in concert with the embrace of multinational business, scientific and educational entities. There likely will be a growing emphasis of live and work 'in place' for elites (a half billion or so globally) who fully participate in emergent digital work communities and digitally-enhanced social lives. The metaverse will spill over into arts, entertainment, sports, virtual travel and health care delivery and training for a few billon more."

The four most-mentioned reasons these experts expect that extended reality and the metaverse will advance significantly by 2040 are:

- Profit motives are driving significant investment in advancing these tools.
- Compared with today, far more people will come to find the metaverse useful enough to access it daily.
- The technology to create an immersive metaverse is possible by 2040.
- The pandemic gave XR development a big boost.

The next four sections offer insights into these themes.

Profit motives are driving significant investment in advancing these technologies

Of course, a primary force driving investment in technological development always has been the opportunity for people to profit from its success. Many of the experts who said they are confident XR will be advanced because of its commercial potential.

Mary Anne Franks, president of the Cyber Civil Rights Initiative, a nationally and internationally recognized expert on the intersection of civil rights and technology, said, "It's quite likely that many daily activities will take place in the 'metaverse' by 2040, given the resources being poured into extended-reality technologies by billion-dollar companies ruthlessly focused on profit potential."

R "Ray" Wang, founder and principal analyst at Constellation Research, said, "We have just issued a report outlining expectations for monetizing the metaverse economy. We see many components to metaverse development. Interfaces – headsets, glasses, gesture-based and human APIs. Worlds – every studio, esports, gaming platform, digital twin and social network will create a world as a distributed autonomous organization (or DAO) in order to set up membership rules, governance and voting rights, token economic models, funding mechanisms, and balance between

centralization and decentralization. Value exchange – blockchain, NFTs, digital assets, Web3 – all are elements of a new decentralized infrastructure and technologies. Just like with the evolution of the web, social and mobile before it, we will see a shift from 2D to 3D immersive experiences. These technologies will move from persuasive to consensual to mindful technologies. Ambient experiences powered by AI will deliver a choose-your-own-adventure-type level of personalization in which every action is a demand signal that's captured. For many developers the goal is for individuals to be able to traverse worlds using just one identity, but there will still be walled gardens."

Mei Lin Fung, chair of People-Centered Internet, wrote, "The vast majority of people may not go to the metaverse to work and play by 2040, but with Facebook putting its entire corporate existence at stake in a huge bet on the topic, the metaverse goldrush has begun."

Dmitri Williams, associate professor of technology and society at the University of Southern California, wrote, "The shifts that do happen will be driven largely by capital, so they will have their pros and cons. These elements will be well-made but will struggle with being particularly organic. They will also largely not be unified and instead be a series of parallel metaverses run by different intellectual property holders. Some may merge and interoperate, but because capital and antitrust are what they are, we should expect the Cokes and Pepsis of metaverses rather than a grand unified 'Ready Player One' vision."

Barry Chudakov, founder and principal at Sertain Research, wrote, "Will the metaverse merely become another gold rush that attracts wealthy investors who want to make more money than they already have? Or is there a way to encourage investment while also creating clarity and focus around a fact-based assessment of the real world while looking to resolve large and pressing global issues that face humankind? After all, in a mirror of the world, like a telescope, we should be able to see and do something positive about things and issues we typically miss or ignore with the naked eye."

Albert "Skip" Rizzo, clinical psychologist and director of Medical Virtual Reality at the University of Southern California Institute for Creative Technologies, commented, "The perceived benefits of this form of interaction and access to experience will certainly drive development in this area. It will not be for everyone, and there will be unintended or unanticipated consequences that will emerge beyond what we can already imagine, but the 'metaverse' will grow because the benefits and commercial potential on the other side of the equation for some people will be significant. There will be a large market for people who choose to access services in this context. Areas of benefit will of course be the usual suspects: improving access and more-intuitive interaction with education, health care, work activities, social interaction, commercial sales and entertainment."

The director of technology innovation and architecture at one of the world's largest telecommunications companies wrote, "There is significant investment in the metaverse. It is the only place outside of a theme park that one could fully immerse their customer in a brand. As experiences become more important, we will see the economy focus on opportunities in this space."

Winston Ma, managing partner at CloudTree Ventures and author of "The Hunt for Unicorns" and "The Digital War," responded, "I am writing a new 2022 book about how blockchain breakthroughs will empower the cryptocurrency, privacy and security foundations of the metaverse. There are many competing visions for how we'll build this persistent, infinitely-scaling virtual space with its own economy and identity system. Facebook Horizon is an ambitious bet that it will be realized in VR. Epic Games is doubling down on a game-centric approach with Fortnite. But the most exciting part about the metaverse is not its scope or infrastructure, but its potential to reinvent the way we interact with our friends and loved ones. Metaverse is the future of social networks."

Alex Simonelis, professor of computer science at Dawson College in Montreal, responded, "A full answer to this question would be as long as a Ph.D. dissertation. The U.S. is a hothouse (the only one) for visionary tech entrepreneurs like Musk, Page, Brin, Bezos – and Mark Zuckerberg, who will make this happen. In brief: Social media are addictive and the metaverse will be more addictive – imagine being able to realistically ski down the Alps or surf in Hawaii or go on a date with a Hollywood celeb or attend a Stanford lecture, or you name it, all for the price of a $200 headset and a $10/month subscription. Among the positives of this are great experiences at inexpensive prices. Among the negatives: more addicts."

Gordon Jones, co-founder and CEO of Thrivacy, an expert on blockchain, data privacy and self-sovereign identity, said, "The metaverse is made up of many Web3 technologies being built now for all kinds of uses. So definitely by 2040 we will have the tools that we need to operate an affective and immersive metaverse."

A professor of sociology and chair of African American Studies at a major U.S. university commented, "The shift will come because the billionaires want it to come. Facebook/Meta will push this. It will start off as fun and then turn damaging. For example, Facebook was a fun way to connect at first, but some people began to use it to promote ethnic cleansing, political misinformation and as a vehicle to broadcast live violence."

Compared with today, far more people will find the metaverse useful enough to access it daily

Respondents who expect the daily use of XR to advance significantly by 2040 said they believe it will be more broadly adopted in many common realms in addition to its current niches in gaming and entertainment. As happens with any technology, they say these use cases and the movement of more human activity into more virtual settings will lead to both positive *and* negative societal impact.

Helmet Krcmar, chair for information systems at the Technical University of Munich, an expert in digital transformation, responded, "The metaverse universe will add but not superimpose physical reality yet it will be an extremely important element of perception and be perceived by those humans that are connected as probably the most important influence on their life. For those humans that cannot or do not want to connect, a different life will result since the metaverse will be available to others but not to them, new disparities will result. Wealth via 'ownership' via NFTs [non-fungible token] will be not evenly distributed. Without political discourse about the integration of metaverses into human life, a bleak future might result."

Susan Aaronson, professor of international affairs and director of the Digital Trade and Data Governance Hub at George Washington University, responded, "The shift to immersive technologies is already taking place. For example, Barbados has an embassy in the metaverse. South Korea already uses XR to provide services. The World Bank uses XR to evaluate how various loans might change conditions in water-scarce countries. The Hub maps the governance of these data-driven technologies, and we plan a June 2022 conference on how XR is already changing international affairs. We see talk of it affecting trade."

Marta Szekeres, a complex systems researcher based in Hungary, wrote, "I am sure the shift to immersive activities will take place similarly to how the previous shifts happened. As with email, mobile phones, etc., it will be gradual. First, organizations, institutions and firms will apply the metaverse, and then the general population will get involved slowly. I expect that it will improve society overall. Humanity can leverage the metaverse to overcome its own limits. There will be many positives.

1) People can use their imagination without limits while not affecting the real world. This will free them from the negative psychological effects (frustration, aggressivity, depression and so on) caused by real-world limitations. People may become more tolerant, friendly and able to compromise.

2) It can help humanity to move away from spending most of its time doing mandatory work, allowing more time for enjoyable creativity and activity that give rise to a technically and socially highly-developed society.

3) People's use of the metaverse in ways that avoid wear and tear on the real world might also help eliminate environmental pollution and further exploitation of nature and Earth.

"The metaverse could operate with few negative effects. In the past both the good and the bad have been fairly equal, but now we must go forward more wisely if we don't want to destroy humanity, nature and the Earth. If literally everyone can be connected, then the life of humanity could become a dream.

"Digitalization in the metaverse should set people free from digital tasks, leading to a lot of new creativity. Connecting things and people could reduce the need for being physically present everywhere. Travel could be reserved for pleasure and entertainment. This is also a health benefit for both people and Earth. I hope a fully developed metaverse will help people think about themselves and the world as a whole, in which everyone and everything is equally important. I hope people will not feel fear, loneliness, anger anymore and will feel responsibility and interdependence. But if creation of the metaverse is focused on just the devices, software, gadgets and network with no steps made for general and unconditional availability for everyone, it is difficult to see when (if ever) the system could turn into a wholly connected human system. While a properly designed and operated metaverse might be able to free all humans, I am very skeptical of our society wanting to free its people."

Thyaga Nandagopal, senior adviser in the directorate of computer and information science and engineering at the U.S. National Science Foundation, shared examples of use cases in several categories: "1) *Learning:* With virtual reality/immersive experiences enabled by the metaverse, the ability to learn hands-on will be a major advantage in speeding up the absorption of new concepts by a range of learners. It has the potential to impact how diverse learners can absorb and grasp new material. Education will also shift to a continuous-learning model, where the K-12 system will end up teaching 'how to learn' rather than 'what to learn,' and the metaverse will offer everyone the opportunity to learn the essential skills needed for jobs, personal care, finances, etc.

2) *Work:* With the ability to interact with far-away objects, data and people through the metaverse, the nature of work will fundamentally change. It will shift from being 'skill-driven' to 'information-driven.' We will be able to work from anywhere, anytime. More jobs will not be on a 9-to-5 basis, and instead fit into more of a freelancing model where tasks get parceled out to those who can get them done within a set of performance parameters. Humans will be prized for their

ability to rapidly parse data from diverse sources and extract pertinent information from the sea of data floating around them.

3) *Human relationships:* Through immersion, existing human relationships could potentially become stronger by being able to stay connected all the time, but the risk of disruption is always there. The advent of highly realistic digital avatars can lead to humans associating with purely virtual characters for company and pleasure, as these can be programmed to give them a greater sense of satisfaction than most human-human interactions. The metaverse may bring to reality a collapse of human-to-human relationships.

4) *Government:* While it may eventually improve access to government services and information, until the government tech is perfected and the public comes to understand how to use it, the metaverse will initially make things much worse than they are today. This could be mitigated over the span of a few decades. The metaverse will also potentially allow lawmakers to connect with constituents, but it can also allow them to evade responsibility for meeting and engaging with individuals in the communities they represent, instead using avatars or virtual agents that operate on their behalf to placate the public rather than really listening to what people have to say."

Katie Harbath, public policy director at Facebook from 2011-2021, now founder and CEO of Anchor Change and director of Tech and Democracy for the International Republican Institute, commented, "As in the early days of the internet in the 1990s, it can be hard to envision exactly what the metaverse will look like in 2040. I expect it will be particularly strong for communities and areas where physically being together or traveling to a place is difficult. Gaming is already immersed in the metaverse, and the teenagers playing those games today will be in their 30s by 2040. They will be more accustomed to the fact that they then can fully immerse themselves in visiting a landmark like the Taj Mahal or the Great Wall of China without needing to travel there. They'll be able to tour museums or attend concerts and collectively experience something like that without a ton of effort. In many ways, this technology will make our daily lives better. No longer will we have the stress and cost of travel. If we can't make a meeting, we have many other ways to join. We'll be able to do activities with friends and family even if they are on the other side of the world. People in the military and emergency workers will be able to train in more-realistic environments. Moreover, people won't have to fly to Singapore for a single meeting. Instead, they'll be able to participate from home – reducing the amount of business travel impact on the environment.

"The positives of this transition have the potential to make us a much more global society, allowing us to experience different cultures and people without the added expense of traveling. People will have more opportunities to learn and have an impact on the world. My hope would be that it would make us a more empathetic society when we can truly walk in someone else's shoes.

Negatively, it could isolate people. It could make them feel more lonely because they don't have as much face-to-face physical interaction. We're just learning what the mental impacts of isolation during COVID-19 were, and it is evident these technologies can sometimes make that worse."

Andrew Tutt, an expert in law and author of "An FDA for Algorithms," wrote, "How do I envision the metaverse changing human society? Most importantly, it will continue to make individuals more data-driven in how they interact with each other and the world, and it will continue to put pressure on certain kinds of traditional expertise. For most of human history, if you saw a red bird in a tree you had no way of knowing whether that bird was a cardinal or a scarlet tanager unless you were a trained ornithologist or an amateur birdwatcher. The same can be said across a range of human endeavors from cooking to painting.

"The availability of ever more accessible data will reduce the need to rely on conventional kinds of rote memorization and potentially expand the ability of people to understand and convey to other people information about the world around them. Increasing the amount of virtualization also permits the real world to be more fluid and dynamic (and changes to the world to therefore be made more cheaply). A spartan retail space with completely barren walls and a kitchen could – through the use of augmented reality – be a bright and colorful family Mexican restaurant by day and a bouncing nightclub by night. The ability to hot swap the trade dress of physical spaces only begins to scratch the surface of what might be possible. There could potentially be implications for fashion, where outfits look different through the lens of augmented reality. And if augmented reality became pervasive enough, even traffic signs and traffic lights could theoretically be replaced by augmented reality, allowing for cities to potentially change traffic flows dynamically without having to repaint the roads and replace lights and traffic signs.

"There is hardly a field of human endeavor that will not be changed in some way by the introduction of this blended reality metaverse – but they will be changed in ways that all individually may seem somewhat small. Essentially, all of them will be enhanced or changed by the ability to generate data about the world on the fly and create or take advantage of digital representations overlayed over the physical world. But the collective implications for efficiency and human happiness are likely to be enormous.

"These technologies will vastly increase the speed that many people can be taught many tasks. They will vastly lower the cost to virtually visit far-distant places. They will allow people to engage in new forms of entertainment that are more visceral and exciting than what they have access to now. Overall, I expect this to improve human society drastically in the long run. There will be problems and there will be dangers."

Kathee Brewer, editorial director for CANN Media Group, wrote, "The metaverse is another in a long line of developments that saw their genesis in science fiction and later became reality. (Think cell phones, the internet, 'smart' homes, space travel, nuclear submarines, etc.) Already, virtual reality and augmented reality are making new-product demonstrations safer and more immersive in fields like medicine. Gamers, of course, have engaged in an elementary form of the metaverse for years, and real estate agents offering 'virtual' real-world property tours (another very early stage of the metaverse) has become de rigueur. Going forward, the technology seems ripe for use in educational environments, allowing students 'hands-on' experience with places and things to which they otherwise could not get near. Virtual vacations could allow people who are unable or unwilling to travel to experience distant lands – perhaps even planets. Business meetings could be much more immersive than Zoom allows. People could participate in movies, plays and TV shows instead of simply watching them. There are innumerable ways in which the metaverse could be employed in daily life. As with all technology, the potential for abuse/misuse is enormous. Could literal wars be fought in the metaverse? Could authoritarians and conspiracy theorists use the milieu for evil ends? Probably, and those are the scary things that must be addressed."

Rob Frieden, professor of telecommunications law at Penn State, commented, "I expect early metaverse adopters to include gamers, consumers of pornography and practitioners able to exploit the third-dimensional presentation, such as CAD-CAM designers, architects and geospatial engineers. As with every prior technological evolution, society will have to make adjustments, often without much forward thinking by governments. The metaverse will represent both the greatness and awfulness of society."

James Gannon, a health care policy expert whose focus is on emerging tech, a consultant for Novartis and PharmaLedger, responded, "The metaverse concept will come to be a major factor of life for people in developed nations over the coming two decades. If we look back to 20 years ago in the early 2000s, the internet was still emerging as a facet of life, whereas now it is an integral part of modern society. We will see a similar emergence of the metaverse concept, particularly in terms of social-based interactions, however this will also bring with it the same policy challenges as we have seen in the internet space. It will be a challenge for policymakers and legislators to keep up with the pace of technical change."

James Hughes, bioethicist, sociologist and executive director of the Institute for Ethics and Emerging Technologies, wrote, "Immersive VR and wearable AR will be common by 2040, and there will be many people globally implementing it for leisure, work and educational use. It will not itself generate negative impacts, but all the bad aspects of human behavior found in the real will be present in the virtual – capitalism, patriarchy, nationalism, sloth. The metaverse will be isomorphic, similar to the real. It will need laws and regulation, private property, taxation and law enforcement."

Rahul Saxena, CEO of CoBot Systems based in India, previously a director at Cisco, said, "The first shifts are likely to happen for gaming, entertainment and pornography. This, alone, would account for more than half a billion people. They will arrive in a fantasy world that tries to look like the real world. Let's call it Fantasy-Metaverse.

"The next set of shifts is for situations where our natural faculties are augmented by imaging and actuators, for instance in laparoscopic surgeries guided by real-time scanning. These require specialized immersive worlds that people enter to gain augmented powers in doing their jobs. Health care, especially surgery, will benefit from these shifts. Let's call it Super-Metaverse.

"Making business decisions is a multidimensional and analytics-rich problem that could move to the metaverse. It will be hard to consume, as it will depict an alien world unfolding in analyst-generated scenarios. In the same way as global information system layers add complexity to maps, decision-complexity navigation is likely to demand generating non-natural dimensions. Instead of x, y, z and time, we could need a metaverse with navigation in profit, sales, customer satisfaction and time. Let's call it Alien-Metaverse.

"We hope that education fits in somewhere and becomes more easily accessible in the Metaverse. It will collide with the shift to the Fantasy-Metaverse, where unformed minds will prefer to live. Teaching them to exercise their faculties in the metaverse is also likely to collide against the economic basis of the Fantasy-Metaverse that would prefer gullible consumption over critical thinking. As the Super and Alien metaverses evolve, they may provide doors into the Fantasy-Metaverse through which residents can traverse metaverses.

"The shifts to the Fantasy-Metaverse will be like the unleashing of an opium super-epidemic. There will be a backlash. Blockchain technology will initially try to promise immutable memories in the metaverses. They would likely fail in that promise, overwhelmed by the sheer volume of the storage and attacks by players who will have strong incentives to either put prices to memories or to make them mutable. It will take a while and several iterations for the technology-commercial aspects of immutable memories to settle down. I'm not sure whether the equilibrium will be to the benefit of residents; it can be likely to favor the powers who manage coinage or commerce in the metaverses."

A North American futures strategist and consultant responded, "More fully-immersive digital spaces and digital life will be more seamless than today, with more robust infrastructure and more flexible devices available from almost anywhere. Geographical distances will all but disappear as people will feel immersed in whatever environment they choose without physical travel. People will need to make concerted effort to keep their bodies healthy by physical activity

as they use the metaverse more often for many of the transactions and communications in their daily lives. It will be much more difficult for people to be 'unplugged' from daily life."

A geoscientist based in Oceania commented, "Virtual worlds offer many interesting opportunities for people because, in them, we are able to 'author' ourselves quite intentionally and experimentally. The flexibility of form and experience within a virtual world can have an amazing developmental influence. I have spent, off and on, something like 17 years experimenting as an avatar and exploring virtual spaces and experiences within Second Life, and I have found this to have moved my perception of myself quite considerably in my real life. The whole experience can be summed up as being *liberating*. Virtual worlds dissolve social and geographical boundaries, and in them we are able to interact and form relationships with people whom we would never otherwise meet.

"Other-worldly experiences are also a matter of course in virtual worlds; it is all down to the imagination of the creator of a virtual realm. You can thus inhabit the imagination of another in a way which is quite different to that which you would experience by, for instance, reading a book. The liberating and exploratory experience of virtual worlds will become ever more important as the impacts of population increase, climate change, environmental degradation and pandemics become more apparent to people.

"Our society has undergone many forms of liberation as people have sought more from their lives and a deeper understanding of themselves and their purpose in society. I see the evolution of virtual worlds as a next natural step in human liberation."

A highly respected computer scientist based in the U.S. Upper Midwest said, "The technology of virtual reality is improving substantially, and that will lead to a technology-pushed emphasis on greater use, whether or not those uses are actually beneficial. It is clear that entertainment will be the dominant use for most people: the extension of today's games, probably substantially increased pornographic use, and I hope some greater expansion of virtual presence at live events (sports, theater, music) and virtual events. On the positive side, I see huge educational benefits (sending people to engage in periods in history, explore science, etc.) and substantial benefits for training in all spheres (from practicing surgery to simulations where people can train for talking down a potential bridge jumper or counseling others in crisis situation). On the negative side, I think there is a real risk of amplifying negative social interactions, including increased sexism, racism, isolationism and normalization (in the virtual world) of behaviors that use, abuse or marginalize others."

Several respondents predicted a proliferation of "digital twins" – that is, digital representations and actors that are extensions of "us."

Jim Spohrer, board member of the International Society of Service Innovation Professionals and longtime IBM leader, wrote, "As our personal, episodic experience data become our AI, our 'digital twins' will be invited to participate in online digital worlds. The diversity of types of worlds will be very large. People can choose to let their true digital twin engage in some worlds and they can create alter-egos for other worlds. Monetizing both true digital twins and alter-egos will be the focus of some digital world platforms. The UN Sustainable Development Goals will be a focus for many people, including battling misinformation (which may be added as a goal). Poverty will be a thing of the past, as 1% of every purchase that a person makes is deposited in a central bank digital currency individual retirement plan for that individual. An important and complex legal issue will be maintenance or disposal of digital twins and alter-egos of people once that person physically dies."

Ray Schroeder, expert in technology-enhanced learning and senior fellow at the University of Illinois-Springfield, said, "By 2040 metaverse platforms will be as widely integrated and dispersed as the web is today. We will see the phenomenon of digital twinning in which individuals will be digitally represented by avatars which, driven by AI, will speak and respond with the authority and image of the person herself. This will enable a host of applications with virtual twins engaging in all of the aspects of society, from business to learning to recreation. It will become a preferred mode of communication, interaction and engagement. The transition to the metaverse will change the human self-image from flesh and blood to our idealized personae. It will create a world in which we are our 'best' or 'worst' selves. This is a huge step in the evolution of the human species. We will no longer be subject to the DNA-defined body and mind but will have an electronic version as well."

Mei Lin Fung, chair of People-Centered Internet, wrote, "Concepts such as the ways in which 'digital twins' might link the real world and the digital world will eventually be greatly advanced by social contracts, property rights agreements, access controls, permissions and other tools and institutions are going to be developed during the metaverse goldrush. I do think that between now and 2040 most activities will be limited to that which is already popular, with some advances in other specific areas like online health, education, business, employment, investing and saving, conferences and social gatherings."

Vipp Jaswal, CEO of Interpersonal Intelligence Advisory and C-suite advisor, commented, "If history is a reference, then it logically follows that the exponential change we have seen in the existing digital world we live in will equally apply to the virtual world that is presently being built: the metaverse. The metaverse will be three-dimensional, i.e., users will feel fully-immersed, and they may even eventually be able to engage in sensory features such as touch, feel and smell. Human society will change in that it will allow for users to exist in two or more worlds that allow

for expression of their true self. As an analogy, the metaverse will almost be an opportunity for people to 'reincarnate' themselves by giving themselves permission to be their true self.

"One of the positive outcomes will be allowing people to pursue multiple careers in various settings. It will allow for greater interaction and community building. The possibility of engaging in a much broader range of experiences will be far greater. There are some worries: At present there is little discourse on monitoring individuals' virtual safety. Very limited exposure is given to any regulation of code of conduct. A level of interpersonal intelligence needs to be developed and shared – a new metaverse literacy – so that people have a safe and rewarding experience. Otherwise, this could be the Dark Web turned upside down. Daily lives are going to be impacted in every way, but our experiences with the evolution of the internet have trained us to expect, manage and utilize change in technology. We will adapt very comfortably to this new world, and its constant evolution will change our way of living dramatically. From shopping to entertainment, health, work, relationships and more, the way we live our lives will change exponentially."

The respondents to this canvassing took a number of additional approaches in imagining how and where XR might be applied in the future in work, business, relationships, national defense, education and nefarious acts.

Stephen Abram, principal at Lighthouse Consulting Inc., predicted, "A lot of the metaverse infrastructure is already here and it will be developed. I don't believe that there will be one single meta-universe. The primary metaverses will be goal-specific and you'll choose them based on your goals. We'll belong to many planets in the metaverse and not be restricted to our home planet. For example, there will be metaverses that specialize in learning goals, workplace workflow and decision-making goals, and gaming, entertainment and culture goals. We can somewhat see this in the diversity of social media/networking/content platforms now, where adding too much diverse content destroys the experience – for example, if LinkedIn took its eye off the ball (in regard to user needs) and offered entertainment-focused content like music. That doesn't mean that a variety of formats aren't necessary for each metaverse experience, but they must be fit for purpose."

Patrick Hsieh, a digital sociologist who works in the Digital Technology and Society program at RTI International, said, "Many jobs in the service sector will become automated and augmented into immersive digital spaces that blend the virtual and physical worlds together. Wearable devices will no longer be bulky. New jobs will emerge, such as those for logistical-support people who assist and maintain automated services."

A vice president for research and economic development commented, "AI will be driving largely every functionality as we know them today. Communication and other interactions such as

business transactions will likely be virtual and via avatars, AR and VR. We will be responding to prompts and directed actions, banking will no longer be in-person, and it is likely that all education entities will default to online virtual training. A big challenge will be getting processes and policies to keep pace with the tech advances."

An expert in internet engineering and policy said, "Enhanced transparent displays have obvious use cases for machinery, vehicles, warfare and entertainment. It's hard to conceive of a scenario in which advances in one field won't feed advances in others, creating network effects that will lead people to rely more and more on this intermediation to interact with one another, and the world at large."

Vincent Alcazar, a retired U.S. military strategist experienced in global intelligence, commented, "The metaverse is becoming commercially instantiated to serve gaming interests. But its most interesting use case is not in that realm, it's in national defense. By 2040, one or more non-public U.S. military research and development and operations metaverse(s) in technology, meta systems in size and organization, will be paired with U.S. real-world combat operations to test scenario-specific and engagement-specific measures, countermeasures, tactics and counter-tactics. This will speed decisions as to what validated tech and tactics the U.S. military can bring to the future battlespace to out-innovate and outpace adversaries."

Steven Miller, professor emeritus of information systems at Singapore Management University, commented, "There will be positive and negative uses. A forthcoming book I co-authored with Tom Davenport, 'Working with AI: Real Stories of Human-Machine Collaboration,' includes a case study describing a machine shop that already uses XR to train new machinists with the help of the Microsoft HoloLens and a commercial software application. This is starting to happen now. It can and will continue to happen more frequently. XR will play an increasingly bigger role in knowledge support. Deepfake video images will be extremely difficult for ordinary people and ordinary detection methods to identify. Another book, 'AI 2041: Ten Visions for Our Future' by Kai-Fu Lee and Chen Qiufan, outlines this and more. The second story in that book, 'Gods Behind the Masks,' does a wonderful job of helping to envision everyday life 20 years from now, when the ability to synthesize images is so good that fakes permeate aspects of everyday life in new ways – though of course, there will be new and better ways of detection as well."

Ben Rutt, a Baltimore-based psychologist specializing in cognitive behavioral therapy, said, "The shift to the metaverse will occur much like our shift to the internet in the 1990s. People will react in one of four ways. There will be Early Adopters, Slow Adopters, Disengaged People and Resistant People. Early Adopters will embrace the metaverse. They will rush to take advantage of all its features. Their level of engagement with the metaverse will be very high. Slow Adopters will be less enthusiastic about the metaverse. They'll use it for their job, if required to do so. They won't use

the metaverse much in their personal time. People who are disengaged from the metaverse won't be paying attention. It won't even be on their radar. This is kind of like your grandfather who refuses to buy a cellphone. They won't have the capacity or interest to use the metaverse. There will also be people who resist the metaverse. Every new technology has its skeptics. These people will be afraid of how the metaverse will change society. They'll be a small but vocal group. (See the article 'People Who Hated the Web Even Before Facebook' for more details on this.) The metaverse's success will largely depend on how many early adopters it can attract and how many slow adopters it can get interested. Tech companies will try to encourage disengaged people to get interested in the metaverse by showing them the metaverse as a place that will empower them and that it's a place they can put their trust in.

"Positives that will emerge from the metaverse include the ability to connect with people all over the world, the ability to work from anywhere and the growth of a new segment of the economy. As the metaverse becomes popular, companies will be under immense pressure to keep innovating. Users may ultimately benefit from that. However, these benefits will not be evenly distributed. People who cannot access the metaverse may be left behind. The people who make the metaverse will take advantage of our psychology to make it an engaging place. By doing so, we will surely see an increase in metaverse addiction. The extent to which the metaverse will channel our negative impulses is unknown. The 2010s and '20s have illustrated how social media can harness our dark impulses. Political polarization; fake news; it all seems to have gotten worse. How will the metaverse influence this dynamic? That is anyone's guess."

Andrew Schwartzman, senior counselor at the Benton Institute for Broadband & Society, commented, "It is dangerous to extrapolate from historic patterns for something like this, but as with the web, I do suspect that some valuable use cases will emerge, quite possibly not the ones that are currently expected to be the likely scenarios. Think Zoom to the twelfth power. I would think that disproportionate attention will be placed on individual users, but that the more-important applications will develop in the enterprise space for design, logistics and enabling collaboration. Education might be next. But I am skeptical that this technology will radically change society."

The technology to create an immersive metaverse is possible by 2040

A number of the experts who responded to this canvassing said they expect that by 2040 software, hardware, user interfaces and network capabilities should be advanced enough to create a much more refined, more immersive and better-functioning user experience.

Rod Beckstrom, author, tech entrepreneur, former CEO of ICANN and founding director of the U.S. National Cybersecurity Center, said, "Some forms of new metaverses are certain to unfold by

2040. Why? Because the hardware and software technology advancing today will easily enable it. It will evolve to deliver humans what they seek and are willing to pay for, whether through advertising, licensing fees or payments for products and services that include its features. As it is an embryonic new-technology market, no one knows today just how it will evolve, but it will happen, and – just as with AI – it will be applied in many diverse fields. If you want to understand where it is today and where it will evolve, follow the eyeballs and follow the money."

Peter H. Hellmonds, founder/owner of Arete Publica, a public affairs consultancy, responded, "Increasing bandwidth and computer power plus future development of appropriate gear that is not as clunky as today's VR goggles will bring an epochal change in the way we access these worlds within a couple of years. Google Glass was a beginning. Apple and Samsung may develop the next best thing in terms of sleek, stylish, AR/VR glasses, coupled with great sensomotoric experience. It will probably start with big hype in South Korea and Japan before a major spillover into the U.S. and Europe. The porn industry will figure out how to make the most of it. Our generation saw the advent of the Internet, starting with dial-up modems, quickly evolving to DSL, VDSL and now gigabit connections via fibre-optic cable. We saw computing power race from 8-bit computers with 128 kilobits of RAM to the possibility of 433 qubit quantum computing power in 2022 in high-end machines. We have seen the advent of social interaction from Usenet newsgroups and Internet Relay Chat to today with WhatsApp and Signal, Telegram and a host of other chat apps. We saw the advent of social networks like Facebook and Twitter, Instagram and TikTok, all within the span of 10-20 years. We have as much time ahead of us as lies behind us until 2040. Never underestimate the power of inventors and adopters worldwide. I can even imagine that the world described by William Gibson in his early 1980s 'Neuromancer' trilogy, where he coined the word 'cyberspace,' with neural implants that connect your brain directly to a computer deck that allows you three-dimensional interaction in a VR world could possibly happen before 2040. Blockchain is still very much in its infancy today, but the possible positive influences on our lives are manifold. From verifying financial transactions to documenting shipping of goods to certifying the origins of diamonds or other minerals used in international trade, I can imagine that blockchain's everyday uses will soon surpass the uses as a means for cryptocurrencies."

A global strategist who works for Meta toward promoting technology for the common good wrote, "Many of the technologies that will be used to create the metaverse are already available. We should expect rapid development of metaverse hardware/wearable, devices and tools in the coming five to 10 years. By 2040 the metaverse should be a fairly mainstream and well-used technology enjoyed by millions of users."

A longtime global internet policy leader at one of the world's largest telecommunications companies said, "Technology such as distributed computing and high-speed mobile broadband *will* enable trends that have been underway for years. The metaverse will

offer a wide range of applications, from entertainment to online education to business-related environments that will drive development."

Brad Templeton, chair emeritus at the Electronic Frontier Foundation and director at the Foresight Institute, said, "What we will see in 2040 depends on yet-to-be-developed breakthroughs in technology. To become ubiquitous, you need to be able to access it without effort or much thought. It has to be always available, perhaps in glasses you wear all the time (not just to do the application) or at a desk you sit at all day, or perhaps useful while you are in your living room or kitchen. Given that development, yes, people will use it regularly because it is effortless. 2040 is 18 years out, so it seems this might be doable before then. If we get something radical, like a contact lens, hearing aid or other such invisible wearable, expect more. Entertainment will be the easiest thing to move to this platform, along with certain business applications. I am more skeptical of a 'Snow Crash' vision where people feel they 'live' in a metaverse rather than access it as they need it, or explicitly 'visit' it as we sort of do now."

Marjory S. Blumenthal, senior fellow and director of the Technology and International Affairs Program at the Carnegie Endowment for International Peace, responded, "The Internet continues to evolve, and so does the collection of technologies that we call 'the Internet.' Metaverse concepts will grow, evolve, compete and cohere between now and 2040 as (loosely) a new generation of the Internet. The only way this will work as 'immersive' is if the technologies are easy to use and engaging. I would caution against the assumption that that has to mean 3D graphics and gaming – those technologies will loom large in some but not all metaverse implementations. After all, 3D and compelling graphics don't do a lot for the visually impaired, and if nothing else, the aging of the global population will make more of us visually and hearing impaired to some degree. The observation that past virtual worlds have atrophied or become marginalized speaks to the need to engage more people more persistently. It is unlikely that a single platform can do that, and like the network of networks idea, a metaverse of metaverses promises to be more adaptable."

Andrew Tutt, an expert in law and author of "An FDA for Algorithms," wrote, "The kind of real-time rendering technology necessary to make a metaverse really exciting, especially in handheld and wearable devices, will require maybe about 15 years more development in GPUs (and that timeline assumes Moore's Law continues to hold)."

Stephen Downes, expert with the Digital Technologies Research Centre of the National Research Council of Canada, said, "William Gibson-inspired full-body immersion is still far in the future, and would require a direct neural connection, which will still be in development stages in 2040. We will be limited to what we can do with headsets, glasses, pop-up displays and the like, but the gear will be lighter, cheaper and much more affordable. Bandwidth will enable the much-greater data transfer needed to support realistic VR. By 2040, one of the key challenges will have

been addressed: the production of enough content (ranging from games to VR, movies, educational simulations, live events). We will be able to *record* VR rather than be required to use a design platform. By 2040, we should be seeing the VR equivalent of YouTube and TikTok. Critics will complain that people are withdrawing from society, hidden as they are from the rest of the room behind their VR headset or glasses. There will be concerns about harmful and disturbing content, and because of the verisimilitude of VR experiences, there will be concerns about misinformation, propaganda and brainwashing. The cost to access and use VR equipment will also lead to questions about the widening digital divide. Many people will argue, not inaccurately, that VR (or even augmented or extended reality) are simply not necessary for most social functions. Another less-discussed aspect of the metaverse is the idea of object and identity persistence in virtual space. We're already seeing the first signs of this with blockchain records and NFTs."

Alexander B. Howard, director of the Digital Democracy Project, wrote, "By 2040 we should expect the personal and public metaverse terminals that Neal Stephenson once envisaged in his 1992 cyberpunk novel to exist in many forms around the globe, from public kiosks to university pods to connections in private homes to library booths to commercial gear operated by corporations to police and military interfaces. If the world is anything like today, each will have its own affordances, stigma, power and privileges that will be reflected in capacity and appearance. We should also expect that in two decades time our current smart glasses, VR goggles and AR browsers in smartphones will be seen to be as antiquated as we now view the personal computers of the 1980s and cellphones of the 1990s to be. The emerging panoply of computing devices that can augment what we see and enable us to explore virtual worlds using avatars by projecting images onto lenses or our eyeballs are still in their relative infancy today, as are digital smartwatches, health bands and fitness trackers. By 2040, we should expect spoken and gestural interfaces like the ones we saw in 'Minority Report' that enable us to interact in augmented-reality layers in a given physical location, viewing the annotations and glyphs others have left, with background systems pulling up information about the people, places and objects we observe. This will have many implications for how we live, work, play, govern, conduct business, pursue romance and more, as these new civic, corporate and private spaces become commercialized or co-opted by the same societal forces and institutions that shaped the development and extension of Internet technologies in the 20th century."

June Anne English-Lueck, professor of anthropology at San Jose State University and a distinguished fellow at the Institute for the Future, said, "If by 2030 there is greater coherence between the different proprietary systems of coding and interface design, and if more universal standards are adopted, the use of VR for social interaction and AR for education, training, community activism and art will increase. Undoubtedly the metaverse will carry exactly the same social costs as the internet. Immersion will make engagement much more compelling."

Robert Petrosino, head of emerging tech and innovation at PeakActivity, a digital strategy and implementation company, responded, "By 2040 the metaverse will play a crucial role in everyday life. There will have been a transitional change from a mobile-first experience into a headset-first experience. These headsets allow people to transition quickly and easily between augmented and virtual reality as well as notify us of our current geolocation specific to events, interactions and digital content. As we have seen in prior generations of technology evolution, the winners will be those with the deepest pockets who are the fastest to adapt this technology into their daily lives. Our worlds will blend from a split between digital and physical to a single metaverse that combines some of the best and worst attributes from both into a display-driven experience that may move from contact lenses to ocular implants."

Andrew Czernek, former vice president of technology at major company, commented, "In 2022, it is apparent that 5G technologies will emerge in mobile applications first, in phones and cars. Specifically, all of the auto manufacturers are starting to use LIDAR and other technologies to make vehicles more driver-independent. A killer application for the home – where people are relatively immobile – is yet to be seen. However, analysts are predicting that 5G will break down the monopoly on the Internet pipeline that Comcast, CenturyLink and a few other companies dominate. Already we're seeing better connectivity for rural and third-world populations who can use cellphone technology to communicate and better participate in global markets. Kasongo, a town in the eastern Congo, has cellphone access without the difficulties of stringing thousands of miles of cable."

Walt Howe, a longtime information technology and services professional, now retired, said, "Steady improvements in miniaturization and AI will lead to a more-positive, augmented experience technologically. There will be no more heavy headsets and it will be more sustainable. People will appear as themselves in most communications, not as anonymous gamers. XR will integrate with, enhance and modify the normal."

A communications expert based in British Columbia responded, "The metaverse will become a place to escape the realities of the world. It may not be as it is now, with clunky VR gear. Rather it may be more integrated into everyday functions, objects and clothing, so that people shift seamlessly from the physical to the virtual world."

The pandemic gave XR development a big boost

The pandemic of the early 2020s was cited by many experts in this canvassing as a spur to billions of dollars of new investment in research and development of networked digital tools that allow for excellent augmented- and virtual-reality experiences.

Gary L. Kreps, professor of communication and director of the Center for Health and Risk Communication at George Mason University, said, "Much of the recent development has been fostered by the COVID-19 pandemic, which necessitated digital delivery of health care and educational services to the public. Necessity is the mother of invention, and the health and educational programs have been refined through use. Similarly, consumers and providers of health care and educational services have become increasingly sophisticated at using these new technologies. Now that so many people have grown accustomed to using these new digital communication-delivery systems, I foresee growing demand for introducing additional and more-sophisticated systems of this kind."

Brooke Foucault Welles, associate professor of communication and core member of the Network Science Institute at Northeastern University, said, "With the additional nudge of widespread remote work and learning during the COVID-19 pandemic, it seems inevitable that corporations will invest in developing the hardware and software to support metaverse(s) over the next 15-20 years."

Mei Lin Fung, chair of People-Centered Internet, wrote, "COVID-19 has accelerated by many decades the level of new digital transformation across many cities and nations. We are building infrastructure which had no chance of being funded five years ago. Because of this, devices and software developed originally for the metaverse will emerge more quickly. They will also be repurposed as a means of augmenting human activities in the real world – allowing people separated by space and time to engage in activities which only 20 years ago were largely only possible face-to-face."

Olivier Crépin-Leblond, founding board member of the European Dialogue on Internet Governance and board member for the European At-Large Organisation at ICANN, wrote, "Many activities will take place online by 2040 using more-immersive interfaces than the current web, for example, e-commerce options in which you feel as if you are strolling down the aisle of a store, meetings in full virtual reality and fully immersive VR or holographic physical fitness options. The technology already exists today, it just needs to be refined, made bug-free, and made user-friendly and affordable. Many of the positives of this will be similar to what we have experienced during the COVID-19 epidemic: less need for travel, more-efficient use of the earth's resources, etc. Many of the negatives will also be what we are seeing during COVID-19, including a rise in psychological distress related to social isolation and the lack of real, physical human contact. Will 2040 technology find a way to solve that problem, somehow trick our human minds into thinking that we are in someone else's presence.? Unless we physically and physiologically evolve as a species, virtual presence may never be able to fully replace a physical one."

Bitange Ndemo, professor of entrepreneurship at the University of Nairobi Business School, commented, "In my view, it will not take too long before the future of the metaverse becomes part of our life. The reset started in 2020 with the onset of COVID-19. We had to transition into providing services like education as normally as we could, doing it all online. The metaverse and Web3 will further facilitate the mimicking of natural space. Already many graduate school students are questioning why we should resume 'normal' physical classes when remote courses in the current 2D have worked. With blockchain technology promising security in transactions due to its principles of cryptography, decentralization and consensus, it is not far-fetched to see top universities beginning to offer remote teaching that is close to teaching in real life. If the addiction we see in gaming is anything to go by, then the metaverse will rule the future. There are many positives like improving productivity in virtually every sector from education to health care to agriculture leading to greater inclusivity and prosperity. This will, however, happen at the expense of socialization that is essential to our livelihood."

Moira de Roche Holmes, chair of the International Federation for Information Processing, wrote, "The immersive aspects will help make people comfortable with the technology. We will truly live digital. The big positive will be for education. The big positive will be the improvements in creating more-personal experiences in education. During the pandemic over the past couple of years, learners and students have been forced into an online setting where the missing component was in social learning. Immersive learning spaces will address this issue."

Valerie Bock, principal at VCB Consulting, wrote, "One thing the pandemic has taught us is how much can be accomplished using technologies that permit virtual presence. Another, however, is how much we prefer actual presence with one another and how much more easily we learn when we have the full bandwidth of sensory perception at our disposal. So, I see the metaverse much as I do the internet – it will become an indispensable *part* of daily life, but for most people, it will be only a part. It might be where we do some of our commerce, if we're spending a lot of leisure or work time there. Some people will be professionally involved with running it and spend most of their time there. Until headsets become much more comfortable and less fussy, there will be resistance to 'having to go' there to get the tasks of daily life done. It's easy and convenient to pay for a transaction with a mobile phone – I don't see people wanting to have to don a headset to do transactions, though if the transaction is an 'in-game' one, that resistance disappears. We will still see a lot of resistance to wearing headsets or accessing augmented reality a la Google Glass because of the threat people of being surveilled and recorded. Expect that norms will develop about the times and places in which such equipment is 'appropriate' because we have learned so much about how the mobile phone can disrupt interpersonal communication when people are actually together."

Giuseppe Riva, director of the Humane Technology Lab at the Università Cattolica del Sacro Cuore in Milan, Italy, has been studying the use of virtual reality in mental health for 20 years. He responded, "One of the key problems of the uses of technology and social media today is that they erode our sense of community because, as I explain in 'Surviving COVID-19: The Neuroscience of Smart Working and Distance Learning,' they do not allow for the different syncing mechanisms that reduce the distance between individuals communicating online. Research shows that during the COVID-19 restrictions individuals experiencing distance learning and working felt more fatigue, anxiety, worry and discomfort. These types of experiences lead to a significant weakening of physical communities – they lead to more loneliness and individualism. There is hope that the future metaverse, by bridging the digital and physical domains using VR and AR, will actually create hybrid communities in which we neurologically feel the same syncing mechanisms we feel in real physical places, without the limitations online spaces have today. In a sense, we will no longer experience the separation of the physical and digital worlds, we will feel that we are working and learning in a hybrid setting with few if any boundaries. Obviously, this will also change what we consider to be 'real,' because everything digital will be as real in our minds as the physical stuff. There will be significant changes in our view of reality."

Stephan Adelson, president of Adelson Consulting Services, an expert in the internet and public health, predicted, "Business interests and the money they bring will help to move the technology. Those that provide a virtual work 'environment' for remote employees will prove to be profitable in many ways. Gaming will help to push physical technology, and, as media becomes more consumable through VR, new ways of interacting with movies and other forms of entertainment will emerge. I have already been seeing how my time in VR is changing my relationships. I am being exposed to people that I would likely have never met in the physical world and have become 'friends' with many that I know very little, always at their request. In many ways, links to these virtual friends are more casual and the connections are more transient and situational (per game, social environment, etc.).

"The virtual world Horizons by Facebook is a great example of a business that is trying to move an existing model into the VR world. In Horizons, people are able to create their own world and share it with others – in many ways, this move and structure is reminiscent of the MySpace when it first arrived on the scene. Each person could code their own page to make it personal and an expression of themselves. In some ways, Horizons is like Facebook meets MySpace in the metaverse.

"Some changes I expect to see are in how daily business is conducted in progressive companies. VR meetings could easily replace Zoom and Skype while making meetings more personal (being able to give a high-five for example) while giving the employee a 'place' to meet at the water cooler and chat – something very much missing from the current home-based working environment and

something that will be proven to be psychologically beneficial. People will begin to share with each other about positive relationships in VR and – similarly to what happened with online dating – because of positive word-of-mouth sharing the use of VR for socialization will increase, I think this is true especially because the isolation caused by COVID-19 has changed our social nature."

Conversely, **Melissa R. Michelson**, dean of arts and sciences and professor of political science at Menlo College, cited the pandemic for two impediments to rapid XR development, writing, "I doubt that the metaverse will be this far along by 2040 because: 1) The pandemic has revealed the degree to which modern life is dependent on chips, electronic parts and chemicals that are not always available. Generating a widespread metaverse will require large amounts of these items and a smoother supply chain. 2) The isolation imposed by the COVID-19 pandemic has illustrated just how crucial face-to-face interaction is to many parts of daily life. Some industrialized, wealthy enclaves might have robust metaverse presences by 2040, but I don't think it will include half a billion people. It will take longer, perhaps an additional generation."

Steve Jones, professor of communication at the University of Illinois-Chicago and editor of New Media & Society, wrote, "We have learned from experience of the pandemic in many parts of the world that interacting in other than face-to-face fashion is not as satisfying."

An expert on the evolution of algorithms responded, "The metaverse as currently articulated by Facebook/Meta is unlikely to be the point of all immersive activity/alternate world as it has been presented. However, given the range of pressures as a result of climate change, pandemic and the rise of flexible working, etc., alongside advances in technology, some form of metaverse seems quite likely. While there have been virtual worlds and a range of immersive options previously, these have been less evident or pressing in part due to the lack of contextual pressures we see now as well as some digital/technical literacy challenges that make engagement either cumbersome or less visible or attractive. Circumstances have changed, and it seems quite likely that this alongside changes in user tech literacy, new tools, etc., will enable a metaverse type of environment to become more desirable, much as the shift to the World Wide Web enabled the public uptake of internet as an everyday technology. This shift will bring with it many of the same challenges, rhetoric, etc., we have seen with the widespread adoption of other digital technologies."

A computational social scientist based in the U.S. observed, "Over and over, we have thought that the next internet technology would be the one that would finally connect people across distance. While each technology has helped somewhat, by and large, physical distance is still a huge factor in who we spend our time with."

A lecturer in psychology based in Cambridge, UK, commented, "The pandemic has revealed to us the importance of our experience and existence as biological entities. The only way the metaverse will be attractive is if the real world is rendered uninhabitable physically, economically and politically. Some large companies would appear to be targeting that as an outcome of their current practices, aided by the politically malevolent or naive, but my suspicion is that they will fail. Unfortunately, their failure will come at great cost to humanity and the planet, but they will fail."

Daniel S. Schiff, Ph.D. candidate at Georgia Tech, responded, "While some imagine extensive VR/AR adoption for regular organizational and business collaboration purposes, it is less clear that this major segment will drive uptake of the metaverse. Given the experience during the pandemic of frustration and digital burnout related to the use of mere two-dimensional video conferencing platforms like Zoom, individuals may be even less prone to more-immersive and potentially invasive VR-based socialization as a means of workplace collaboration. The same types of factors may limit uptake for regular primary, secondary and postsecondary educational uses that would otherwise promote widespread adoption and acculturation into VR."

5. The metaverse will not fully emerge in the way today's advocates hope

Nearly half of these expert respondents said much-more-immersive virtual settings will *not* have significantly broader influence in people's daily lives by 2040. Some said the buzz about extended reality (XR) is mostly what one called "typical tech hype." A share of them said they expect this cluster of technologies is likely to make a few expected but fairly minor ripples in the stream of overall tech development. Many expect that there will be meaningful upgrades in gaming, entertainment and business/education communications realms by 2040, and a notable share agree that XR will progress steadily as interactive technologies continue to gradually mature. Many noted that while quite a few fairly-immersive augmented and/or virtual spaces already exist, those spaces have not attracted a large percentage of the public's time and attention. This is proof, they say, that fuller immersion will remain uncommon.

Mark Nottingham, senior principal engineer at Fastly and a longtime leader in the Internet Engineering Task Force with expertise in internet and web standards, commented, "The 'metaverse' is a marketing confection with no basis in reality as of yet. Its proponents are focused on capturing a future market, not building new shared space without any single owner. There are no current efforts at interoperability, common standards, open governance or any other sign of creating what is being marketed – a peer of the web as a public, open space. As a result, what little that is emerging is lacks novelty; we've seen it before (e.g., Second Life). If it plays any role in future online life, based on what we see today the metaverse is likely to be 3D Facebook, more or less – a platform that a big tech company uses to monetise attention, in a winner-take-all marketplace."

Steve Wilson, founder at Lockstep Consulting and a VP and principal analyst at Constellation Research focused on digital identity and privacy, said, "The metaverse is mostly hype. It is not well enough defined for us to make predictions about a 'fully immersive' experience being more important by 2040. I actually agree that metaverse, as advanced virtual reality, should be important. It's not something that should be designed or rushed by commercial interests but rather may need to be allowed to evolve ecologically. I have been involved in digital identity since the dawn of e-commerce (1995) and I have seen how weirdly this field has evolved. The reasons are multifaceted, but some themes are clear and are important for metaverse:

- Most people underestimate what it takes to convert analogue life to digital.
- Digital assumptions/presumptions tend to be erroneous.
- A lot of work is based on false intuitions of what things like identity really are, at heart.

- Unilateral tech-driven analysis shuns decades of social science, humanitarian studies, political science, etc.
- There is overreach in digital, a personification of really mundane digital things, like IDs.
- There is an oversimplification or outright overlooking of risk because digital seems cool and antiestablishment.

"If we haven't got digital identity sorted out already (now, after 25 years), then we will find 'digital life' much harder to sort out and it will take much longer. In a nutshell, any metaverse by Facebook will die for the same twofold reasons as the libra cryptocurrency by Facebook. Firstly, obviously and almost trivially – the commercial interest of the platform operator is blatantly clear. Secondly and more subtly, blockchain and decentralisation technologies are a waste of time in the face of extant administration [of these platforms]. It is better to have transparent human governance to keep networks administrators in check than to put faith in a novel, opaque, unstable, misunderstood and inexplicable technology that promises to do things in the human sphere that no technology has ever done before."

A globally respected internet sociologist and best-selling author wrote, "The 'metaverse' is a bad idea being pushed by industry so of course it will have a presence, but it will not be adopted. It is a less intuitive, less useful form of connection. There will be less trust and more abuse."

A tech developer and administrator proclaimed, "The 'metaverse' is straight up cyberpunk dystopian nonsense. If I'm wrong about it not being a thing, it is to our collective detriment as a species."

Dave Karpf, associate professor of media and public affairs at George Washington University, observed, "I expect in 2040 we will have some very slick VR and AR head-mounted displays, but we won't have anything that matches the grand ambitions of 'the metaverse.' VR and AR are instead going to look more like today's wearable tech – nice computer products whose market reach and social implications are far more modest than their proponents and expert observers initially expected. The metaverse is not a new idea – the term was coined by Neal Stephenson in his 1992 novel, and it borrows heavily from the imagined futures of virtual reality pioneers in the 1980s. Technologists have been trying to build something like a metaverse since before there was a World Wide Web. The two things that make 2022's metaverse push different from previous iterations of the concept are 1) it has now been expanded to include augmented reality and extended reality, and 2) the hardware and software offerings have gotten much better. One can now play fun VR games, chat in VR chat apps, even attend VR meetings in some circumstances. If the previous failing of VR/the metaverse was primarily a supply-side problem, then we should expect to be on the verge of turning a corner. But if it's a demand-side problem – if people don't

especially want their gaming and their virtual meetings to be more physically embodied – then the technology will once again fail to gain traction on the mass scale. It is noteworthy, I think, that people have been promising this technology is going to change everything in the next few years since 2014, when Facebook acquired Oculus. We have now lived through eight years of tech evangelists insisting that the corner is about to be turned. At some point, we ought to start grading them on their performance instead of their potential. Even after the global pandemic lockdown year VR gaming is a niche activity. A few VR titles are now quite successful, but they are nowhere close to being the most popular or profitable games in the world. If gaming is supposed to be the killer app of the metaverse, then we ought to wonder why it still isn't making a killing."

Fred Baker, internet pioneer, longtime Internet Engineering Task Force leader and Cisco Systems Fellow, commented, "The 'metaverse' is a marketing program for the company that used to be called Facebook. Like most marketing programs, it will have its impact but it will not take over the world."

An expert on the sociology of information technology responded, "None of this online stuff changes human psychology at all. The metaverse is just a marketing term being applied to things we already have, and we've already seen how those things have played out, that is: Second Life, massively multiplayer online games (MMOs) like World of Warcraft, and MUDS (multi-user domains), just to name a few. It's mostly going to be like Second Life, which became populated by a lot of crazy people, sexists, racists, bigots and furries. Wired magazine was full of breathless articles every time some giant company decide to open a store in Second Life, but almost no one covered it when all of those companies quietly quit the platform since it was really quite problematic. So, yes, it is just a marketing term that seems flashy coming back and attracting the attention of young tech journalists and their public who have no idea that the metaverse is an old idea about 'new' worlds that will simply be taken over by really horrible people like those who have already taken over the tone of interactions on Facebook and Twitter."

Johnny Nhan, expert in law, cybercrime and policing and associate dean of graduate studies at Texas Christian University, wrote, "For now, there is no perceived value-added in the metaverse. Maybe 15-30 years from now, people's attitudes may change, but this is a case where the social is driving the technology and not vice versa. Socially, we have seen and documented the negative side effects of non-meta social media, and there has been a backlash on information sharing, especially with intrusive immersive technologies. They are not embraced as they once were, and devices like VR remain a niche. We tried earlier with Google Glass and augmented reality, and the social blowback from that undermined its success. Until we can get over the social factor, the metaverse will remain something that keeps getting reintroduced as something new and exciting but ultimately is a gimmick. The factors that contribute to this include privacy, safety,

convenience, price and, most importantly, social acceptance. The last part is a difficult hurdle that may be decades out."

Alexander Cho, digital media anthropologist and human-centered-design researcher at the University of California, Santa Barbara, responded, "There will be no duplicate reality in a digital realm mimetic to the 'real' – this is a fantasy of White male sci-fi writers that we keep buying into. Instead, what we will continue to see is the increasing interweaving of real and digital sociality, particularly the kinds and formats of sociality that are easy to monetize (pitched battles of affect, extremist content, algorithms driving experiences), with even-more-immersive ads. The real conversation should be less about shiny digital futures and more about the shocking gap between government regulators and the social technologies of today. The Federal Communications Commission should establish an algorithmic review panel, and social internet companies must be compelled to put together paperwork for government review whenever they want to change their algorithm in a way that might have disparate or disastrous effects, akin to review such as with the Voting Rights Act or an environmental impact report for new construction. That is what we should be talking about instead of being complicit in fantasies about the 'metaverse.' This current iteration of thought around the so-called 'metaverse' and its imagined futures is faulty for two main reasons:

1) It is a shameless and well-executed PR ploy by Facebook to deflect attention and drive discourse away from what we should really be talking about, the stark and galling disregard for basic democratic values, basic human dignity and basic ethical practices that The Facebook Papers uncovered – only to be buried by Facebook's rebranding announcement. I can't emphasize enough how successful this PR scheme was. Facebook was in hot water – one exec even capitulated to the idea that the government should be able to regulate their algorithm in an interview with the British press. And now where are we with that? Totally gone. We do not need to be talking about the 'metaverse' anymore, it is itself playing into Meta's branding exercise.

2) It is completely ahistorical and unsophisticated/not informed by the decades of research we already have on internet and social media spaces. It is ahistorical in the sense that we have had many attempts and philosophies of this ilk before, from the disembodiment rhetoric of early internet thinkers and text-based chat rooms (and all their accordant raced and gendered baggage) to the fascination with Second Life. We need to ask, 'Who has the privilege to be uncaring about the markers of their physical body?' And, in that sense, it is unsophisticated because it perpetuates the idea that there is even a binary in this way."

The director of a center exploring the future of knowledge infrastructure responded, "AI is in yet another hype cycle. It is unlikely that people will be that interested in virtual reality. Real reality is hard enough for most folks. Climate change, cyber warfare and actual warfare are

much bigger concerns. AR, VR, etc., are likely to go the way of those sim worlds in which universities were buying islands a decade ago. We're all tired of Zoom after two years of pandemic. A walk in the woods or even the city streets is much more attractive."

Bernie Hogan, senior research fellow at the Oxford Internet Institute, commented, "Is the metaverse a representation of space or a reconfiguration of sociality? There is no doubt that social life will be reconfigured as ML/AI-based predictive technologies will continue to shape our experiences and constrain our choices. However, the representation of this data as being in a 3D environment or somehow requiring sensory immersion is as much of an artifice now as it was when social network sites conquered virtual environments a decade and a half ago. What's more likely than trying yet again to skeuomorph or project a fantasy land is that conversational bots will get smarter, drones will get more autonomous, and generally our meatspace will get more datafied rather than simulated. Ultimately the most powerful tool for seeing is the mind's eye. And in the mind's eye we have already created vast social spaces of data, from text-based ones to our current feed-oriented social media systems. Virtual-reality spaces are likely to increase in popularity as a leisure time activity for some, but for others they will remain hopelessly inaccessible or too restrictive. Technologies for augmented reality may become increasingly popular in niche applications, but their social impacts and discomforts are likely to persist in everyday life. The real interesting feature will be how we choose to structure and encode life, not how we choose to represent these encodings visually."

George Lessard, information curator and communications and media specialist at MediaMentor.ca, responded, "It's marketing bull---- and I hope people will figure that out by then but probably not, just like it is now with Facebook."

Gary M. Grossman, associate director of programs in the School for the Future of Innovation in Society at Arizona State University, responded, "There are several reasons why I don't expect the evolution of the metaverse to be this far along:

1) This sector has always overstated the impacts of technology on human society. Technology will change some things in some respects, no question. Information technology has transformed many human activities. However, this has not happened in ways as imagined in, say, 1980. Fundamental human issues persist, regardless of the level of technology a society embraces. Human society of 2040 will look a lot like human society of 2022, with certain changes in certain sectors, just like it is now and as it was in 1980, in 1900 and in all previous times.

2) This anticipates a far more extensive access to the technology than is likely to occur in fewer than 20 years. I can imagine that certain strata in each society will engage some aspects of XR more fully, but for it to reach so far, so deeply and so quickly will involve many more issues than

mere technological potential. We would have to accept far greater social, political and economic infrastructural change to accommodate it effectively, and I doubt very much we shall.

3) Implicit in the previous point, human society evolves as well. The vision of the metaverse is an idea from 2022. How it becomes incorporated into human society is the key."

Kerry Rego, a social media and technology consultant based in California, commented, "I can't think of any positives that come from this technology adoption, only inequities and negative impacts on physical, social and emotional health. The technologies used in the metaverse have been around for decades. The cost of the hardware has been consistently out of reach of the average buyer – not that some can't afford it, but it's beyond the comfort zone. Its development has been clunky and its usefulness is debatable. There will be some adoption, but not en masse the way it is currently envisioned by enthusiasts. It's not that it's not possible, but with the current players it is unlikely."

Matt Schmidt, physicist and programmer at Washington University School of Medicine in St. Louis, responded, "The metaverse seems to promise to bring a new era of economic exchange when in fact it should be considered only of use for its entertainment value. Many people are coming to the realization that cryptocurrencies, as well, serve no real purpose and have no intrinsic value. They are simply an investment piece as a speculative asset that will most likely not last in value."

Neil McLachlan, consultant and partner at Co Serve Consulting, Australia, commented, "The current and likely next-generation technologies are no more capable of synthesising believable VR worlds than they were 20 years ago. The trip from, say, the first Skype release in 2003 to the clunky incompleteness of pandemic-boosted work-from-home technology such as Microsoft Teams is a reasonable approximation of what happens with interactive technology over a 20-year timespan. A lot happens but little real progress is made."

Jesse Drew, associate professor of technocultural studies at the University of California, Davis, wrote, "While fundamental aspects of the so-called metaverse will be implemented, this experience will be relegated to a more trivial aspect of daily life, certainly not the deserving the hype that is being generated about it. Gaming, communications, household tasks and electronic control systems will be improved, but I see two forces that will curb its importance. Overall, the environmental appreciation/devastation now unfolding will render nature more important to us and help to trivialize our gadgetry. Reaction to blockchain will be part of this rejection, as was the case with nuclear energy in the 1970s and 1980s."

William Lehr, an economist and tech industry consultant who was previously associate director of the MIT Research Program on Internet and Telecoms Convergence, said, "I think the vision of a fully immersive metaverse is important and relevant, but 2040 is 20 years is too soon. Reaching the goal of XR being 'fully immersive' is a tall order, and adoption by half a billion people globally suggests rapid takeoff. We aren't going to be there.

"Metaverse is best understood as a vision of the horizon. It is a vision for a much more capable virtual world that will both augment and substitute for real-world activities and engagement. Moreover, once we have the basic capabilities to enable a much richer and comprehensive virtual world (one that extends beyond the 'horizon' of users embedded in the world), why should we think we would want or have only one? There are lots of potential forks in the road, and which of those forks that folks follow will be a result of both policy and path dependencies – I do not significantly believe that technical constraints will be the most important limitation (i.e., inability for AI systems and computing hardware/software to solve the necessary problems to enable a much more immersive and capable virtual world experience than we have today). With respect to the forks (and path-dependency issues), we do not know yet which forks we want to foreclose and whether we may be able to do so. Is the metaverse a good thing on balance? That is akin to asking if AI is a good thing on balance, and it is a silly question ultimately.

"Obviously, there are lots of good and indeed necessary things in AI, and the metaverse will enable that are good, but there are also lots of bad things that may come. It could be a tool for promoting equity, social justice and better matching supply/demand for more localized markets (where local is any difference that makes a difference). I believe that metaverse and the capabilities that will make it possible (and metaverse may mostly be about demand pull to create those capabilities – although I am not saying that, just suggesting it as a sufficient basis for seeing its development as positive) will prove essential for us to address climate change problems that pose an existential threat to the planet (aka, we need the AI and connectivity that the metaverse will need to sustain a shift to renewable and more efficient energy usage and other scarce-resource models)."

Glyn Moody, technology journalist and author of "Rebel Code: Linux and the Open Source Revolution," responded, "Different versions of the metaverse will exist, but most will be fairly trivial and low-level – more like games than anything useful. But they will nonetheless appeal to many people who wish to while away their time."

Ian O'Byrne, assistant professor of literacy education at the College of Charleston, commented, "The term 'metaverse' is currently a catch-all term for anything that will change with the Internet as it evolves over the next decade. The same is true of the use of terms like Web3. What is exciting about these changes and the maturation of digital spaces is that it appears that a general decentralization of places, practices and policies could be possible. Web3 may become an arbitrary

evolution of digital spaces in which connections between users can take multiple paths. Perhaps digital spaces will be more distributed and, hopefully, users will have more control over their data, information and identity. However, it does seem like most of the solutions we're seeing in terms of blockchain, distributed ledgers, the metaverse, NFTs and 'what comes next' may not turn out to be better than the current solutions. Still, it is exciting to think about possibilities of decentralizing power and decision-making. Add transparency in the model, and count me in."

A tech developer and administrator proclaimed, "The 'metaverse' is straight up cyberpunk dystopian nonsense. If I'm wrong about it not being a thing, it is to our collective detriment as a species."

One respondent expects there may be some new wrinkle by 2040 that will be much better than the metaverse. **Jean Paul Nkurunziza**, secretary-general of the Burundi Youth Training Centre in East Africa, commented, "In 2040, there will be more-efficient online platforms providing more-efficient solutions than the metaverse."

And **a professor of sociology based at a major university in Texas** wrote, "There are competing technologies that will inhibit the widespread use of virtual reality and other component parts of the metaverse. Capitalism thwarts cooperation. The metaverse will be possible, but not a fully-functioning reality within the next 20 years."

More expert responses by those who do not expect the metaverse to be widely embraced by 2040 follow below. They are organized in sections that help illuminate the four most-mentioned reasons for these experts' doubts:

- The "metaverse" will not be seen as useful in most people's daily lives.
- The technology needed to reach more people more often will not be ready in 2040.
- People will prefer living in layers of "real" reality.
- Public worries over the impact of surveillance capitalism and authoritarianism will slow or stop adoption.

The metaverse will not be seen as useful in daily life

A share of doubters about significant and widely adopted XR advances predicted that, unless people are required to do so – for instance, by employers, government agencies or health or other public services entities – most will not wish to spend their time, money or attention in more-immersive virtual settings. These experts point out that the public has not found the tech to be useful enough to become immersed in it. Second Life was often used as an example when respondents commented that the public has had the opportunity for many years to participate in a

number of fairly immersive virtual spaces but has not broadly embraced them. This early VR metaverse platform emerged in the mid-2000s and has gradually been improved, but participation on it plateaued years ago.

Leah Lievrouw, professor of information studies at UCLA, wrote, "Ultimately, to succeed and be an acceptable and meaningful part of social life, the metaverse will have to be far more inviting, comfortable and relevant to the lives of a much wider range of people, communities and cultures and better-articulated with people's real-world experiences and concerns than it is being positioned as now."

Morgan Ames, associate director of the University of California Berkeley Center for Science, Technology, Medicine & Society, wrote, "We have already witnessed several hype cycles focused on virtual worlds, the most recent widespread one focused on Second Life more than a decade ago. One thing that every single one of these hype cycles has failed to engage with is the Achilles' heel of virtual reality: how badly it integrates with patterns of real life. First, it is hard for people to have enough space in their physical environments to realistically move around in virtual worlds. Moreover, these virtual worlds tend to be solely visual and aural; relying only on these two senses is far from 'immersive,' and the many attempts to give tactile and other kinds of feedback have been crude at best. In addition, there is a significant portion of the population that continues to experience motion sickness, migraines or other debilitating physical symptoms in virtual worlds. While increased frame rates can help some with the last point, the first two are not going away. The comical lack of legs in Meta's metaverse vaporware videos just drives this home! A vital element of this is virtual reality's inability to blend with commitments and attention needs in real life. When we use our mobile phones or other devices, we still have ambient awareness of our environment and can generally be easily interrupted. This kind of use blends with caretaking duties and other practices of care that shape many people's lives. Virtual reality, in contrast, removes that ambient awareness. Indeed, there are plenty of videos of people with VR headsets tripping over their toddlers, and the vaporware videos that Meta has put out about the metaverse exhibit this as well – even as they try to pitch it as a 'plus' for people to escape real life."

Ben Shneiderman, distinguished professor of computer science and founder of Human Computer Interaction Lab, University of Maryland, commented, "I believe that there will be rapid evolution and improvement to immersive digital spaces, which will be used by many gamers, people seeking entertainment and some specialized users such as surgeons. The greater successes will not be what I would call 'immersive.' There will be improved versions of Zoom, Kumospace, etc., to make conferencing more interesting and video phone calls more enjoyable, e.g., allowing those receiving images to shift the view left, right, up or down. In 2040 immersive spaces which require users need to block out the surrounding 'real' world will be attractive only for some users and for some applications."

Christine Boese, an independent scholar, wrote, "I've been re-listening to a recording of author Neal Stephenson's 'Snow Crash.' His metaverse had its best chance with Second Life. Well, Second Life didn't hold audiences as fully as the science fiction imagining of it. Nor has AR/VR proved as compelling as William Gibson cast it in his wide-ranging books. If communities and social postings can't hold an audience in an immersive, virtual environment, how could virtual commerce reinvigorate the space?"

Jon Lebkowsky, a former CEO and founder of three tech companies, now an activist writer/blogger focused on strategic foresight, cyberliberties and digital culture at Plutopia News Network, commented, "My three decades of experience working and playing online has taught me that, in general, the simpler approaches prevail. For example, the strong preference of simple text messages for communication. A lot of people play immersive 3D games, but many more don't. Second Life has had a pretty devoted set of adopters, but it never took off in a big way. I don't see any evidence that people will prefer to spend time online in immersive 3D environments, which is really what the term 'metaverse' suggests. This is not to say that there won't be meaningful advances and implementations in using mixed-reality technologies. But I think the technologies most readily adopted will be those that are more subtle and nuanced in their implementation, perhaps practically invisible."

Thomas G. Dietterich, professor emeritus of computer science at Oregon State University and co-founder and chief scientist at BigML, which provides large-scale cloud-based machine learning services, commented, "While I can imagine their use for compelling art, entertainment, education and gaming, inherent limitations of virtual worlds will limit their use in other aspects of life. We have decades of experience with virtual worlds. They have attracted only a small fraction of the population. Why haven't they been more popular? Let's turn this question around and ask: Why would we expect them to be popular? For gaming and for artistic experiences, virtual worlds offer experiences that are not available in the physical world. One can also imagine virtual travel that would allow anyone to visit Pompeii or the great pyramids without the need for travel. But virtual worlds cannot replicate physical experiences. Virtual swimming is not physical swimming; virtual roller coasters are not real roller coasters; virtual displays (especially head-mounted) cannot replicate all aspects of visual experience. And, of course, virtual sex is not real sex. In addition, virtual worlds have increased risks of fraud and deception. In the physical world, you can at least see a person's real face and read their actual body language. In a virtual world, this can all be fake. We already see many forms of fraud, including relationship fraud, happening without VR or AR. In addition, virtual worlds remove risk, and hence, are less compelling and less authentic. The risk of making yourself physically vulnerable to another person for courting or for fighting. The risk of sports. I predict there will be an 'authenticity' backlash against not only virtual worlds, but also Instagram. The hippies of the 1960s will seem clean and well-kempt compared to the authenticity seekers of the 2030s."

Jason Hong, professor at Carnegie Mellon's Human-Computer Interaction Institute, wrote, "This is, what, the third, fourth, fifth time that industry has tried to advance AR/VR? What's different this time? Okay, we've got better hardware that is lighter and better battery life. We've got faster networking and cloud computing. But is this really enough? VR has been around for ages and works pretty well for some gaming situations, but what other use cases? Or, put more simply, will AR/VR offer enough value over existing smartphone + web, at a low enough 'cost' (price, usability, social acceptability, battery life) that it will take off? How many scenarios are there where AR/VR works better than a person whipping out their smartphone to get the same information? Sure, smartphone + web is not as dazzling or awe-inspiring, but it's cheaper to make, easier to program and it gets you probably 80%-90% of the way there. I'm a huge skeptic of blockchain apps, too. It's been around for 14+ years, and bitcoin is still the only compelling app. And bitcoin, so far, is only really good for transferring funds from one place to another (cheaper but probably not easier than Wells Fargo), buying drugs and other illegal things online, and ransomware. And it only takes the same amount of electricity as … I don't recall, Iceland? Venezuela? to do these things. The first good webpages came out pretty quickly after Tim Berners-Lee invented the web. The first good applications came out pretty quickly after the PC and the smartphone. We're still struggling with AR/VR as well as blockchain, despite many more years. I don't see anything fundamentally changing here."

Micah Altman, social and information scientist at MIT's Center for Research in Equitable and Open Scholarship, responded, "To be sure, virtual world-building has the potential to offer rich, immersive social interactions that support a freedom of association that creates opportunities to build new communities and new types of communities. However, environments like Second Life and the even earlier text-based MUDs [multi-user domains] demonstrate that these benefits do not require sensory immersion. In *some* conditions social interaction can be enriched by sensory immersion. For virtual worlds to fulfill this level of potential however, the users themselves must be able to meaningfully shape them and the social affordances they provide – something unlikely to be part of Facebook/Meta corporate-owned unified metaverse."

Eugene H. Spafford, internet pioneer and professor of computing sciences at Purdue, wrote, "The 'metaverse' may be useful in entertainment, but for many business uses it will be too much overhead for interactions. We have already seen some real fatigue for virtual meetings during the pandemic. Maintaining and using the avatars and environments will likely be similarly novel at first, then quite fatiguing for regular use. Problems with privacy, security and rejection of abuse (ads, trolling, stalking, etc.) will make it problematic for many users. Cultural differences also will mean that it will be a poor mechanism for international trade and communications.

An anonymous respondent commented, "I see the metaverse as a cynical ploy by tech companies to grow their margins. It is a product that lacks product-market fit. I don't see the need

to which the metaverse is responding. For niche applications like video games where immersion in an alternative reality is half the point, VR immersion can be cool. But removing physical attributes in work or social settings can actually hurt communication. Zoom meetings are bad enough; what would Zoom meetings with avatars add?"

Robert Y. Shapiro, professor of political science at Columbia University, said, "People will not devote the time needed for this. They have a life in the real world, barring future pandemics."

Adam Peake, a longtime expert in internet policy who has been active in global policy circles at ICANN, IGF and the World Summit on the Information Society, wrote, "Unless people change their attitudes about body modification and the metaverse via implants, I can't see people wanting to use the service. Just as many people today who have to wear glasses to see well do not get laser surgery – a well-established procedure – I can't see such mass changes in attitudes happening."

Howard Rheingold, pioneering internet sociologist and author of "The Virtual Community," said, "Although the term 'metaverse' is being applied to ideas outside the scope of 'fully immersive digital spaces' (which I take to be a term for what is now known as VR), my experiences with VR and Second Life have led me to believe that while there will indeed be a significant and lively population in metaverse worlds, (think of how e-sports is already more lucrative than physical sports) it will not be a significant proportion of the human population."

Peter Rothman, lecturer in computational futurology at the University of California, Santa Cruz, responded, "The current metaverse concepts fail one key point: There's no reason to use them. Sure, entertainment spaces – previously known as online games – will continue and extend to include persistent worlds, economies with real value, etc. However, in order to be a metaverse worthy of the name people would need to operate in and literally live in the metaverse on a daily basis, much like they use social media today. See the 2007 report from the Metaverse Roadmap project."

Dmitri Williams, associate professor of technology and society at the University of Southern California, wrote, "The metaverse or metaverses will be very robust by 2040, but I don't think the metaverse as seen in some fantastical visions will be a part of daily life for a majority because it doesn't fulfill the roles and functions we expect in daily life – conducting business, managing friendships, getting information, etc. It will become more important as entertainment for those who enjoy that kind of interface and like playing a participatory role in imaginary content. This has been a vibrant niche since the 1980s, and I don't see that fundamentally shifting. I expect the same kinds of shifts and effects we've seen in the transformation of streaming TV and games, and likely not on a much larger scale. Those functions are already at maximum penetration for most of the world, and so we have to take on the zero-sum perspective: New technology always prompts

people to say, 'What is this new thing doing to us, or for us?' but that's not the right question. The right question is, 'What is this new thing doing to or for us more or differently than what it replaces?'

"Games had to be viewed in terms of their relative merits and harms compared to TV, not just on their own. So, metaverses will be the same. We'll see loads of the types of predictable values-and-concerns questions outlined in the 1980s by media effects researchers Wartella and Reeves: What is this new wrinkle in communications stopping us from doing that we value? How does it harm us physically? How does it harm us socially?

"I don't think the answers to these questions will be a lot different than what we've seen over the last 30 years with video games and the Internet. For what it's worth, this was my dissertation topic: I foresee old wine in new bottles. The positives and negatives are the same as with games and the Internet: There are some small harms in regard to aggression but more harms in regard to being social and experiencing communities in real space, being less present and less connected with each other. There will be some positives in regard to individuals' self-expression and the ability to transcend location to make new connections and experience new cultures and ideas."

Meredith Goins, a group manager connecting researchers to research and opportunities at U.S. laboratories, responded, "I have yet to hear a compelling story as to why I should be interested in joining the metaverse, I have a hard enough time keeping up with my current physical world space, I don't need another space to maintain. Heck, I am barely on social media anymore as it is too divisive and time-intensive and rarely pertinent to my daily needs."

An expert in large-scale systems and networks commented, "Overall, I find the metaverse narrative unconvincing. People want to connect to each other, but it is not clear that they want to connect mediated by 3D virtual reality. I suspect many people will prefer to connect in person for rich interactions, and that 3D virtual reality will be limited to more-narrow or specialized uses."

George Capowich, retired associate professor of sociology at Loyola University-New Orleans, wrote, "The technology will not evolve as quickly as its advocates expect. It has a long way to go before it is more than a way for people in different locations to play games together and meet. People already do those things with their computers. Its influence on daily life will definitely take time to develop. Google Glass was introduced in 2013 as an early form of augmented reality glasses and it bombed with the public. The capacity it gave people – showing them an information display in eyeglasses – was limited and in many cases unnecessary. People who used them seemed awkward to people they encountered, who often thought they were acting oddly and perhaps a little spookily (i.e., what is that person with the glasses looking at while talking to me). It takes time for optimal uses of new technologies to emerge. The microwave oven was first introduced in

1947 and billed as a revolution in cooking that could save time and completely eliminate the need for ovens and stove tops. Over the many decades it took to finally be widely adopted, we learned that microwaves are useful but in more-limited ways. They're great for warming leftovers, cooking frozen meals and making popcorn. We still need ovens to make family dinners and stove tops for sautéing meats and vegetables. The metaverse is in its early days and will be for a while."

Randall Mayes, journalist, author and instructor, responded, "The positives are not obvious. People are not saying if we had a metaverse, we could do this and do it better. Internet entrepreneurs are presenting a vision of the building of a rather ambiguous cyberland and will let others figure out what do with it. There are two distinct ways to look at the metaverse. Some see a revolution or paradigm shift to a new era some are labeling as 'Web3.' I am more in line with the line of thinking that it is not a move into a virtual world or space, it is simply a continuation of the evolution of the mobile internet. The way the internet looks in 2040 will depend on how the metaverse's different products, services and capabilities integrate over time. For gamers, the benefit is recreational and perhaps feeding their addiction.

"In order to inspire broader adoption, tech startups and established businesses will have to integrate products and services that can provide benefits by outperforming other digital technologies. However, because this evolutions does not have a well-defined conceptual definition or legal infrastructure, investing large amounts of money in virtual real estate and business transactions is risky. McDonald's recently announced that in the future customers will have an option for ordering food from their virtual McCafe using digital coins and rather expensive hardware in the form of a headset and have it delivered. This will help eliminate paper money and coins, but does it really have an advantage over a credit card order?"

John Lazzaro, retired professor of electrical engineering and computer science at the University of California, Berkeley, wrote, "We already ran this experiment with Second Life. Wagner James Au, author of 'The Making of Second Life: Notes from the New World,' makes a compelling case that the asymptotic endpoint of metaverse communities is a multidimensional niche: People of a certain age group, willing to spend a limited amount of time in the medium, to do a narrow set of activities. I read an interview with him conducted by Parmy Olson in the Bloomberg Opinion section and he makes his case well. I'd recommend that people interested in the topic track down this interview on the web and decide for themselves."

A veteran principal engineer who has worked at several major tech companies wrote, "Its success will be all about what it can do to enable and coexist with actual human factors. The metaverse is an area that can continue to enable better and more-complete remote collaboration on a variety of different fronts – telemedicine, remote work, social interaction, customer service, training/school, even things like virtual shopping – trying on clothing to see how they fit you

personally, testing how you fit in a vehicle, virtually touring a home or apartment and trying out some art or a new paint color in your space. While it is true that there are some experiences that do not translate well to the virtual space and continue to benefit from physical presence, there are also many that will benefit from a better representation of physical space in the digital domain so that humans can interact more naturally with one another – the virtual bar, watercooler, meeting space, etc.

"There *can* be a better representation of things like social cues, facial expressions and the like. This will be critical for the metaverse to become something better than a glorified Zoom call. We've gotten a lot of experience over the last two years on what it's like to have much more of our day-to-day interactions be in the virtual domain – what works, what doesn't, how to make it feel more natural. We have to learn from those experiences to have this be something other than another Second Life clone that is only ever adopted by a subset of society that already takes well to existing in primarily-virtual spaces. If 'normal' people can't see this being an acceptable substitute for physical presence in a variety of applications, it will fail."

A UK-based expert in virtual environments, digital media and the social science of the internet said, "As someone who has studied virtual reality for 30 years, with two books, edited books and many papers in top journals on the topic, I can definitely say that the metaverse concept is complete bull----. VR goes through waves of enthusiasm and disappointment and will evolve toward niche uses of immersive plus widespread videoconferencing and various mixed applications."

The technology needed to reach a lot more people will not be ready in 2040

A share of respondents said they believe the needed developments in software, hardware, user interfaces and/or network capability will not be advanced enough within the next 18 years. They cited various reasons, including that the network infrastructure will not be sophisticated and built out enough to handle it; the gear will not yet be user-friendly; and there are cost and accessibility issues.

Vint Cerf, Internet Hall of Fame member and vice president at Google, wrote, "I am unpersuaded that we will see the same proliferation of headsets as we see with mobiles and laptops. It is possible that 500 million may actually have headsets by 2040, but the 'network effect' might require much denser proliferation before people will feel compelled to acquire them. If inhabiting the metaverse involves physical movement to move about in the VR, this would have to be done in facilities especially designed for that purpose to keep from running into walls, windows, etc. Virtual conversation will be very artificial because the headset obscures actual faces. Manipulation

of virtual objects may be interesting and useful (3D whiteboards for example). Concurrent occupation of a 3D space could allow interesting simulations to be undertaken, models to be examined. If the concept does catch on, there will be interesting business opportunities selling virtual clothing, objects, tools, avatars, etc., and the difference between real and fake will continue to shrink."

Eric Burger, who recently worked in the White House Office of Science and Technology Policy and as chief technology officer at the FCC, now on the computer science faculty at Georgetown University, responded, "The metaverse will pan out like remote-controlled self-driving cars or roadable aircraft: almost here for decades yet *structurally unlikely for decades*. The use cases for fully immersive experiences have a small niche that, for economic reasons, is unlikely to grow into a global phenomenon for decades to come."

Leah Lievrouw, professor of information studies at UCLA, wrote a comprehensive response that covers several of the issues that are likely to slow development of a more-sophisticated XR metaverse. She wrote: "The estimate of a half billion metaverse users by 2040 is a relatively small fraction of the world's population, which is currently nearing 8 billion and will be nearing 10 billion if current growth rates continue. To support smooth-running, broad-based accessibility and ease of use, digital infrastructure would need to evolve and innovate at a much quicker rate by 2040 than it has done over the last decade or so.

"Today's devices are increasingly loaded with features and sensors, etc. – smartphones, watches and other personalized tech are essentially always-on surveillance tools – and networks/'clouds' carry and capture a lot more data, but people mostly use the same smartphones, tablets and laptops for everyday internet use that have been around for a generation, and the internet runs on the same (still robust) protocols.

"Today's quirky and cumbersome headset or haptic-type devices for VR, AR, etc., have *not* gotten a lot of uptake – they're intrusive, disorienting (even nauseating). More powerful desktop devices are still required to support full-spectrum, intensive gaming, data analysis and visualization, perhaps especially blockchain technologies, and so on. All require mind-boggling inputs of energy and natural resources (minerals, water, non-recyclable materials).

"This is itself a separate matter from real (social, economic, geographic, etc.) accessibility to high-speed digital networks, which is extremely and persistently uneven as a result of market pricing and monopolization and the near absence of public service obligations or consistent regulation that would ensure competition."

Steve Jones, professor of communication at the University of Illinois-Chicago, said "The extent of development of technology to make some kind of virtual reality better than the next best thing to being there is out of reach in a 20-year time period."

Daniel S. Schiff, a Ph.D. candidate who studies the governance and social and ethical implications of AI at the School of Public Policy at Georgia Tech, offered an even more comprehensive view of a number of issues tied to the tech needed for fuller AR and VR functionality and adoption. He said, "Today, a decade after Oculus had a wildly successful Kickstarter campaign, adoption of VR and AR headsets and accessories remains limited. Headsets continue to be bulky, clunky and often difficult to use, especially for individuals without significant technological literacy. Setup is challenging, often involving the use of high-powered and currently hard-to-access video graphics cards, base stations for tracking, sufficient room space and wired connection to high-end computers. Less-advanced VR systems rely on presently inconsistent wireless connections or offer less graphical capability while also presenting challenges in terms of battery capacity and interoperability. Meanwhile, the cost of these systems often remains in the high hundreds to low thousands in U.S. dollars, an inaccessible price point for most of the public even in high-income countries, much less for individuals in low-income countries or regions. This alone presents a significant barrier to global adoption on the scale desired by the metaverse's advocates.

"Many of these barriers might be surmounted over the next decade or two. To solve these challenges, developers will minimally need to take advantage of wireless technologies perhaps two or more paradigms further along, improve battery capacity and visual fidelity, improve internal or cloud-based graphical processing power and simultaneously decrease the size and increase the comfort of VR devices. Moreover, they arguably need to address all of these challenges together rather than trading off between them, and they must do so while reducing costs by almost an order of magnitude. Such advancement not only requires generational leaps in VR/AR technology directly; it also depends on broader trends in computing, battery and wireless technology adoption, and will be sensitive to challenges such as supply chain stability, rare-earth mineral availability, cryptocurrency mining, energy usage and environmental concerns and regulations surrounding privacy or misinformation. Challenges with interoperability may come into play as companies compete to 'own' the metaverse.

"The broader public is the audience that is critical to the development of an actual metaverse. The phenomenological experience of embedding oneself in a virtual space arguably requires a deeper shift in paradigm as compared to the shift in adopting computers, smartphones and wireless internet, and such a shift may require generational change. It will be hampered by intolerance of older generations and parents/guardians of youth. These changes are not likely to occur seamlessly. It seems possible that many tens of millions of individuals will enjoy VR spaces for

activities like simple conversation, digital shopping and digital tourism or other entertainment activities. However, even these basic activities come with possible discomfort from headsets, motion sickness or eyestrain, wearing a VR headset, goggles or gloves for hours at a time.

"The further expansion of widespread multi-environment or user-generated approach to the metaverse (the Second Life, Roblox or Minecraft model) and its use in training settings is plausible. To become more broadly populated, the metaverse may need to replace current social media (the Facebook or TikTok model) to truly reach hundreds of millions of people consistently. Overall, then, while it seems likely that hundreds of millions of individuals may engage with VR/AR technologies in the next decade, my suspicion is that most uses will be targeted in nature, rather than reflect a societal-wide shift toward a shared metaverse or metaverses as a staple of daily life."

The biggest stumbling block to rapid high-resolution, low-latency, real-feel VR immersion is the cost of creating a global network that can support this vision

Randy Marchany, information technology security officer Virginia Tech – he previously worked with the White House Partnership for Critical Infrastructure Security – wrote, "Universal high-speed internet access won't be ready by 2040. You need fat pipes to handle the traffic, and not everyone will have equal access to the net. High-speed Internet infrastructure is the key to allowing these new technologies to work."

Neil Davies, co-founder of Predictable Network Solutions and a pioneer of the committee that oversaw the UK's initial networking developments, commented, "There are fundamental network constraints relating to both the amount and timeliness of information that has to be exchanged, irrespective of the amount of local storage and computation. Those limits are fixed, some of them are physical (timeliness being the main one), some of them technological (capacities of non-wired connections), many of them economic (computational power need to create and maintain an environment, whether the statistical multiplexing needed to make deployments cost-effective can ever be reached).

"There will be niche uses – but to affect daily lives in the hundreds of millions? For that to happen it will either be a low-grade experience (not that immersive) or only for the few (so not much of a global society). Will it be a new digital divide? The question that needs to be addressed is what are the set of experiences that can be effectively distributed? If the digitally-mediated 'reality' is one that does not allow the user to enter 'flow' then it is not going to be usable/used (and may even be deemed harmful – this concern is already present in other areas). Distributed haptics (as needed to emulate remote sensations of touch) is already a barrier – a 1 millisecond variance between what the user 'expected' and what they 'experienced' is sufficient to create cognitive dissonance. It

creates a visceral uncertainty that jars people fundamentally. Think missing the bottom step on a staircase or similar.

"When it comes to distributed-ledger technologies in regard to metaverse development, again the fundamental constraints above are going to create the limits. The global distribution of information for ledger updates takes a non-trivial time. Combined with the information density that such global distribution requires means that they will hit two fundamental limits: timeliness and economics. I am all for the breaking down of hegemonic barriers and creating high-value distributed interactions, it is just that approaches being promulgated are ignoring the fundamentals and are only going to disappoint. This doesn't mean that fortunes can't be made along the way, but it does raise the question of whether those pushing this future understand – are they unaware or just blowing up the next bubble?"

Stephan G. Humer, sociologist and computer scientist at Fresenius University of Applied Sciences in Berlin, said the focus of network development the next decade will not be on enabling widespread XR. "The war in Ukraine," he said, "will strongly influence the further development of digitization. As a result, we will see a strengthening of, among others, cyberdefense, resilience, disaster management, civil defense, civil digital competence and critical infrastructure. As a result, other aspects of Internet development such as the metaverse are likely to have to take a backseat to those needs, if not bow to them."

A share of respondents said the metaverse will not be broadly popularized unless its level of ease of use can match the natural feel and convenience the public has been experiencing with smartphones.

A longtime leader in IETF and principal architect at one of the world's top five tech companies said, "The current metaverse ecosystem has inherent limitations that will prevent it from becoming a mass-market phenomenon. One is cost: The headgear requires the computing power of a high-end smartphone or game console. Unlike games, which can be streamed from the cloud, attempts to support the metaverse on smartphone platforms (e.g., Google's Daydream View) have not caught on. Unless the cost problem can be addressed, widespread adoption within developing nations will be precluded.

"Another issue is intrusiveness: The current generation of goggles, unlike a smartphone or smartwatch, or smart glasses, interferes with daily life. Instead of tackling these basic issues head on, Meta is attempting to bring Oculus headsets to the mass market via brute force: attempting to unload them by the truckload at Costco, and spending huge sums on developing the metaverse ecosystem to drive demand. This effort has been an unprecedented failure, destroying a third of Meta's market capitalization as soon as the debacle became clear to analysts. At this point, the

only likely potential prospect for bringing the metaverse to the mass market lies with Apple. Microsoft is focused solely on enterprise with HoloLens, Google has given up on Daydream and Meta needs to refocus on competing with TikTok."

Daniel S. Schiff, Ph.D. candidate at Georgia Tech, responded. "Though norms can and do change, continued challenges with social acceptance and feasibility of use could significantly limit the penetration of the metaverse. For example, while primary and secondary school students can easily access a smartphone to use traditional text, image or video-based social media services, it seems highly likely that it will be more difficult to pull out a VR headset in a classroom or school hallway, for functionality and safety reasons, and given limited tolerance of authorities. The same applies to individuals waiting in line at the grocery store, doctor's office or in the workplace generally. If the metaverse is then relatively relegated to protected entertainment time in dedicated spaces at home, its overall penetration could be significantly undermined. Considering that persistent usage of smartphones across all spaces of one's life is associated with social media's 'addictive' qualities, a lack of persistent usage of VR headsets inversely implies less adoption."

Christian Huitema, a privacy consultant, 40-year veteran of the software and internet industries and former director of the Internet Architecture Board, asked, "Can virtual reality really appeal to most people? We see people glued to their phones and we might imagine them lost in their VR helmets, but the human interactions for VR are very hard to design, as shown, for example, in the absence of legs in Facebook's 2021 avatar prototypes. The current technology can capture facial movements and transport them to the head of an avatar, but managing the whole body is lot harder. People using VR equipment cannot move much without risking bumping into walls, knocking over flower vases and possibly hurting themselves. A fundamental limit to acceptability of virtual games is that movements in them have to be generated through interaction devices. This is also a potential reason for market fragmentation, with different virtual games experimenting with different user interfaces. This is one reason augmented reality is likely to be much more acceptable than full virtual reality."

Alex Gekker, a senior lecturer in communications at Tel Aviv University who first described the assetization of top-tier video games which is leading to investment in the metaverse, commented, "Most stakeholders building the metaverse seem to have very little experience in virtual worlds, the tech is cumbersome and unappealing, and it all goes against the logic of the highly interpretable, casual media use that has successfully been pioneered by smartphones and embraced by the public."

Jennifer deWinter, a professor of interactive game theory and VR and AR game production and management at Worcester Polytechnic Institute, wrote, "The majority of humans in the world today can easily and affordably access online communities on phones, even in the U.S., yet the

metaverse is imagined on more-costly PCs that have significant processing power and graphics cards. When I imagine the positives of the internet we will see in 2040, I see that they will still be found in the distributed-knowledge communities that are already accessible. This can be knowledge work, of course (school, work, research), but it can also include community formation and the identity knowledges that emerge from that (LGBTQ+, diasporas, BIPOC communities and the like). Location is not as significant a barrier to access in the best-case scenario. We are already in a computer-mediated, networked society. Problems arise from how Western nations are conceiving of the metaverse – often as virtual reality, augmented reality or data-intensive."

Adam Peake, a longtime expert in internet policy who has been active in global policy circles at ICANN, IGF and the World Summit on the Information Society, commented, "I don't think the technology required to access 'the metaverse' will be developed by 2040 in a way that would make it attractive as a mass-market product/service. The headsets and other user interfaces will remain clunky things that will not be useable for long periods of time. Even if they manage to shrink optical head-mounted displays, for example, to an evolution of Google Glass, they will not be socially acceptable for many reasons."

Robert Bell, co-founder of the Intelligent Community Forum, wrote, "I have great difficulty believing in mass adoption of a technology that requires you to strap goggles across your eyes that block your view of the real world and wear haptic gloves that dull your ability to touch the real world. The times that I have been introduced to the current generation of VR, I have felt a visceral fear because my key senses had been purposely blinded so that I could have a virtual experience. The technology will be eagerly adopted by niche audiences. Gamers are one. Real pornography devotees are another, especially if the haptic devices become … *really* haptic."

Rosalie Day, independent technology policy consultant, said, "Conversion rates to immersive digital spaces of older Millennial, Xer and Baby Boomer generations in the next decades will be low through 2030, primarily because of the extra equipment which is both expensive and cumbersome. Fully-immersive digital spaces in the next decade will create more divisions in society along the lines of technology adopter and nonadopter. The current subset of population who are gamers, not solely phone gamers, and future cohort adopters are likely to be strong users of immersive technologies for leisure activities."

Kerry Mark Meyer, network development senior principal engineer at Dell EMC, responded, "While computer technology is capable of providing a rich visual and aural experience for users, there are limited possibilities for the other senses. This makes creation of a 'fully immersive' experience a stretch, if not an impossibility. I do believe, though, that the metaverse will be a much more refined and well-functioning aspect of daily life for many people by 2040."

A researcher at Meta (Facebook) whose work is focused on helping the public understand and deal with social media effects commented, "The immersive technology needs to improve substantially, and costs need to come down in order for billions of people to take advantage of it. Internet will be required in all spaces. I believe the metaverse will be an integral part of gaming and other experiences but will remain a complement to real life and not an integral part of it."

An award-winning AI ethics expert commented, "2040 is too soon. Adoption of AI will accelerate as cloud adoption will accelerate, too, in the next five years. AI will be a key foundational element as technology matures into the metaverse – a convergence of technology trends enabling users to experience our digital world in a new way and with a new level of autonomy and freedom. By itself, data can't create much value. It needs to be organized, analyzed and used at scale – which AI can do. For this kind of AI investment to really pay off, it needs to be embedded in application systems that can work 24 hours a day, 365 days a year. These systems, in turn, need cloud-based computing power that can scale up and down to cost-effectively meet ever changing demands. With these imperatives, it's clear why leading companies increasingly invest in and manage data, AI and cloud (DAC) as a unified whole."

A principal scientist at a major center for accessible technology wrote, "While many technological issues have been resolved with respect to the 'metaverse,' there are still prohibitively difficult problems in delivering a truly immersive experience that is natural, organic and has no side effects for all users. Secondly, there are also environmental and infrastructure prohibitions in delivering a truly immersive experience in environments where wireless networks may be poor or insufficient.

"If we think about the proliferation of cellphones and eventually smartphones, the growth of adoption for cellphones was firstly a progression to environments that could support the required infrastructure (like transition from the earliest mobile phones in cars and the first in developed nations where cell towers were installed). Right now, we are in the age equivalence of the earliest cellphones people installed in cars. And, in my opinion, this is a technology that will never be as 'justified' in adopting than mobile phones ever were in terms of utility, urgency and need to overcome barriers to adoption."

A longtime engineer and internet pioneer who works as an open-source consultant commented, "It will take more than 20 years for various players to converge on a standard. It will require that two or three of them grab 30% of the mindshare, and then they will still FAIL."

People will prefer living in layers of 'real' reality

A share of the experts predicted that even if the tech becomes more streamlined and affordable, most people will continue to find full immersion in VR unappealing because they prefer being absorbed in the real world.

Matt Moore, a knowledge management entrepreneur with Innotecture, based in Australia, asked, "What does 'virtual reality' even mean? Could it be sending a text message to someone? Answering an email? Being on a Zoom call? Getting absorbed in Wordle? Getting absorbed in 'Hearts of Iron 4'? All of these things are absorbing, and we are immersed in them, but they aren't what is talked about when we discuss 'immersive digital spaces.' Human beings quite like 'real' reality, and the only way we will spend most of our time in digital worlds is if we screw up this real reality so badly that we have nowhere else to go. Then again, there is a good chance of that happening, so maybe we will all become refugees from reality in the metaverse. That's a really depressing thought."

Christopher Fry, chief language officer at Haddington Dynamics, responded, "I was involved in VR research in the 1980s. Others preceded me by decades. Certain tech directions seem 'obvious' but they're not. We humans have severe cognitive biases that prevent us from understanding complexities about ourselves and physics. VR happens to be one of those things."

Eduardo Villanueva-Mansilla, associate professor at Pontificia Universidad Católica del Perú and editor of the Journal of Community Informatics, wrote, "Unlike current social media services, the metaverse demands free time and dedication that is not necessarily available to many people. While especially young users spend significant amount of time using social media services, the attention span required for those is shorter, the sensory overload is distributed among many different options and the possibilities of sharing are varied. The metaverse is designed not as much as an option for immersive experiences but as a full experience, demanding a subsumption of cognitive resources that would be too time-consuming and expensive in technical resources to become that attractive to the same number of people that are currently using social media. Also, control over the experiences would be perceived differently, and autonomy of experiences – the metaverse demands interaction in real time with other people – may be hindrances."

Michael H. Goldhaber, author, consultant and theoretical physicist who wrote early explorations on the digital attention economy, wrote, "VR will never be of much importance to most Internet users. It will not change society nearly as much as the current Internet, smartphones and social media have so far. If we look at the history of 3D in movies, with repeated attempts starting in the early 1950s, we see that it never really caught on in any permanent way but remained a fad with occasional reawakenings in new formats. In any of the multiple formats

that ensued, the extra dimension could never add sufficient realism or drama on an ongoing basis. Humans actually perceive the world normally in just over two dimensions; the third doesn't add much.

"Similarly, but perhaps even more, VR will be simply too much added trouble for too little gain. Of course, some gamers will use it, and it occasionally might be advantageous for people discussing specific projects. But most of the time, even when VR could be of use, such as displaying data in more than two dimensions, it will be just as easy to use ordinary perspective plus time-unfolding to reveal the same without the need for VR. Consider the video used by Zuckerberg when he changed the Facebook company name to Meta. It's purely a novelty act that would take normal people too much time and effort to set up to be very worthwhile. Good for children's parties, perhaps, but not most web interaction. I suspect the fundamental draw of the Internet and social media will remain competing for attention. VR is just an inefficient way to do that, for most of us, most of the time, and that can't really change. We don't need to be showing our bodies in 3D or in elaborate disguises to get attention, except as a rare novelty."

Henning Schulzrinne, Internet Hall of Fame member, co-chair of the Internet Technical Committee of the IEEE and professor at Columbia University, commented, "Adding virtual reality by itself seems unlikely to be a be transformative unless it makes the activity significantly more productive or enjoyable. Given the much higher mental and physical engagement needed for VR, I see this as a very time-limited activity for most, where one might spend an hour a day in the immersive environment, but the remainder of the workday or entertainment activity is lower-intensity, lower-engagement. After all, nobody likes a full workday of back-to-back Zoom meetings – and there, you can turn the camera off. Just as the transition to online video meetings during the pandemic has made people more aware of their home office decor, you might see the same for digital spaces. But the novelty of fake bookcases and green screens wore off quickly, with people returning to simple backgrounds and blurring. I wouldn't be surprised if people in professional settings quickly placed themselves in generic digital office cubicles and meeting rooms in the metaverse."

Joshua Hatch, director for digital platforms and audience at The Chronicle of Higher Education, responded, "The adoption of digital technology has happened when and where it has solved problems or made 'real-life' tasks easier – reading the news from distant locales; downloading movies in an instant; having real-time conversations with dispersed loved ones. The metaverse is an alternate method to doing those things, but nothing about it suggests it makes any of it so much better or any easier. In fact, it appears to make those things worse and harder. Perhaps I'm not imaginative enough to envision how it could work with technology so streamlined as to be nearly transparent. Even then, though, I struggle to see what value it brings."

Bob Frankston, internet and software-innovation pioneer, wrote, "Shared visualizations and other experiences will become increasingly important as enhancements but not as substitutes for the larger reality. I typically turn off my audio and video during a meeting (a term increasingly used to mean online) unless my presence is needed. My attention is too valuable to be at the mercy of a metaverse. I look forward to the new technology, but emulating the past seems to be a simplistic view of the future. Concepts like 'immersive digital spaces and digital life' are already with us, but we tend to use the richness of words rather than just pictures. And it is enriched by allowing asynchronous interactions. We've seen recurring efforts to do programming by drawing diagrams and the use of icons in an attempt to reproduce the physical world digitally. Yet programming has moved away from diagraming approaches. It is telling that supposed pictographic languages like hieroglyphs quickly become abstract and phonetic because we need abstractions to understand and communicate."

James A. Danowski, president at Communication and Technology Sciences, predicted, "Humans don't need additional bandwidth for interacting with other humans for most kinds of work. By 2040, the metaverse and social media will have faded from daily life. Direct interaction through digital means will continue to be important, but there is already sufficient or even perhaps too much social presence with current video apps like Zoom.

- As social media declines so will the metaverse built on it.
- The net effect of the metaverse on how we think about our world and ourselves will be a renewed emphasis on direct interpersonal interaction that is unmediated by avatars.
- Consensus will develop that social media and the metaverse have created more social problems than benefits and their use will be restricted.
- By 2040, the new digital world order with China at its center will see the widespread global effects of Chinese paternalistic leadership and digital authoritarianism.
- Like Second Life and current VR, metaverse platforms will only be attractive as niche entertainment spaces. They will not be the dominant activity on the net."

Mark Crowley, an assistant professor of computer engineering at the University of Waterloo whose research seeks dependable and transparent ways to augment human decision-making, responded, "The real world is far richer and more important than virtual reality and it always will be. I believe the limiting factor to fully immersive activities will be that *they are unnecessary*. Some people may think they want this or that they can make money from it. I know a great deal about this, I'm an AI researcher myself and I have read most modern science fiction predictions about different types of metaverse, as well as having used Second Life and other previous attempts at VR worlds. The more advanced we become, the more we must realize that our connection to the real world is important. Also, no matter how advanced the options that are available to us, people always seem to gravitate to the primary expressive forms that ground them in reality: text, images,

videos. The rise of Instagram and TikTok are prime examples. But, for me, one of the most compelling reasons is the frankly shocking enduringness of 'ancient' communication paradigms such as IRC chat commands, VI keyboard shortcuts and basic emoticons. Human beings did not evolve communicating and telling stories via three-dimensional storyboards.

"I have no doubt that dedicated and creative people, artists and engineers, will continue to spend huge amounts of time and create incredible content in these new realities. But the average person will limit themselves to text, images and the occasional video edit. Sharing remade videos and memes is nothing new, that kind of thing has always existed in different media, but creation is hard. The metaverse requires everyone to create and to communicate in ways that go beyond any natural inclination, and what you then end up with are incredible interactive galleries and event spaces, where the vast majority of people still simply text, chat and video call with each other. So why bother?"

Patrick Larvie, global lead on the workplace user-experience team at Google, pointed out problem areas that are another likely factor in the bulk of the public preferring living their digital lives using current interactive options. "The metaverse will remain relatively cordoned off, separate from most realms of digital life. Significant privacy and data-management issues will persist and prove daunting to commercial services. Further, 'fully immersive' is not necessarily a positive. Many aspects of 'fully-immersive' environments will be shown to have psychological, social and physical downsides, some of them significant."

Adam Holland, project manager at Harvard University's Berkman Klein Center for Internet and Society, wrote, "1) No matter how good, the virtual reality spaces will be too clunky and annoying. They will improve but remain a niche thing. Living in Second Life – really living in it as your real reality – sounds awful. Reality is hard enough; we don't need an overlay. 2) Climate change and coping with it are going to make anything power-hungry useless or prohibitively expensive to all but a few."

John L. King, a professor at the University of Michigan School of Information, said, "The experience of Second Life is instructive. It's still around but is not what many thought it would be when it first appeared. The necessary 'real-world' social controls, conventions of etiquette, and so on cannot evolve within a few years. The metaverse might function in 2040 as it does now – with sufficient suspension of disbelief, which usually means distortion of reality – but it will feel like a game for a long time."

Alan D. Mutter, consultant and former Silicon Valley CEO, wrote, "While the Metaverse undoubtedly will be more refined and more widely used by many in 2040, I find it difficult to imagine that humans will forsake personal interactions in favor of virtual contact. The metaverse

may be useful tool useful tool in many applications, but will it rule the world? Perhaps. But I hope not."

Kenneth A. Grady, futurist and founding author of The Algorithmic Society blog, wrote, "Enthusiasm and anticipated economic riches tend to drive predictions about technology more than sober estimates of technological evolution and societal acceptance. The past two pandemic years have given us real-world insights into technology adoption and its pitfalls. We saw rapid uptake of video conferencing and other online communication tools. At the same time, we saw increases in user discomfort with the alienation brought by the dramatic increase in using online tools. We also saw significant gaps between what technology could deliver and what users desired. Users wanted real-time communication that was as smooth as in-person communication. But the reality was a huge decrease in the information needed for smooth communication. Visual cues that enable users to know when to start and stop talking, shift communication style, clarify, stop overcommunicating and adapt to multi-party discussions were missing. The missing visual cues (and, to some extent, filtered auditory cues) hindered communication and reduced the humaneness of the conversations.

"Now, as people resume in-person interactions they are finding that their social skills have become rusty. They missed the spontaneity of unfiltered interactions and enjoy the fullness of being in the same room with others. Compounding the problems of planned interactions, the metaverse will have great difficulty replicating unplanned interactions. The accidental meetings on the escalator at a conference, the shared taxicab ride to the airport, the fortuitous adjoining tables at a restaurant. These types of experiences, though they may substantively result in nothing most of the time, bring joy to the participants. Only the unlimited enthusiasm of the technophile and the similarly unlimited desire of technology companies to expand markets suggest that the metaverse will rise to meet such challenges."

An expert in the evolution of knowledge creation at a time of accelerating technological change responded, "The barriers are not primarily technical but social, psychological and experiential. I find it hard to imagine wanting to live in an augmented and disorienting world, especially given the likelihood that based on the current ecosystem (in both VR/AR and in the normal app space) there would be limited ability to move between platforms and apps without constantly changing identities, avatars and experiences. When I shift from my email identity and interface to my Facebook identity and interface, I have to follow a different set of interaction rules and have a different facet of my identity on display. If I was trying to do that in an augmented space, it would be completely jarring and undesirable."

Philip Salem, distinguished professor emeritus of communications at Texas State University, responded, "There are too many other competing diversions, thus I don't believe there will be rapid adoption of the technology by 2040. Development may actually slow."

Kelly Bates, president of the Interaction Institute for Social Change, wrote, "I don't know if humans of all generations will adapt that quickly to moving so many aspects of 360-degree human interaction online. One positive of its positive evolution would be that if the world has more catastrophic events it could offer more alternatives for business, the economy and human communications. On the negative side, it will foster less of the in-person human interaction necessary for collaboration, cooperation, peace and quality mental health. I could see the metaverse happening sooner, but to be responsible it must be aligned with a global plan, commitment and principles of necessary physical human interaction. I would be interested in helping with that."

Kerry Mark Meyer, network development senior principal engineer at Dell EMC, responded, "There are many other aspects of daily life that the metaverse will probably never replace, at least as the preferred option to the 'real' thing. As an example: While I personally participate in a form of virtual reality for bike riding (via bike training applications and a bike trainer designed to work with them), it will never be as fully immersive an experience as riding outside. It's great for a rainy day and other situations where an outdoor ride isn't practical. But I don't expect that it will ever provide the sensations of wind blowing by me, carrying the changing scents of flowers that are blooming today and the synchronized sensations of acceleration going down hills or around curves."

Public worries about the impact of surveillance capitalism and authoritarianism will slow or stop adoption

A portion of these experts said they expect that the general public will not be willing to invest their time and energy in virtual spaces or use virtual tools if they perceive that it will subject them to being further manipulated and surveilled by corporate and/or government interests.

Seth Finkelstein, consulting programmer and Electronic Frontier Foundation Pioneer Award winner, commented, "I'm hardly the first person to bring up all the old hype about Second Life, and how ridiculous all of that looks now. But the point isn't to be reflexively skeptical. It's to ask, why did that fail, and what reason is there to think that this latest iteration will succeed? The metaverse promotion strikes me as being mired in the basic idea that multiplayer games are really cool, and if you could somehow push more of real life into an online game, that would be like printing money (literally) for the company that manages to do it. While the conclusion does indeed follow from the premise, the execution leaves something to be desired. It's like an Underpants

Gnomes format joke: 1) Online game worlds are awesome. 2) Some aspects of real life can be simulated online. 3) What? 4) PROFIT! Also, I see blockchain as a bad fit for metaverse applications, being almost entirely opposite in terms of architecture. Blockchains so far have one real type of application, for relatively powerful entities with complete mutual distrust but all of which want to avoid an even more powerful regulating entity (e.g., very wealthy people who want to avoid government restrictions on capital flow, currency controls). This isn't decentralization, it's narrower, akin to the conflicts of feudal lords against a king.

"Metaverse, however, is purely a lord/serf relationship. Some of the largest corporations in the world run services involving huge resources of computation and bandwidth where every individual has negligible power. I presume there will be a bunch of punditry about the possibility of portable identity among different domains. This is the standard data-portability issue. None of the lords has any incentive to let the serfs move freely."

Morgan Ames, associate director of the University of California Berkeley's Center for Science, Technology, Medicine & Society, observed, "There is too much suspicion around the surveillance practices and the commodification of our everyday lives by large corporations like Meta. There is really nothing that's compelling enough about virtual reality for people to be willing to submit themselves to that level of surveillance and commodification. Most virtual reality depictions in science fiction have been situated in a dystopian world. This, I think, is telling. The real world would have to be a pretty hellish place for most people to *want* to spend a lot of time in what will always be an impoverished experience that is subject to heavy surveillance and commodification."

Guenther Goerz, professor emeritus of AI at the University of Erlangen-Nuremberg, Germany, commented, "It is a nightmare to see that finally Baudrillard could be right. The so-called 'metaverse' is the latest business trick of digital platform capitalism. I hope people will be wise enough to realize the difference between real (social) life and computer-game-like simulations aimed at financial gain for the benefit of a few of the super-rich. They are eliminating the social contract, democracy and the success of enlightenment. People's online activities should be embedded in real social life in the service of a better and peaceful life for the whole world population and a sane environment. Instead, many become addicted to temptations which are beyond their control. So, I hope there will be no metaverse transition whatsoever. In terms of the mindset of global dictatorship where the metaverse ideology finally may lead, the difference between Mark Zuckerberg and other Silicon Valley supercapitalists and [Chinese President] Xi Jinping and colleagues is smaller than you may think. So, resistance is the motto, not adaptation."

Felix Stalder, researcher, lecturer and activist in the field of social implications of ICTs at Zurich University of the Arts, wrote, "I imagine the scope of the metaverse to remain limited, and have a strong backlash. It will be limited because of the ultra-commercial focus that hampers radical

experimentation and the problematic behavior and position of the major companies prompting a social backlash that will further limit its application. It will be a collection of specialized settings, such as remote work, conferencing of all sorts, gaming and shopping."

A Canadian teacher and multimedia journalist commented, "It is shocking the speed with which the metaverse is being considered to be an acceptable extension of the digital world, given the dangerous problems it currently hosts. Regardless of the speed with which investors secure footholds in new revenue-generating ways to exploit human curiosity and naivety, the metaverse is poised to deepen current dangers, such as mis/dis/mal-information, discrimination, bullying, sexism, racism and more. It will ensnare generations more in more digital manipulation."

Adam Peake, a longtime expert in internet policy who has been active in global policy circles at ICANN, IGF and the World Summit on the Information Society, said, "I can't see individuals, companies, etc., trusting Meta (Facebook) or any organization with the data generated in a fully immersive setting."

Jonathan Taplin, author of "Move Fast and Break Things: How Google, Facebook and Amazon Cornered Culture and Undermined Democracy," said, "The metaverse is just another version of the Big-Tech Surveillance Economy. It is an attempt by the billionaires to escape from the very real problems that confront our society like the climate crisis, the mental health crisis and income inequality. It solves none of the urgent problems of America."

Janet Salmons, consultant with Vision2Lead, responded, "If the metaverse is owned and run by Mark Zuckerberg, it is a nonstarter. I don't think this kind of surveillance capitalism will continue, as we already see from defections from Facebook."

Simeon Yates, director of the Centre for Digital Humanities and Social Science at the University of Liverpool, UK, wrote, "Do we really want the socio-political cesspool that is much of today's social media replicated in 3D VR? We already live in an incredibly complex high-fidelity immersive space – the real world. It is both beautiful and brutal (see Ukraine and Myanmar just today). The metaverse is another example of libertarian tech bros looking for a space to hide from this real world. I would rather they spent their billions on climate change, food supply and hunger, education, vaccines."

An award-winning computer scientist who spent most of her career working at a top-five U.S. technology company wrote, "It will take a long time, if ever, to get to a state where the metaverse is king. Already the increased intermediation of technology between people has had a range of negative consequences, leading to more depression, suicide, more economic imbalances (often along racial lines), more polarization and so on. I don't see any hope that the

metaverse will solve this. Some of the darkest science fiction I've read basically explores the metaverse and its effects, some of it way ahead of its time. But as we get closer to making the science/technology work, I see us no closer to preventing the evils that will follow. The internet didn't take off until a huge proportion of our society had access, and until a critical mass of businesses were online and could start to automate. The motivation for them to make the switch was clear – reach more customers, then recognize more efficiencies. As prices tumbled, everything steamrolled. It's not clear to me that the metaverse will offer the same value. It may offer more-enriching experiences – a chance to better differentiate yourself, as today a better website or app does. But will it really help businesses reach more clients, or become more efficient? Even when you can be immersed through a device the size of your phone, will you want to be? Especially if that device costs more than a phone that provides today's level of access?"

Dave Karpf, associate professor of media and public affairs at George Washington University and expert on the digital transformation of political advocacy and activism, said, "The metaverse has a demand-side problem. It will not develop by 2040, because it will become clear over the next five to 10 years that people do not want the product that Mark Zuckerberg and his Silicon Valley peers are trying to sell them."

A program manager for privacy and public affairs at one of the world's top five tech companies said, "There will always be multiple modalities of online presence. Email, chat and video conferences will not go away. Most people will spend most of their time online *outside* of fully immersive, persistent virtual environments. There are too many trade-offs to being in those spaces. A fully-immersive, persistent virtual environment probably will not offer benefits offsetting the hardware, power and privacy trade-offs."

Laurie Orlov, principal analyst at Aging-in-Place Technology Watch, commented, "Metaverse is a hype term wielded by the ultimate hype company, Facebook (now hiding behind Meta). This conjures a dystopian view, enlarging the percentage of a lifetime spent in front of a screen or device. One can hope that there is a backlash against the company and the concept."

A professor of sociology expert in culture, race and ethnicity responded, "There is no way this is a good idea with the amount of surveillance these technologies are allowing. We give up so much privacy already with all of the technologies we are being forced to use out of convenience, yet we don't know exactly how the data gathered from these technologies are used and who they are shared with. The costs, in my opinion, outweigh any benefits of a digital society. In fact, studies show children need less time on devices and more social interaction in person. I hope this does not come to fruition."

A North American sociologist wrote, “The idea put forward as the metaverse is the latest in a list of over-hyped suggestions of the role of technology. This view of what is possible is driven more by the desire for profit, rather than by any objective developments.”

A scholar and professor based in Singapore responded, “It is hard to see the benefit of a metaverse at this time when the harms from being online are becoming better known. Internal research by Facebook itself has uncovered much evidence of harm, too. The whistleblower was blowing the whistle on precisely this matter. I do not see this transition at all.”

The director of a center focused on computational analysis of social and organizational systems commented, “Global wars, the increase of authoritarian rule, the lack of funding for key research and increasing distrust of everything cyber will keep this from being a daily activity for most people.”

6. What about blockchain?

This section gathers a selection of experts' comments in regard to where blockchain might fit into the picture, if it fits at all. Some entrepreneurs who define Web3 as a packaging of the metaverse plus blockchain and NFTs are doing so to promote the monetization of emerging spaces and the creation of new business opportunities.

Experts fell into three camps on this:

- Blockchain is orthogonal or not related or a nonstarter when it comes to the metaverse.
- Blockchain is important to the future of internet transactions of all sorts, including those enabled by the metaverse.
- The impact of blockchain is an unknown.

Those contending ideas are represented in the back-and-forth found in the following collection of remarks.

Steve Wilson, founder at Lockstep Consulting and a VP and principal analyst at Constellation Research focused on digital identity and privacy, said, "The identification of blockchain as being intrinsic to metaverse is frankly bizarre. I think it is based on a mythological status that is way out of line with actual blockchain experience. The blockchain-will-change-the-world set have never really grasped how mundane it is. Blockchain was carefully designed to solve one very dry problem – double-spending – without an umpire. The 'consensus' reached by a blockchain is very limited; it cannot be easily extrapolated to governance or voting, let alone whole-of-democracy as some writers lazily guessed. Double-spending for e-cash is easily solved with an umpire, but e-cash diehards reject central banks, digital mints and the like. So blockchain is very political; it chooses a solution pattern that is entirely politically motivated. That's fine – I grok that everything is political at some level. But to think that this technology can be abstracted from the very simple problem space of electronic money to shift the power balance on a bigger stage is just wishful thinking.

"'Self-sovereign identity' is another notion (and little more than a notion) that comes into play here. Blockchain and identity are a heady mix, but it misses the essential aspect of identity being relational. A blockchain crowdsources decision-making about the order of events; there is nothing much in the nature of identity that can be crowdsourced, and even if a blockchain can play a part (such as letting people spawn and self-publish a unique decentralised identifier – DID) this is a tiny part of the problem space. These ideas are fueled by false intuitions and supercharged by carefully selected political words like 'sovereignty.' Identity is actually not the sort of thing that anyone can be sovereign over. Identity is how I am known. It's an uncomfortable truth but for the

most part, identity is created not by us but by those who know us, name us, credential us. Identity is not the sort of thing that can be 'owned' by individuals, much less controlled."

Mike Liebhold, distinguished fellow, retired, at the Institute for the Future, wrote, "Currently, while blockchains are publicly visible indelible ledgers, all of the attached software, services and human practices tied to them are as vulnerable as any other digital systems. But by 2040 – based on current developments at Hyperledger.org and elsewhere – many properly engineered, reliable and trustworthy blockchain services will be widely used."

A researcher expert in automated decision-making and its societal impact commented, "I feel like we're trapped in an endless, rapid and recursive hype cycle. Most of the hype about the metaverse, Web3, blockchain and etc. is not new, and the associated movements – take NFTs for an example – are falling apart as quickly as they emerge."

Barry Chudakov, founder and principal at Sertain Research, said, "Blockchain constitutes a new underlying framework, a new order. We think of that new order in terms of digital currencies (that are based on blockchain technologies) or newer encryption methods that use the blockchain to create greater security. Possibly lost in the fervid discussions of whether bitcoin will take over state-sponsored currency – or whether bitcoin and dogecoin are losing early backers – are the larger implications of blockchain technology itself. When a third-party commercial enterprise like blockchain creates a new way to value money, various dependent orders are challenged:

- National borders
- National currencies
- National trading regulations
- International trading regulations
- National and international privacy regulations
- Regulatory oversight
- Public record keeping.

"As Frontiers in Blockchain described it:

> *According to some, as a record keeping technology, blockchains could be truly revolutionary. They could reconfigure power away from nation states and traditional elites and redistribute it. … The central questions then become … does blockchain technology offer a viable trusted alternative to state-backed record keeping? To whom is power redistributed in a world of blockchain record keeping and what kind of socio-political power dynamics may this configure?*

"Passwords are an old, word-based tool that is a relic of the alphabetic order. Newer technologies, including blockchain, will likely supplant passwords as soon as this year. What is this telling us?

- We are moving from the alphabetic order to a new, non-word-based order.
- We understand words; our understanding of newer technologies is less – much less.
- Not fully understanding the basis of newer technologies, we are effectively blind to their larger implications.

"Record-keeping was first manual, then became digital. But blockchain uses a distributed record-keeping system called a ledger that keeps track of changes to assets within the chain. Unlike a bank or financial accounting system, the ledger isn't centralized, but is distributed to all the computers in the chain. This changes the way transactions are initiated, processed, authorized, recorded and reported.

"Changes in business models and business processes may impact back-office activities such as international and corporate accounting, financial reporting and tax preparation. Kevin Kelly, writing in Wired, may have had the best notion of the value of the blockchain: 'Blockchain has been looking for a job, and ensuring the integrity of an open mirror world might be what it was born to do.'"

Marjory S. Blumenthal, senior fellow and director of the Technology and International Affairs Program at the Carnegie Endowment for International Peace, responded, "Although blockchain is often discussed as a basis of Web3, which itself is a cousin of or alternate frame to metaverses, its role is as an enabling technology – and metaverses will have many. Blockchain is cast as an enabler of decentralization and an antidote to monolithic control of a metaverse. The historic tension between centralization and decentralization in information infrastructure will likely evolve in multiple waves and with multiple mixes of technology over the next couple of decades (and beyond)."

Toby Shulruff, senior technology safety specialist at the National Network to End Domestic Violence, said, "The promise of blockchain and Web3 is based in the power of tools like cryptocurrencies, smart contracts and decentralized autonomous organizations (DAOs) to decentralize the financial, legal and governance realms in order to counter the consolidation of power by governments and corporations. However, the underlying infrastructure of these systems is becoming increasingly centralized, and up to this point blockchain has been driven by the priorities of a narrow set of actors. Particularly when based on proof of work, blockchain also comes with substantial energy and environmental costs. If Web3 is to benefit more people in more ways, like all digital technology it will need to become more environmentally sustainable, and,

equally importantly, become more accessible and accountable to those with the most to lose from failure."

Brad Templeton, chair emeritus at the Electronic Frontier Foundation and director at the Foresight Institute, responded, "I see blockchains as mostly orthogonal. They are about trust (or lack of it) and transactions. They could allow applications in this metaverse to be more peer to peer, which has value, but they allow that everywhere, not just in what you would call a metaverse."

Glenn Edens, Internet Hall of Fame member and professor of practice at the School of Global Management at Arizona State University, wrote, "Your final question was about the blockchain, and while related to the metaverse, it is orthogonal. If you were to tell me that wasting electricity on a global scale creates value, I would suggest you were crazy – and that might still be correct. The blockchain is simply a database, yes, a more transparent database; however, all of the visions of a grand new decentralized world (and by implication a 'better' world) are largely false. The current systems are highly centralized, run by the same old rules of commerce, economic benefit-driven governance and systems to favor large investment returns. One could have implemented the blockchain in many ways, and the move from proof of work to proof of stake is a necessary path, driven by the previous bad design decisions. Couple this waste with an industry where the culture drives the 'crypto bros' to not use their real names and you have a recipe for a potential disaster. While we don't know the real numbers, it would appear that fraud and theft are no less a problem in the crypto world than they are in the real world. Another recent development is the crypto-custodian as a new business model and investment opportunity – didn't we used to call those 'banks'? I'd suggest while we've transferred a lot of wealth, we actually haven't made any progress for humanity, yet."

Thomas G. Dietterich, co-founder and chief scientist at BigML, commented, "You ask about blockchain. Surely you are joking. Cryptocurrencies are today's tulips."

William Lehr, an economist and tech industry consultant who was previously associate director of the MIT Research Program on Internet and Telecoms Convergence, said, "Blockchain is important for lots of reasons. See Lehr (2021) on smart contracts. Blockchain is inextricably bound to multiple other technologies and market/political developments that could take us in multiple directions that ultimately have little to do with blockchain. It is certainly a shiny new technology with lots of disruptive potential."

Mei Lin Fung, chair of People-Centered Internet, wrote, "Blockchain will be very, very important, providing the provenance for digital footprints that is required for science, regulation, oversight, etc., basically all the functions we have in the real world that our eyes, ears and senses

provide to authenticate our perceptions, in conjunction with interactions with other people, institutions and networks."

Andrew Tutt, an expert in law and author of "An FDA for Algorithms," wrote, "Blockchains are here to stay, I have no doubt about that, and they may prove to be the most convenient way to determine ownership over virtual assets in the future. But decentralized blockchain technology is not necessary to the development of the metaverse. Traditional notions of sovereignty and traditional legal systems and tools will at least continue to play a prominent role in the metaverse no matter how it develops."

Mark Johnson, a technology adviser, administrator and consultant, wrote, "Blockchain (as a distributed ledger, not currency) will find a place for recording transactions where provenance is important. Medical records, education transcripts and scientific data may be examples. It's possible that blockchain could offer an aid to combating disinformation by making it easier to trace disinformation to its source. Lowering computational overhead will be required or it will be environmentally impossible to sustain."

Simeon Yates, director of the Centre for Digital Humanities and Social Science at the University of Liverpool, UK, said, "Unless they find a way to make blockchain use far less energy, we need to regulate it out of existence to meet our climate change goals. It is a libertarian's dream tech, but it is in fact a potentially serious threat to democratic accountability in our economic and social lives. There are good reasons for central banks, centralised accounts for process and transaction records – it makes visible *all* the actions that can have huge social impact. Blockchain does not free us from the constraints of central banks and regulators – it frees the powerful who can afford to use it from such constraints."

Vint Cerf, Internet Hall of Fame member and vice president at Google, wrote, "Blockchain is oversold, but the visibility properties are useful. There are other ways to implement immutable objects, so that particular method does not have a monopoly. To be useful, blockchain applications need a lot of surrounding software. The blockchain is a record of transactions, but it does not contain that which was transacted – think NFTs, for example. Even if the transaction involves, e.g., an executable contract, the contract object is not itself in the chain – so it needs its own protection, just as coins in cryptocurrency are not in the chain but in a wallet which, by the way, has been the area of greatest vulnerability. There remain scaling issues associated with blockchains – how many transactions can be managed per unit of time. They must remember the entire chain forever for certain kinds of transactions – such as real estate ownership, stock ownership – until sold, which could be decades later."

Stephan Adelson, president of Adelson Consulting Services, an expert in the internet and public health, responded, "Regarding blockchain, the idea that 'what happens on the internet is forever' becomes even more true. The current thinking that Web3 will be 'of the people and for the people' is linked to the idea of blockchain as 'decentralized' – but I do not believe this will be the case. There is already a huge battle by the biggest financial interests for their piece of control. Blockchain will help solve long-lasting problems when computers become more 'quantum.' In regards to the bitcoin protocol and the financial implementation of blockchain and cryptocurrencies, I suspect something like the U.S. Federal Reserve will likely emerge to regulate it. There is too much money involved for some opportunistic entity to not succeed in getting a share – all it would take is a series of events like the Great Depression and control would be fought for and won. Also, the use of blockchain for illicit activities and the possibility that there would be multiple regulations by various global and local jurisdictions will be fodder to ensure some group or groups will find ways to gain control of a large share of the value."

Peter H. Hellmonds, founder/owner of Arete Publica, a public affairs consultancy, responded, "Blockchain is still very much in its infancy today, but the possible positive influences on our lives are manifold. From verifying financial transactions to documenting shipping of goods to certifying the origins of diamonds or other minerals used in international trade, I can imagine that blockchain's everyday uses will soon surpass the uses as a means for cryptocurrencies."

Olivier Crépin-Leblond, founding board member of the European Dialogue on Internet Governance and board member for the European At-Large Organisation at ICANN, wrote, "Blockchain is still very experimental. I would like to think that it will allow for real decentralised organisations to emerge. I would like to think that traditional top-down firms will be replaced by bottom-up, distributed firms where integrative management is practised as a norm. But bottom-up has its limits, and it is not in the immediate interests of the people at the top of the current firms to allow or to promote anything that will weaken their current power. It must be demonstrated that a bottom-up, massively distributed firm that uses blockchain to balance its control structure is vastly more efficient and successful than a traditional top-down structure. Attempts so far have been unsuccessful, but that doesn't mean that future attempts will be unsuccessful. You just need one winning model to revolutionise the way we operate."

James Gannon, a health care policy expert whose focus is on emerging tech, consultant for Novartis and PharmaLedger, responded, "Blockchain is a technical concept rather than a religion, its use will increase (I work full time on blockchain in health care for the world's largest health care company) but I feel the religious and social aspects will minimize and we will see it in the same way we speak about DNS or TCP/IP."

Deirdre Williams, an independent internet governance consultant, said, "Blockchain as a guarantee of a type of "truth" is a very useful mechanism. It could, for example, allow for disaggregation to specific local sources in a supply chain and so add value for small producers. Blockchain as cryptocurrency represents a risk with an unacceptably high possibility of disaster, and another mechanism with the potential to divide rather than to bring together."

Michael M.J. Fischer, professor of anthropology and science and technology studies at MIT and lecturer in the department of global health and social medicine at Harvard Medical School, said, "The promise of blockchain is as decentralized anonymized exchange systems that are secured only through registers of transactions. The worries are that: 1) these will contribute to the further destruction of regulatory governance in favor of criminal and authoritarian activities; and 2) with current technologies of cryptocurrency mining, it is terribly energy expensive and ecologically destructive. Relatively carefully controlled 'sandbox' experiments are being pursued, and we can see if better solutions can be found."

Melissa Sassi, global head of IBM Hyper Protect Accelerator, wrote, "We are still quite behind in seeing the many benefits and advantages of blockchain. I would absolutely love to see more blockchain applications come to fruition, as decentralized checks and balances are definitely needed when it comes to health care, the supply chain, our food supply and other industries. I would also love to see there be more checks and balances on fiat currency, as many governments continue to print money like it's going out of style, giving rise to the need for a people-centered currency that reduces the amount of corruption and nefarious actions in the world. Blockchain has the power of bringing a people-centered approach and transparency to the world. I'm excited to see what role bitcoin continues to play when it comes to disrupting the world of fiat currency and our evolution through the history of money, the economy and traditional power structures."

Frank Kaufmann, president of the Twelve Gates Foundation, said, "Blockchain seems to be the only promising structure I can see presently that provides even a slim hope of re-introducing individual freedom in a world poisoned and sickened by the capacity to surveille. Unfortunately, blockchain already seems to have been infiltrated by power-greed addicts, and may prove insufficient to provide freedom-seeking people with the hope of a dignified life with freedom, property, privacy and dignity. If power-greed addicts succeed to corrupt and infiltrate blockchain technology, a replace for blockchain will take its place."

Paul Brigner, head of U.S. policy and strategic advocacy at Electric Coin Company (which seeks to support technology that provides the public with access to a fair and open currency), responded, "Regarding blockchain, I expect to see decentralized finance based on a plurality of interconnected blockchains to have a significant impact on the global financial ecosystem by 2040. I also expect

that the predominant blockchains of today, namely bitcoin and ethereum, will lose market share to blockchains that have incorporated privacy protecting technologies (e.g., zk-SNARKs)."

Mark Nottingham, senior principal engineer at Fastly and a longtime leader in the Internet Engineering Task Force with expertise in internet and web standards, commented, "While there are some potentially useful applications of blockchain, they are a footnote compared to the scam culture that it supports today and will likely continue to support failing regulation that reins it in."

Guenther Goerz, professor emeritus of AI at the University of Erlangen-Nuremberg, Germany, commented, "Ecologically sustainable implementations of blockchain may be useful for contracts, but bitcoin and similar so-called currencies are void; they have no utilitarian value but are an extreme form of exchange value without any real basis. It's another attempt to turn the world economy into a giant casino where the profits are privatized and the losses socialized."

Micheal Kleeman, a senior fellow at the University of California, San Diego, who previously worked for Boston Consulting and Sprint, responded, "Blockchain has many different applications but in this context the ability to have validated transactions without central authentication will enable more global activities, and perhaps more criminal activities."

Laurence Lannom, vice president at the Corporation for National Research Initiatives, wrote, "Blockchain is just another technology whose applications are hard to foresee. The current optimistic view that it can generate trust independent of any human activity, that one can trust the technology even if one can't trust the people, is, however, misplaced. In the end, trust is a human reaction to experience, and this is especially true in the case of a technology that very few of its potential users understand at a basic level."

Lee Warren McKnight, professor of entrepreneurship and innovation at Syracuse University's School of Information Studies, responded, "While blockchain is not a panacea, and creating new permanent records/immutable data trails has obvious downsides, AND there are many falling victim to crypto scammers and rug pulls today and there will be more tomorrow, blockchain does offer significant hope for data privacy and security enhancements, and self-sovereign data and identity management by design, which could – but only if we are fortunate, and law and policy helps – prevent the worst-case meta-scenario from unfolding in 2040."

Bob Frankston, internet and software-innovation pioneer, wrote, "Asking about blockchain in the context of a metaverse is a big red flag that puts them in the category of NBG – Next Big Thing. Blockchain is an interesting technology that has become an answer without a question. What does it have to do with shared visualization? If anything, the idea of everything in the world being on the same blockchain is a dystopian idea at odds which a fundamentally distributed reality. Is a

transaction on Mars going to be tied to the one blockchain? The danger is the financial disruption of virtual gold bugs."

Dmitri Williams, associate professor of technology and society at the University of Southern California, said, "Blockchain is pretty interesting in that it may allow for less friction and possibly (not certainly) decentralization, which would be a good thing to free up creativity and break us from purely capitalist structures."

John L. King, a professor at the University of Michigan School of Information, responded, "Blockchain might be useful for particular kinds of contracting, but these will be low-level activities and have significant impact mainly in the aggregate. Most blockchain effects will be outside the realm of cryptocurrencies."

John Sniadowski, a systems architect based in the United Kingdom, wrote, "It is unclear in my mind how blockchain is going to pan out in the longer term as each of its various instantiations have significant weaknesses in regard to resource consumption, security and regulatory governance. It undoubtedly has many potential benefits to society, but repressive governments will balk at its deployment because of the problems of legislation. Of course, some countries will likely use it to further monitor their citizens by building in back doors for transaction surveillance, and they won't require democratic consent because consent is actively suppressed. Thus, oppressive countries will implement blockchain technologies far faster than democratic societies and thus apply catch-up pressures to those who wish to have technologies that enhance their democratic rights and daily life experiences."

Matt Moore, a knowledge management entrepreneur with Innotecture, based in Australia, said, "Blockchain makes a great supplement to roulette tables. I remain less than convinced about the power of distributed ledgers."

A veteran principal engineer who has worked at several major tech companies said, "First off, blockchain and its applications are likely to have little or no role in any of this. Right now, they are contributing to the overall sense of hype and solutions in search of a problem in a way that is fundamentally not helpful, as it tends to suck all the oxygen out of the room on any discussion of the practical applications of what you're calling the metaverse. Little to none of the challenges in making the idea of the metaverse a reality are improved or enabled exclusively through blockchain and its friends."

Charles Anaman, founder of waaliwireless.co, based in Ghana, wrote, "Until energy is available to all members of the internet-connected nations, there cannot be an equitable redistribution of wealth in a meaningful way that can undo the damage of the many invasions of the last 800 years

that have shaped the globe. Blockchain technologies that cannot reset the ledger value to all members to enable constant collaboration while also decapitating any entity's ability to hoard resources or assets are crucial. Access to information and cultural inclusion is not possible until the above listed requirements are met."

Antoine Vergne, co-director of Missions Publique, an organization working to include the voices of all citizens in global policy, wrote, "I can imagine the metaverse as a seamless, global, decentralized, interchain financial system. Blockchains will be central to this. But for this they need to solve the question of governance, which is still very much in its infancy."

Yvette Wohn, associate professor in informatics at New Jersey Institute of Technology and director of the Social Interaction Lab, wrote, "Blockchain will make virtual assets more valuable. Many people currently think of virtual items as being ephemeral or something that is not a physical asset or 'property' (e.g., do people list virtual items in their will?), but blockchain will make ownership of digital assets meaningful."

James Hughes, bioethicist, sociologist and executive director of the Institute for Ethics and Emerging Technologies, wrote, "Blockchain will play a role in the virtual Internet of Things, and could create new economic opportunities for creators."

Gary Marchionini, dean of the University of North Carolina-Chapel Hill School of Information and Library Science, responded, "Blockchain as a distributed ledger with the possibility of anonymity can be highly beneficial to information sharing and management. The proof of work implementations a la bitcoin are severely evil and wasteful of resources."

An expert in large-scale systems and networks commented, "Blockchain strikes me as basically a bunch of baloney. I see it as overblown marketing hype that does not solve a real problem. I write this as a technical expert who has an admiration and appreciation of the beautiful mathematics that underpin it (Sybil-resistant distributed consensus, cryptographic proofs of work, non-interactive zero knowledge proofs, oh my)."

Gary Arlen, principal at Arlen Communications, responded, "Blockchain is SUCH a work in progress that its evolution in coming years is difficult to predict. It has implications beyond the current cryptocurrency focus, which itself is a cauldron of creepiness. Let's see how the movement toward CBDC (Central Bank Digital Currency) evolves to create some types of fiat monies that are stable and trustworthy."

Cathy Cavanaugh, chief technology officer at the University of Florida Lastinger Center for Learning, said, "Blockchain could ease access to technology and virtual spaces by providing a secure and durable virtual identity for everyone."

Greg Sherwin, a leader in digital experimentation with Singularity University, wrote, "By 2040, the growth of quantum computing will have broken public key cryptography and rendering all of today's crypto assets and NFTs as 'public domain.' So blockchain needs to be radically redefined by then to be relevant."

Jonathan Kolber, author of "A Celebration Society," wrote, "The blockchain MAY serve to provide a kind of rigorous 'quality control' for VR experiences, making such hacking rare or impossible by providing an un-hackable 'proof of reality.' In my view, this will require a quantum-hacking defense such as Quantum Origin's new product."

Kelly Quinn, clinical associate professor of communication at the University of Illinois-Chicago, responded, "Blockchain will develop some important applications in the (very near!) future, especially in areas where ownership and provenance are critical. Domains such as real estate, the arts and even food and wine present opportunities to use this technology in important ways to establish ownership chains and provide validation of origin."

Amali De Silva-Mitchell, futurist and founder of the UN IGF Dynamic Coalition on Data-Driven Health Technologies, wrote, "The problems with blockchain are the high energy costs it incurs and concerns that it no longer be a secure option once emerging technologies like quantum computing are perfected. It will remain a useful option for some time yet, as it is one of the best available solutions in many cases in our current supply chain age."

Ray Schroeder, expert in technology-enhanced learning and senior fellow at the University of Illinois-Springfield, said, "Blockchain will robustly roll out in the coming few years. It enables distributed sharing and transacting most effectively with numbers, non-fungible tokens, and other less-animated images than the metaverse. The accounting and ledgering of a wide array of items will provide secure and instant transactions and records. It is a far different technology from the metaverse."

Eugene H. Spafford, internet pioneer and professor of computing sciences at Purdue, wrote, "Blockchain is overhyped right now. There is only a very small set of uses where it provides any advantages over centralized systems. Its speed and environmental impact do not make it attractive."

Tamarah Singh, a global business manager expert in technology-led innovation based in Singapore, responded, "A globally integrated system needs to be interoperable and trust-driven. Blockchain has a role to play in this. However, the interoperability of chains will need to be designed to not introduce points of failure (of trust and beyond) into the system. Given how much of the metaverse is being designed for commercial gain at present, it would take an exceptionally well-funded, reasonably revolutionary thinker-doer to create the platform from which a true metaverse could exist, though, debatably, Android is an example of how something like this could evolve."

An expert in the evolution of knowledge creation at a time of accelerating technological change responded, "We need to get beyond this ridiculous phase of the blockchain hype cycle and start to develop the really useful applications of distributed and decentralized records and not get distracted by financial speculation, money laundering, and opportunism. Blockchain has a lot of potential, but it is not in NFTs and fill-in-the-blank-coin fake money."

A program manager for privacy and public affairs at one of the world's top five tech companies said, "Permissionless public blockchains are problematic regardless of whether they are based on proof of work or proof of stake. I assume that some form of government regulation will emerge to manage these problems."

An expert in cyber policy and platform regulation wrote, "I don't really understand what the blockchain has to do with this. Is the question about identity authentication (which matters just as much in non-metaverse uses)? Or is it about artificial scarcity of digital assets, so maybe you value access to particular metaverse locations because they have the only copy of the metaverse Mona Lisa or whatever? I certainly hope we don't go on that direction. Deliberately forfeiting the value of non-rivalrous digital goods would undo so much of what is good about the Internet."

7. More potential positives and delights of the advancement of XR

When asked to describe some of the positives of the advancement of XR, respondents shared wide-ranging visions of what they imagine will take place in improved metaverse spaces of the future: interactions with famous people, playing-field experiences with prominent athletes, travel to exotic and fun locales (e.g., archeological digs, mountaintops, historic scenes and other-worldly places), deeply enriching learning experiences, remote medical procedures, disaster-response flexibility, the creation of new kinds of communities, expanded venues for commercial exchanges, a flowering of creativity in the arts and fashion and fully automated encounters with smart agents handling such things as accounting, professional training and mental-health counseling.

Some offered answers that covered a variety of issues and raised a number of questions about how the metaverse might unfold.

Kevin Carson, American futurist and political writer and commentator, said, "My hope is that the platforms will be primarily free and open-source software, and that their expansion will be in tandem with economic relocalization and shifts to direct production for use in the face of capitalism's terminal crises. My fear is that they will be proprietary walled gardens. The most promising and genuinely beneficial area for adoption would be something along the lines of the D-space platform in Daniel Suarez's novel 'Freedom,' or the shared virtual space of the Acquis project in Bruce Sterling's 'The Caryatids' – a meta layer for coordinating things like local economy projects, with semantic tagging and embedded information. I think the technology will be adopted for a lot of separate projects."

James Hochschwender, futures strategist with Expansion Consulting, said, "Metaverses have the potential for contributing positively to needed and/or desired cultural evolution, such as toward a future world in which the half of the world's population who, because of automation and AI developed by 2040, shouldn't have to work at a traditional job for their entire 'working life' could instead focus on self-actualization or the exploration of human potential. Metaverses properly constructed could also facilitate changes in daily behavior toward more environmentally sustainable production, transport, services, consumption and lifestyles. There will be a wide range of interactive online services like utilities, banks/finance, retail commerce, gaming, health diagnostic and treatment services, education and learning, entertainment and social gatherings and interactions. The potential of immersive experiences will allow, for example, the opportunity to experience exactly what new furnishings and décor might look like in one's own home/apartment before making a purchase. Health applications will expand upon today's nascent teledoc interactions, offering more-intimate ones that include diagnostics and treatments. A

variety of educative elements could be built into such spaces. They will allow for immersive armchair travel experiences to see global places and cultures. Also on the positive side of the ledger, metaverses can allow people to interact with famous people – from politicians to sports and arts celebrities – in ways not possible in real life. People will be able to experience sports from an 'on-the-court perspective' useful to aspiring athletes as they learn their sport and enjoyable as entertainment for diehard fans."

Clifford Lynch, executive director of the Coalition for Networked Information, responded, "Right now 'the metaverse' is being heavily hyped but there's not much there.

- We will see more-immersive digital spaces by 2040, but I'm skeptical about how much they'll be networked, scaled up and omnipresent because the tendency is for proprietors of immersive spaces to silo and try to maximize people's time in one space. There are strong business reasons for this.
- We will see gradual improvement and increasing use of VR technology by specific communities who populate specific immersive spaces.
- It will be interesting to see when these spaces will begin to be widely populated not just with real people's avatars but with software agents that interact with the people in interesting and useful ways (not to be confused with the very, very primitive chatbot technology that is taking online customer service to new lows on many sites). This might include simulations of living people, or reanimations of the dead.
- Today's video conferencing collaboration technology has gotten very good and very inexpensive. It has become ubiquitous for large parts of the population, at least in wealthy countries. We are going to have to move far beyond today's clumsy and cartoonish avatars wandering around a virtual office in order to displace this type of video conferencing for synchronous collaboration.
- There's a big opportunity to design immersive spaces for education, cultural experiences and virtual tourism (through time and space, places real and imagined) but these will be focused more on interaction with the place or events rather than interaction among visitors present in the space.
- Another set of issues has to do with scale and purpose. We seem to have some idea how to scale environments where those present have a common purpose and some sense of shared social norms: massive multiplayer games, MOOCs, some kinds of organizational collaboration environments. Experiences with things like Second Life or social media today suggest that when you aggregate very large numbers of people in an environment without a common purpose and set of social norms, things tend to deteriorate quickly.
- Mirror worlds are already taking hold in a range of process-optimization activities (manufacturing, for example, or maintenance of equipment), and we are going to see a great deal of growth in this technology/methodology, particularly as tools improve. Inevitably, these

will be networked sooner or later. But the emphasis here is not on people or their interactions; many of the mirror worlds don't include people, or only include them in very simple ways. As sophisticated multi-agent simulation gets more commonplace, that will change. There are already really interesting developments in things like traffic planning, modeling emergencies in large facilities or modeling the spread of disease using these tools. But again, this is mostly simulation and modeling, very different from immersive spaces full of people.

- Today's user interfaces for virtual settings are clumsy. This will continue to be a barrier. There's been only limited progress. One could imagine some kind of neural connection completely changing the picture here at some point at a technical level; the social, political (including national security), and economic complexities of seeing any significant level of deployment of this interface are another matter. Even doing research in this area, outside of certain specific areas like trying to help paralyzed people, is extremely touchy and sensitive, and full of ethical dilemmas."

Melissa R. Michelson, dean of arts and sciences and professor of political science at Menlo College, wrote, "The rise of the metaverse will bring both challenges and advantages. On the positive side, it will allow for people to experience things virtually that they cannot otherwise access. Students can perform dissections and anatomical training without the need for real animal or human bodies. People with limited mobility will be able to enjoy virtual travel. Air travel to conferences will be less necessary; teams of people, and even entire conferences, can have virtual meetings. I do not think the metaverse will replace face-to-face experiences, including education and conferences. There is something added by the real world that even a rich metaverse cannot replace. Negatives of the metaverse are similar to those that arise in all aspects of our digital lives: the danger of piracy, of stolen identities, of fraud and of cybercrimes."

Alexander B. Howard, director of the Digital Democracy Project, wrote, "By 2040, we should expect to see positive applications of augmented reality in education, the sciences, entertainment, manufacturing, governance and more, combined with virtual experiences that mix up holographic avatars with humans in ways that recall Star Trek's holodeck. In the most optimistic timeline, we will see the best of the generative aspects of today's crude virtual worlds on Roblox or Minecraft evolve into global marketplaces in which people can buy synthetic goods and services with digital assets. If nation states can shape democratic norms into globally respected laws, billions of humans will be able to work, learn, play and share in new civic spaces in which privacy and security by default protect human rights and civil liberties across platforms and media. Human nature itself will not change, but the nature of being human will be informed by this shift, as will our capacity to push for collective action to mitigate the worst effects of climate change."

Antoine Vergne, co-director of Missions Publique, an organization working to include the voices of all citizens in global policy, responded, "The metaverse will not be 'Ready Player One.' It may

end up being an invisible layer of services and applications. For example, I will be able to have a seamless workflow for buying a theater movie and see it on my beamer or headset. 3D immersive virtual reality will be focused on proactive scenarios such as virtual conferences to avoid traveling, support for remote operation by technicians and gaming. These will be limited experiences available only to the elite and middle classes."

Greg Sherwin, a leader in digital experimentation with Singularity University, wrote, "I can see a boom in virtual tourism, social calls (think BodyTime instead of FaceTime) and virtual gatherings. Not everyone is a fan of video games, hence I see many parts of society opting out or being left out economically. Playbour (work/careers in game settings) should also continue to be a major theme."

Toby Shulruff, senior technology safety specialist at the National Network to End Domestic Violence, predicted, "Industrial and military applications of extended reality, though less publicized, will be more powerful. Use in educational settings will be promoted but not widely or equally available. XR will increasingly be used for safety training, medical procedures, disaster mitigation and manufacturing. It also has the potential to expand our emotional intelligence through experiences with storytelling, travel and awe of the natural world."

Tamarah Singh, a global business manager expert in technology-led innovation based in Singapore, responded, "The metaverse might work to further 'level the playing field' amongst the privileged, offering access to the American Dream to the mass affluent, educated and/or connected. It also stands to further weaken potentially out-of-date boundaries of sovereignty, offering access to global employment, health care and education at lower costs (subject, of course to systems being adapted to accommodate this – actions like the introduction of global taxation might serve this)."

Mei Lin Fung, chair of People-Centered Internet, wrote speculatively about the positives that might take place down the road, past 2040: "Eventually, employment, businesses and digitization across all industries, across rural and remote areas will be transformed in real life in ways in which digital and physical life integrate and complement each other to achieve human and planetary goals. Once an entire global generation is socialized and educated with sojourns in the metaverse thanks to technology advances beyond the awkward devices of today, Douglas Engelbart's vision of the Human Augmentation System can enable our collective intelligence to be applied to our challenges and to live our lives in nature, tuning in and out as preferred. Positives of this transition, not to the metaverse, but due to the Human Augmentation System, will advance us to joyful, almost effortless yet deeply meaningful cooperation and collaboration: 1) Meeting existential needs – food, water, air, an environment that supports humans. 2) Coming together to build resilient communities with safety guardrails. 3) Setting up the social and institutional

structures for us to live flourishing lives of intentional purpose, engaging with people from all walks of life from anywhere.

"Anyone anywhere will be able to take advantage of opportunities to achieve their aspirations and realize their potential. Businesses can buy and sell from anyone anywhere and can incorporate processes and building blocks in their supply chain that are less wasteful, less energy-generating, more generative in bringing in local talent and creativity at the point of production and the point of consumption, and all points of the global supply chain. We will become more conceptually interconnected by orders of magnitude. Just as neurons that 'fire together, wire together,' people from different parts of the world, connected by eCommerce, eScience, eEducation, eHealth, etc., will in their daily social and work lives encounter and interact with people they might have never been aware of without advances that digital transformation and tools developed in the metaverse will enable. Diaspora families will become closer across generations, even if they have been separated by countries and oceans. The power of 'clans' will emerge to threaten corporate dominance. Governments will begin to offer digital services but at different levels of competence and effectiveness. The global war for talent will expand beyond corporations to countries."

Uses of XR will be widened and accelerated in medical, industrial, training and educational settings

Oscar H. Gandy Jr., emeritus scholar of the political economy of information at the University of Pennsylvania, said, "My sense overall is that the most-positive benefits from the development of these systems would be in the area of education and training at all levels. I would also see a rapidly emerging market for applications of this technology for personal development by individuals, whether learning new skills, including language or in health-related self-improvement. I don't doubt that the kinds of investments being made in gaming will also expand rapidly, but I am not so ready to characterize that kind of activity as being a truly beneficial contribution to society."

Leah Lievrouw, professor of information studies at UCLA, wrote, "To me, the main positive possibilities for an easy-to-understand-and-use digital immersive environment would be that they might enable people to visualize and do things that would not ordinarily be possible in physical contexts – not just reproducing shined-up versions of the existing everyday world or shopping with fun new avatars, or selling ever-more addictive gaming. For people with disabilities or conditions that limit their mobility or other capabilities, a metaverse-type platform might open new possibilities for communication, rehabilitation or just the ability to act and participate as fully as they like with other people and activities. In education and scholarship, it might really bring some power to the kinds of creative visualization or research possibilities that now must be explored in a more limited way, such as in the digital humanities, data science, public health, urban design, and so on. I don't see the private sector necessarily being attracted to these kinds of

uses. Instead, they're likely to fight to maintain the business models and data-monetization tactics that already dominate the online world, which depend crucially on nearly unfettered data capture about individuals – as would any immersive metaverse-type platform."

Monica Murero, director of the E-Life International Institute and expert in AI-based digital therapy and human-centered AI at the University of Naples Federico II in Italy, responded, "I do not think the evolution of the metaverse will be mature by 2040. I expect to see 'niche' uses of metaverse technology, and I expect exciting applications for education, health and some businesses like real estate, learning environments and gaming. Interdigital hybrid teachers may be highly successful in the metaverse in any learning application. It is possible that the entertainment industry by and large may adopt it. A disruptive technology may emerge to offer even more challenging opportunities (and threats) to the current version of the metaverse."

Alan S. Inouye, senior director for public policy and government relations at the American Library Association, wrote, "Technology innovation continues apace, and there will be high-speed broadband in nearly all areas of developed countries by 2040 – especially so for that subset of a half-billion people in the higher income or wealth brackets. Already there are some limited automated agents involved in routinized service encounters. By 2040, we would expect to find fully-developed automated virtual engagements for many service encounters, with only unusual or complex exceptions referred to expert human analysts. One consequence is the demise of many large-scale call centers – at least for this wealthier segment. We will see three mainstream modes for professional service encounters (accountants, teachers, counselors, et al.): fully-automated virtual agent; virtual engagement with a person; and in-person interactions. The latter will be premium-priced or elite-preferenced."

Alex Halavais, associate professor of Data & Society at Arizona State University, said, "The advantages of virtual spaces include the ability for users to create their own environments and allow for more creative interactions. There is real potential to not only improve existing structures of education, but to upturn them. Some of the work in Minecraft already shows the potential contours of this – albeit blockily."

Howard Rheingold, pioneering internet sociologist and author of "The Virtual Community," commented, "My hope is that the use of AR and VR in scientific discovery (i.e., exploring the possible therapeutic effects of various molecular configurations by examining and manipulating models) and education (i.e., teaching about archaeology by exploring models of archeological digs, teaching about chemistry by manipulating models of molecules) will yield positive results."

George Capowich, retired associate professor of sociology at Loyola University-New Orleans, wrote, "One positive is to enhance escapes (take a virtual vacation you cannot afford), enhance

hobbies (walk around/sail a model ship one builds or drive a model sports car), help with imaging for things like pain relief and meditation."

Amali De Silva-Mitchell, futurist and founder of the UN IGF Dynamic Coalition on Data-Driven Health Technologies, responded, "VR, AR and MR have a lot of potential for supporting health care and improving mental health patients' experiences, as well as for medical research and training and delivery. These tools have tremendous potential in education, child and elder care, in workspaces and office meetings in particular, in retail, travel, entertainment. The downsides, such as problems with privacy, security and other potential harms, must be carefully addressed."

Glenn Grossman, a consultant of banking analytics at Fair Isaac Corporation, said, "Certain categories of our lives could easily adapt to a more AI/VR setting. Education that is interactive (such as live classroom instruction) is often cited better than self-paced online learning. This new approach could allow greater access to learning skills while lowering the barrier to access (such as location to education). There are negatives with any technology, so the burden on our society is to find delivery methods that find this balance of value and avoiding deemed negative elements."

Richard Miller, CEO and managing director at Telematica, a technology and business strategy consultancy, wrote, "The use of these technologies for interpersonal, small-group and (possibly) large-group communication will have become so performant and realistic that the impact on travel (transportation) will be monumental. This applies to local and longer reliance on transportation. Education and entertainment using XR will (hopefully) reduce the unequal access to information and educational services. Among the most important impacts is the use of augmented/assistive technologies to advance the human-machine interfaces or 'user experience' in the continued incorporation of automation in manufacturing, in long-distance delivery of medical services, and in the advanced use of microscopic aspects of biology, biochemistry and medicine."

The power to 'travel' in a data-saturated world will create dramatic and enriching experiences

Some of these experts foresee the metaverse enabling people to have enhanced experiences of both the macro- and micro-dimensions of many aspects of the universe. They believe this will help people examine and analyze the physical world in new ways, and they think this will yield dramatic results.

Howard Rheingold, pioneering internet sociologist and author of "The Virtual Community," predicted, "AR is likely to be part of daily life. Today, only old people remember having to unfold paper maps, to cite just one example of the way digital media are intersecting with and changing relationships with the physical world. In the future, the power to examine and analyze physical

world characteristics with all the computational power of the cloud will (IMO) undoubtedly yield similarly dramatic changes. One trivial example of what is possible with today's technology: Look at a printed sign in any language and get a quick translation whispered in your ear or overlaid on your field of vision."

Brad Templeton, chair emeritus at the Electronic Frontier Foundation and director at the Foresight Institute, said, "Interesting metaverse apps I imagine include tourism – putting the knowledge of a local before your eyes as you walk an unfamiliar town, every form of entertainment, new sports and forms of recreation and immersive remote communications. Also of interest – at the point in time when we get virtual worlds with retina-level resolution – is 'reverse tourism.' The great sites of the world can't tolerate being visited by the billions who can now afford it. This is an alternative that helps preserve those special places. Of course, the metaverse allows for all sorts of socialization, where people like doing things with others in a virtual world, not just gaming (which of course they will do) but exploring and partying and watching live entertainment together. It will be of particular value in business, as people work remotely. Because people know that work from home makes them invisible at the office, companies may mandate periods of metaverse socialization for all employees, so they build the bonds lost with WFH."

Matthew Belge, president and principal UX designer at Vision & Logic, a Massachusetts-based design consultancy, said, "I imagine the metaverse will be used for just about everything humans currently do, from social meetings to business meetings, to sex, to games, to medical work, to simulations. I think the most provocative areas will be where it is too difficult or too dangerous to do in 'real life.' For example, climbing Mount Everest virtually, riding a vehicle in outer space or plunging to the bottom of the ocean. It will also be used for synthetic environments where real-life constraints have no meaning – synthetic worlds with their own physics and reality. People have an innate desire to connect with other people, it is built into the very essence of who we are. The metaverse is just the next extension of that going back, from cave drawings and campfire meetings to town halls to the internet and now the metaverse."

Rachel Kowert, research psychologist and research director at Take This, a nonprofit organization that provides mental health resources and information to gaming communities, said, "Greater sensory information will inherently provide a richer experience. I am most interested in the way it may change our daily lives in terms of feeling socially connected but also in learning and experiential opportunities. Think about being able to explore ancient Rome – walking the streets, hearing the sounds, seeing the people – versus learning about ancient Rome in a book. That potential is exponential. How will this transition change the way we think about our world and ourselves? It has the potential to connect us even more and begin to better understand how we are all on this same little floating rock in the middle of space. I think about the experiences astronauts

have when they come back to Earth and realize how small it all really is and how we are all the same – trying to just live our lives as best we can on this planet. I have hopes that the more connected we are as a global society, the more pervasive these thoughts and experiences will be."

The director of an institute examining the legal implications of emerging technologies commented, "Digital fashion is a game changer beyond just the sustainability benefits found in eliminating fashion creation and distribution in physical form. The dematerialization of fashion has made chic attire accessible to the masses: digital representations of high-end clothing typically sell for much less than their physical equivalents. The technology has also flattened the market, reducing barriers to entry and allowing novice designers to compete and even collaborate with established brands in the metaverse. It also provides an accessible entre into the emerging world of the metaverse, perhaps attracting clothing consumers who might otherwise have little to no interest in a digital world.

"Digital fashion in the metaverse will be amazing. Axiomatically, fashion is an incredibly wasteful business. It demands that we discard and/or replace otherwise functional clothing simply because it is no longer in fashion. More clothing than can ever be necessary is wastefully produced, and much of it ultimately ends up in landfills. A perfect example of waste today is the industry of fast fashion, which embodies some of the worst of this increasingly environmentally unsustainable industry.

"Newly emerging digital fashion can help reduce the climate impact of fashion. Fashionistas can scratch their fashion itch with little impact on the environment. Except for the energy consumed by the blockchains that support the cryptocurrencies that are often used to purchase digital fashions, or that host NFTs typically associated with the haute couture level of digital fashions, these garments are exceptionally environmentally friendly."

8. More potential negatives of the advancement of XR

When asked to describe some of the negatives of the XR world, these experts highlighted a wide-ranging number of threats. Those included reductions in personal autonomy and people's ability to control their lives; worsening digital divides; amplified discrimination; new forms of harassment, bullying and hate; new menaces to public safety, especially around sexual violence and exploitation; more avenues for misinformation (especially tied to clever fakes); addiction to metaverse activities; distractions that dissociate people from real life and induce loneliness (or worse); new threats to users' personal data; and the further monetization of many human activities.

The first chapters of this report contain dozens of mentions of these topics that were a fit for the various theme sections. This section includes additional mentions of worries over XR's impact.

Mary Chayko, sociologist and professor of communication and information at Rutgers University, commented, "The metaverse in 2040 will surely be well-developed and far-reaching. It will function, but for whom? We are already well acquainted with the vulnerabilities inherent in digital technologies, networks, environments and likenesses. A meta-expansion of digital life and society will result in a corresponding reduction in personal control, with inevitable costs to our well-being."

Rod Beckstrom, author, tech entrepreneur and former CEO of ICANN and founding director of the U.S. National Cybersecurity Center, said, "At the extreme, metaverse-generated realities may become so seemingly real that they become difficult to differentiate from reality itself, just as many AI-generated digital images of people are taken to be real photos of people in online community platforms today. Some implementations and uses of the metaverse will benefit humanity, while others will harm it; the question is whether humans will be good or not. Metaverse tools and experiences may inspire violence, and they can help people to better process their emotions and conflicts and be more peaceful. Societies often create policies to attempt to curb the deleterious effects of new technologies and encourage good effects. However, it is extremely difficult to craft policies in rapidly emerging technology fields, for a rich set of reasons, not the least of which is the difficulty of understanding the technology itself and how it might evolve, much less the direct, secondary and tertiary effects of said policies and their enforcement or lack thereof."

Andrew Tutt, an expert in law and author of "An FDA for Algorithms," wrote, "One social ramification of continually giving people direct access to data appears to be that individuals have less respect for expertise, even though that confidence may be unwarranted. Security vulnerability is also immense – a society that reconfigures its physical infrastructure around access to a

metaverse cannot afford to have that metaverse hacked or disrupted without significant real-world consequences. We may also confront a problem wherein people have difficulty distinguishing the real world from the virtual world. We may also see, with the continued empowerment of individuals to build their own communities and make connections across the globe, the spread of ideologies in unexpected ways and into unexpected places that could pose a threat to liberal democracies."

An internet pioneer based in Berkeley, California, commented, "[Construction of the metaverse] will happen, but that's not my hope. When the Internet started – I was there – we believed that enhanced communication was going to tear down walls, reduce hatred and end in world peace. It turns out it didn't work that way, and I think the same will happen with the metaverse. This will allow, for example, an environment with avatars that attack others, probably leading to a further degrading of actual constructive discussions between people who are aren't already aligned. It will also further separate the 'haves' from the 'have nots' on the basis of financial status, physical location (due to differences in connectivity), race, religion and so forth. And don't get me started on blockchain, at least in the form of e-currency. It's a money launderer's wet dream, and ultimately, I think, very destructive to our society. There will be good things that come out of this, e.g., telesurgery and a more-immersive environment for personal communication in the same way video calls give you more connection than a voice call, and 3D will be better than 2D."

The director of a university research center focused on ethics and values in technology design wrote, "We're already seeing negatives emerge, of course – sexual harassment, the long road to developing both safety and social norms in VR spaces, and of course the fact that such technologies open even more human interactions to datafication and surveillance. There are also possible harms around addiction that are hard to predict."

Steven Livingstone, founding director of the Institute for Data, Democracy and Politics and professor of public affairs at George Washington University, commented, "The financial incentives are too great to pass up for companies and individuals with enormous resources at their disposal. Add to this Elon Musk's neural net initiative, a neural lattice directly linked to the brain, and one sees the potential for a drug-like addictive quality to alternative realities."

A director of health and life sciences and legal market analyst wrote, "I fear employers will use the new environment to intrude on HBEs (home-based employees) in their homes."

Albert "Skip" Rizzo, clinical psychologist and director of Medical Virtual Reality at the University of Southern California Institute for Creative Technologies, commented, "All the same threats that may occur in the real world will have a presence in these virtual worlds. Early

education for children (and vulnerable populations) on the do's and don'ts will need to be implemented, and some form of non-onerous oversight or management will need to take place in ways that protect, but do not limit opportunity – a hard balance there. Some mechanism for personal responsibility may need to be in place for use of these spaces, perhaps digital IDs that are traceable to the real person might be needed for participation with some content. That will raise the ire of some personal-freedom advocates. But unfettered anonymity could allow bad actors to do damage. Perhaps 'free worlds' without any ID will exist where folks know they enter at their own risk, but many other spaces will need to be controlled or 'policed' to protect the vulnerable from the dark natures of some individuals. With proper security protocols in place or 'buyer beware' designations in place, we may be able to manage the impact of negative consequences and allow the more pro-social areas to thrive. Not much different than real life."

Greg Sherwin, a leader in digital experimentation with Singularity University, said, "Despite the many wows and wonders, it will still be backed by humans, whose ethics will not have changed any – making these environments often as toxic as we witness with social media today. The change to the world will be the escapism of people who wish to control their own fake realities versus those who opt to live 'behind' and continue to work in the shared reality. Much of the metaverse will earn a reputation as a fairly elitist experience, with distributed communities of influencers and advocates and people building their personal businesses off of it."

A geoscientist based in Oceania commented, "There are of course dangers in humans inhabiting a new environment, but as with every niche humans have been able to adapt to, we find social ways to generally get the best outcomes. A significant issue for all such digital technologies will be their likely carbon footprint. Creating a metaverse at the expense of life on the planet is ridiculous and should only be pursued within the context of a radical transformation of our energy resources."

Mark Johnson, a technology adviser, administrator and consultant, wrote, "Fully immersive environments increase the opportunities for monetizing personal data and for spreading disinformation. This could increase the slope of the already dangerous path we are on."

Deirdre Williams, an independent internet governance consultant, responded, "The biggest change is likely to be a broadening and deepening of existing divides, an escalation in misunderstanding of each other's realities, each other's lives. There may be increased separation and division, and a distraction of the attention of the 'rich' world from the difficulties of the 'poor' world. But people have been taught to become bored very quickly, so there is a possibility that the metaverse will quickly follow Second Life out of the mainstream."

Fredric Litto, professor emeritus of communications at the University of São Paulo, responded, "It will grow in use and influence, but will be hampered by its psychological effect on a certain sector of the population that is increasingly unable to distinguish between 'real reality' and that which is artificial."

Mei Lin Fung, chair of People-Centered Internet, wrote, "Negatives will arise out of foreseen and unforeseen consequences of the new tools and software design that is done in an unsustainable manner – without attention to incorporating feedback and quickly adjusting when harms surface to prevent problems or at least mitigate them. People of ill intent will flourish for a while, taking advantage of the gaps in the guardrails of society when advances occur too fast for our institutional social protections and societal norms to be developed."

Tamarah Singh, a global business manager expert in technology-led innovation based in Singapore, responded, "The metaverse will need to have new governance frameworks unlike those that exist today. There are scattered efforts but there has yet to be a concerted effort to convene appropriate expertise toward considering this. The Ethereum Foundation and Blockchain Association may be helpful partners, but the experts convened should reflect the nature of the metaverse, with participation from all corners of the world despite current geopolitical tensions, bringing together the needs of all aspects of global society. Regarding the daily lives of the connected: Near-constant connection will require different approaches to well-being and health. I find a simple, familiar frame to consider this question with Maslow's Hierarchy of Needs. Physiological needs are likely to remain offline to a degree – no doubt there would be online 'homes,' but humanity will still require physical shelter, and I doubt there would be a robust business case for the full digitisation of reproduction :-). Needs for public safety will likely be both on- and offline for some time, but at this level the weighting of how much moves digital starts to increase. Love and belonging may move largely online, though a recent innovation programme I worked on with 20+ year-olds reflected an exhaustion and disenchantment. There, the students sought to make metaverse connections to arrange real-life interactions (beach clean-ups, pay-it-forward coffees, tree planting, hiking). Self-esteem and self-actualisation may change in the metaverse. Social scoring systems may come into play to generate different concepts of worth."

George Capowich, retired associate professor of sociology at Loyola University-New Orleans, wrote, "On the negative side, it further separates people and contributes to the atomization of daily life since we won't interact with an actual person. Another negative (and a big one in my mind) is the potential for compromising privacy, the abuse of data that will be collected about people and the potential for data leaks."

Micheal Kleeman, a senior fellow at the University of California, San Diego, who previously worked for Boston Consulting and Sprint, responded, "If the metaverse were to be more broadly

adopted then it would probably worsen digital and social divides, make mental health issues worse and lead to an expanded risk of misinformation taken to a new scale and level as people's worlds get defined by third parties. Daily lives would be corrupted by an artificial world, and real-world needs would go unaddressed."

A professor emeritus of communications predicted, "The networks could go dark due to the loss of power-generation networks, hackers, terrorism, electromagnetic storms or warfare that disables satellites and core fiber networks. This vulnerability shouldn't be underestimated, nor should the consequences of corruption/fraud, problems with supply chains and issues with the delivery of core commerce and financial services. The combination of climate change and the emergence of the metaverse may become the perfect storm that sets civilization back in unimaginable ways or forces the world to make a quantum leap forward toward more-equitable restructuring of our societies and allocation of resources. There are too many unknowns, and it isn't looking good with the world on the verge of another world war."

Phillipa Smith, associate professor of language and culture and expert in social theory and new media at Auckland University of Technology, New Zealand, responded, "While clearly there are positives in what might be offered with the metaverse, negative aspects need to be foreshadowed, prepared for and responded to such as cybersecurity and online abuse. The objective should be an internet for good, and an internet for all, and one that involves cooperation between governments, tech companies and civil society. The evolution of the metaverse, while an exciting prospect, needs to be approached with caution. Digital divides exist and may continue to exist, so there may not be benefits for all. Assumptions endure about people's connectivity and accessibility to the digital, when on the socioeconomic level there are those who cannot afford devices, data purchase, do not have the digital skills or literacy, on the political level there may be restrictions within countries and regimes allow, and other marginalised groups need to be considered when it comes to technological design – such as people with disabilities, older users, etc."

Griefers, criminals, profit-seekers and manipulators of all types will be able to act more deviously and instantly upon the innocent at scale

Daniel S. Schiff, a Ph.D. candidate who studies the governance and social and ethical implications of AI at the School of Public Policy at Georgia Tech, said, "The existence of a metaverse renews questions about misinformation, protection of privacy, targeted advertising, disparate treatment of subgroups, coercion, harassment, bullying, labor and sexual exploitation, and more. VR theoretically makes many of these and other social and ethical issues raised by the internet and social media even more stark given the enhanced experience associated with immersive audiovisual content. Harassment and bullying could become more traumatizing, while protecting privacy would be even more essential given increased access to data about an

individual's digital location, emotional state or behavior. The early experiences of sexual harassment in virtual spaces indeed point to a dire need for proactive governance and regulation, especially to protect vulnerable groups and children. Further issues surround psychological well-being."

Andrew Feldstein, associate vice president for learning technologies at Fort Hays State University, responded, "Any idealized notion of benefits of fully-immersive digital spaces will need to be tempered by the inherent imperfection of human nature. Technology will continue to outpace the ability for people to change and adapt. Fully immersive digital spaces will not be able to proceed at the pace of technology. They will only proceed if developers pay attention, not only to adoption rate, but to patterns of adoption. This will be a recursive process and, potentially, one step forward, two steps back. Things may become more immediate with increased opportunities to experience new things. However, there will be equal opportunities for using newfound affordances for good or for exploitation."

A North American research scientist responded, "I am very worried about the impact of the metaverse in promoting and making worse intersecting discrimination in online contexts such as misogyny, online harassment, cyberbullying and proliferating hate. Already there have been several articles by women who ventured into metaverse social groups and were immediately targeted by male avatars. If these interactions are already taking place, and given that gaming is already an activity that engages violence in many of the games and that it is well known as a misogynistic feminist forum, it can only get worse without effective regulation.

"Regulation in social media as we know it has been extremely difficult at best. Social media help to proliferate fake news and alt-right racist movements, homophobia, ageism, offensive jokes against people with disabilities, and we can expect much worse from the metaverse. This is especially of concern given that two years of pandemic isolation and lockdowns have created significant anger and polarization as evidenced in the protests in Canada, as well as in the political influence of far-right-wing nationalist extremists globally.

"The metaverse will be extremely difficult to regulate and is not likely to prove any better than social media at maintaining democratic forms and respectful communication. It may be difficult to maintain virtual reality environments that can then benefit people in the real world. And what will happen to our social relationships in the real world? We have already seen burnout and proliferation of mental health issues during the pandemic from Zoom meetings and social isolation."

Yasmin Ibrahim, professor of digital economy and culture at Queen Mary University of London, responded, "It will entail quite a lot of experiments involving human subjects, and, as always,

there will be a moral lag between the social appropriation of technologies and their social, moral and ethical as well as legal consequences over time. What it might engender prior to the establishment of regulatory mechanisms and adoption of appropriate norms is loss of inhibitions and an increased encroachment of violence, misogyny and aberrant behaviour."

A professor of public policy at a major U.S. technological university said, "Today people blithely give up information on social media in response to lures thinly disguised as survey questions but clearly aimed at revealing security questions. What will people yield when they have avatars being lured into 'relationships' with models, movie stars, etc., opportunities to participate in the most ultimate virtual joys (no, not only lurid) that can be imagined, and all it costs is access to their most-personal information?"

Howard Rheingold, pioneering internet sociologist and author of "The Virtual Community," said, "I don't see how it will be possible to prevent bad actors from vandalizing immersive spaces at scale. I recall my experience with 'griefers' in Second Life (gatherings disrupted by squadrons of flying penises) and the current inability of Facebook to deal with bad actors, even with AI tools and thousands of human moderators."

Alex Hicks, expert on the ethical dimensions of economic issues and dean of Oxford College at Emory University, commented, "As the truth homology improves, there will be numerous gullible fools for the metaverse to dupe if the popularity of current social media is any indication."

People's social and cognitive skills will be weakened or lost as they become more fully reliant on technology

David J. Krieger, director of the Institute for Communication and Leadership in Lucerne, Switzerland, said, "Regardless of whether VR or AR become more influential, a major challenge will be the loss of independent decision-making and reliance upon computer-assisted judgments and actions. Many cognitive and motor skills will no longer be needed or will be significantly modified so that it will become difficult if not impossible for people to do many things in life without technological assistance or 'augmentation.' Just as we are coming to the point of not being able to drive a car without a navigation or other assistance systems, we will lose many abilities we now have. They will be replaced by abilities to use technological assistants. A good cost-benefit analysis will be needed in each case and a discussion of what values society should be pursuing."

Oscar H. Gandy Jr., scholar emeritus of the political economy of information at the University of Pennsylvania, said, "My expectations about the negative impacts of the development of this technology are based on the extent to which interactions with so-called 'intelligent devices' are increasingly capable of engaging in interactions with individuals in ways that are routinely

experienced as being often more pleasurable than engaging in interactions with humans. Interactions with our colleagues, our friends and our neighbors are likely to decline rather dramatically."

Alan S. Inouye, senior director for public policy and government relations at the American Library Association, said, "A major concern is the impact to the state of communities and human relationships. In the past decades, technologies have evolved and been deployed. Only later are the impacts to people and communities assessed, or rather discovered. To some degree, this is necessarily true. However, I worry about the implications of the rise of automated virtual engagements on individuals and communities and the resulting de-humanizing of daily life. Just because interactions may be efficiently mediated or performed by technology does not mean they should be.

"Leading thinkers such as Robert Putnam (author of 'Bowling Alone') and Eric Klinenberg (author of 'Palaces for the People') have noted the decline of community and social infrastructure in the past decades. The causes are multiple and complex but surely technology is in the mix. We will want to pay careful attention to how the rise of automated agents may further cause deterioration in human relationships. And there may be ways to deploy automated agents to strengthen individual and community relationships; an effort to do this is worthy of a considerable initiative."

Kenneth A. Grady, futurist and founding author of The Algorithmic Society blog, observed, "We are already seeing hints of what negatives the movement of more work and social activities into a metaverse setting might inflict on us. People emerging from pandemic isolation and a world dominated by online meetings find they have stale social skills. People describe in-person conferences as mentally tiring as they re-adapt to always being 'on.' Participants report having lost some of the fluidity of in-person exchanges. They find they are more prone to talk over others in a conversation (as often happens during online meetings). They say they are slower to pick up on social cues and may miss important ones. These apocryphal stories are hints that as we replace in-person human interaction with online interaction, we may lose some of our humanness. For social beings, this could suggest momentous changes. For example, our governance mechanisms (domestic and international) depend on robust social skills. The depreciation of those skills through overuse of online tools may exacerbate challenges of managing diverse societies."

Henning Schulzrinne, Internet Hall of Fame member, co-chair of the Internet Technical Committee of the IEEE and professor at Columbia University, responded, "One obvious danger is that these digital spaces can further amplify the pseudo-proximity of other digital spaces, where the other person seems close enough to hate or harass, but, as an avatar, doesn't seem real enough as a person to respect and treat as a 'real' human being. For example, critical cues to the emotional state will be hard to convey when the person is wearing VR goggles – at least a facemask only

obscures the mouth, not the eyes and other emotionally expressive parts of the face. If the digital rendering provides some kind of facsimile of my facial expression, how will I know that this is accurate and not conveying the wrong emotional tone?"

A user interaction expert based in Japan responded, "Extended-reality developments will work both positively and negatively for people who can connect and enjoy themselves. Some people may spend much or all of their time there and turn away from attending various real-life challenges. It can become impossible for some to separate the virtual world from the real world; for those who are immersed in the virtual world, the virtual becomes their reality."

A North American futures strategist and consultant commented, "We are addicted to our smartphones, and the apps will be refined and will enrapture us. We will then become less interactive on a person-to-person level, relying on electronics."

A professor of sociology and chair of African American Studies at a major U.S. university commented, "In general, I am critical of the ways in which we are moving away from interpersonal interaction. It seems as if every generation is being socialized into having less and less in-person interaction. More and more young people now find their partners on dating apps rather than in their friend groups, classrooms, communities, etc. And we see the social isolation, anxiety and ennui that it has created in this generation. If we are living in a metaverse rather than in this world, how will we hug our children and each other? How will we SEE each other? How will we hold someone's hand? Just the other day, I brushed my 86-year-old mother's hair. I worry that the metaverse will take us all away from these human interactions. In terms of how we think of our world, it will likely allow us to experience places we couldn't before (including different places and time periods), but at the expense of NOT experiencing the place where we are. The former could create more empathy and global connections, but the latter creates alienation from the immediate time and space."

The digital divide will be widened yet again

Zizi Papacharissi, professor of communication and political science at the University of Illinois-Chicago and editor of Social Media + Society, wrote, "Can we build a metaverse that is non-Western? Can we have an internet that does not speak English as the primary language? What would our worlds look like if our metaverses and collective internets were multilingual and deeply multicultural? I do not think the metaverse will redefine our online experiences by 2040. Frankly, I do not want it to. I find that the metaverse is premised on values and habits of everyday life the reflect Western norms of doing. U.S. norms and social practices of playing, of working, loving and of living together are disproportionately reflected in how the metaverse is imagined and rendered. And there is something wrong with that. It ascribes premium value to how people live in the U.S.

It repeats and reinforces problems and injustices of how we live in the U.S. It does not allow us, in the U.S., to learn from how the rest of the world lives. And yet, we in the U.S. much enjoy traveling and meeting fellow citizens from around the world because we are inspired by the way they eat, they drink, they laugh and live together. It is easy to re-create a mirror image of our worlds on the metaverse and then invite us to step in. I do not want that. I have a world like that. I want a better world, where it is not just the environment that is augmented but our perceptions, our values, our ways of seeing and hearing. Augmented does not cut it anymore. Immersive and inclusive is the way forward."

Tamarah Singh, a global business manager expert in technology-led innovation based in Singapore, responded, "How might this change human society? An absolute segregation of the world based on connection. Unless carefully designed and governed, the metaverse stands to deepen the divides between the connected and privileged, and the disconnected and underserved. The benefits of the metaverse are even less likely to reach these vulnerable populations, which may deprive them of basic social needs like education and health care. An alternative scenario exists where the primary industries associated with agriculture and craftsmanship become the premium industries of the future. There are yet some necessities of life that cannot be fully digitised, food for example, which may see two ways of being emerge – a connected and a disconnected society, each with differing priorities and needs."

Amy Sample Ward, CEO of the Nonprofit Technology Enterprise Network, responded, "The question isn't if, but for whom? It may well be that by 2040 the metaverse will be a much more refined and truly fully-immersive, well-functioning aspect of daily life. But Broadband Now estimates that in 2022 42 million Americans don't even have the ability to purchase broadband internet. In addition, 61 million adults have a disability, and tens of millions of those are folks who have a disability that impacts their use of the internet, from gripping a mouse or using a keyboard to visual, auditory and cognitive impairments. These are just U.S. numbers, so the many forms of digital exclusion are amplified when we consider the whole world. Building the metaverse by some for some will result in a very different offline world and a very different metaverse or online world than if we build it by all for all. What does an inclusive metaverse look like? What timeline does an inclusive metaverse require? The investments we make today toward digital equity – from reliable and affordable broadband service to digital literacy and device access – are actually investments in a more inclusive future metaverse, whatever shape it takes."

Rachel Kowert, research psychologist and research director at Take This, said, "By 2040 we can hope to see more people engaging in digital society on a more regular basis. Today, large proportions of the population remain unengaged in daily digital life. As online activities become not only more immersive but potentially more integral to society, there will be an uptick in engagement. This technology has the *potential* to be an equalizer across societies. *If* everyone has

equal access to the same online spaces and equal ability to connect globally, then human society as a whole will experience a greater equalization of opportunity and accessibility to goods, services and knowledge exchange. Having more-equal access to goods, services and knowledge exchange would exponentially increase the resources to increase human potential across domains. There would be improved accessibility for work and education for those in more-remote geographical locations and those with limiting physical disabilities. *However*, if there continues to be a global inequality with access to this technology, disparities across location and population will increase and intensify. Among the other worries in extended-reality spaces are the magnification of social pressures such as bullying and harassment. With the increase in sensory information available in an immersive space, we are entering new ground in terms of the ways in which digital tools can be leveraged for nefarious purposes."

An AI architect for one of the world's most successful software companies commented, "I predict we will see a large societal divide in those with access to the metaverse whether for entertainment or work purposes."

A professor emeritus of communications predicted, "The physical world will remain central for the many billions who have little access to these digital spaces. This will exacerbate the digital divide into a new stratification, with those able to navigate and leverage the potential power of the metaverse shaping the global economy and the very nature of our societies, access to increasingly scarce food resources, water resources, travel resources and social cohesion. The risks due to this are so large that we should expect legal, political and social resistance that could make it difficult to achieve the XR 'promise' by 2040."

Amy Gonzales, associate professor of communication at the University of California, Santa Barbara, said, "To the degree that the metaverse will become a context for commercial transactions or delivery of services (e.g., education, health care), one of my primary concerns is that it will exacerbate digital divides. Many individuals will not be able to consistently afford bandwidth or devices, and many will not have the digital skills to navigate these dynamic new spaces."

Ellery Roberts Biddle, projects director at Ranking Digital Rights, wrote, "When I look ahead and try to imagine the future of the metaverse, I can't help but imagine a similar story playing out. I'm sure that some people and communities will transition to carrying out certain activities in the metaverse, and that this will work well for them. I expect these communities will be relatively homogeneous in their values and identities, and that they will be located in places where wealth and high-quality internet are a given. This tracks with what we've seen in the development of other novel kinds of spaces that allow for interaction in digital space. What we've also seen, and what I expect to hold true with the metaverse, is that platforms or infrastructure that is meant to engage

people by the hundreds of millions will only really work well for those in privileged enough positions to enjoy smooth connectivity and insulation from some of the social and human rights harms likely to emerge from or persist with this new technology."

A widely published technology journalist based in North America said, "The metaverse will exacerbate inequity, with patient care being different between haves and have nots. There is a heartbreaking cartoon of a child in a house sitting at a computer for virtual schooling, and another child in rags standing on a box to look into a window of a well-to-do family's home to follow along on the same lesson. The metaverse will be more of that. It will benefit many of the affluent and leave behind the working class, many of whom are people of color. We still struggle with basic connectivity issues in the U.S., where rural areas are underserved, which will just exacerbate the digital divide between those who can interact in the metaverse and those who cannot."

Juan Carlos Mora Montero, futurist and professor of planning and foresight at the National University of Costa Rica, responded, "If by 2040 the metaverse will be the reality in which a significant percentage of the world's population lives, its consequences will reach the entire planet and beyond; however, its benefits will be for a smaller percentage of countries and nations."

Thornton A. May, futurist, educator, anthropologist and author, commented, "The transition will be slow and uneven. The real question is one of affordability and accessibility. Will the metaverse be a digital gated community for first-world one-percenters?"

Beth Kolko, professor of human-centered design and engineering at the University of Washington, said, "Consider the growth over the past 20 years around mobile phones and the way they have restructured information sharing, content production and financial transactions. It seems likely that the next 20 years would support a similarly substantive shift in daily activities – this may very well be the advent of the metaverse.

"I do not, at this time, see any particular reason to be optimistic about this transition contributing to a more-equitable world. I do see the potential for new kinds of experts to arise, with wealth-creation opportunities for a small minority (similar to the way mobile has created the category of 'influencer' and helped more people monetize the notion of celebrity), but I do not see how the technology will contribute to any significant rebalancing of the world. The metaverse fundamentally hides the flaws of the everyday (aka global inequity), and once those flaws are hidden, it is extremely challenging to fix them.

"If mobile technology has introduced the personalization of the world, it seems plausible that the metaverse would double down on this trend and create even more fragmented, self-selected communities. Is there a way to maintain serendipity in the online world so that people are brought

into contact with the unexpected, the unfamiliar, and the unknown in ways that build empathy rather than antipathy? Web3 does have the potential to create infrastructures that allow vast swaths of the global population to participate in the global economy in ways impossible previously because of local banking restrictions."

An anonymous respondent wrote, "It *might* allow people with disabilities and other physical constraints to join into aspects of society that were a challenge for them. It *might* afford people marginalized by race, gender, geography and economic status a seat at the table, or in the virtual room, as it were. But my very significant fear is that it will not. The metaverse is already full of White men with access to technology, and it's already becoming weaponized. Blockchain absolutely will play a central role in the building of the metaverse infrastructure, and *might* be a democratizing force, giving millions access to distributed finance and other secure operations without having to go through banks and other government institutions. But, again, without advocates fighting for that vision now, blockchain could devolve into a divisive weapon available to wealthy and White people only."

A human-robot interaction expert based in Japan responded, "For some people, such a world will be realized, but it will not be so for many in the world. For the people for which personal wealth has the most meaning, this evolution might be seen as mostly positive. But the many people who have less than the privileged class may find they are only exploited."

9. Closing thoughts

The following respondents wrote contributions that consider the range of issues societies confront.

Andy Opel, professor of communications at Florida State University, commented, "As someone who has been teaching Immersive Media Production for the past five years and 3D Stereo Media Production for five years before that, I have spent a lot of time exploring these technologies both in and out of the classroom. The evolution of the technologies has been very rapid, with each advancement enhancing the immersive qualities and expanding the possibilities of these technologies. The introduction of the film 'Avatar' in 2009 marked the starting point of the latest wave of immersive media technologies that can be traced back to the earliest stereographs in 1832.

"The arrival of the Oculus Quest wireless headset in 2019 marked a turning point where consumers had access to relatively affordable virtual-reality technology that included stereo 3D, 360 imagery, ambisonic sound and motion-tracking of hands. The Oculus product offered an entry point for many people, exposing new audiences to the power and potential of the medium. As of 2022, almost 50% of users on the Steam platform, a popular source for VR content and games, were using an Oculus Quest headset. The rapid adoption of this one tool is playing a central role in popularizing VR.

"While the technology is becoming more available, there is a slow learning curve taking place for audiences. Collectively in the U.S., we are like the audience in the Lumiere Brothers' theater, ready to jump out of the way of the train that looks like it is coming into the theater. The power of VR to transport someone to a new location is in its infancy but the potential is clearly visible, and this potential is profound.

"Transporting people to real places and telling real stories is one small part of the emerging metaverse, but another dynamic space is 'social VR.' In 2021, I attended Burning Man VR, a completely online experience. The 10 days of Burning Man VR provided a crash course in social VR and an opportunity to experience the creativity and vision of the many artists who created the virtual Burning Man exhibits. Every night, my wife and I would interact with people from all over the world as we explored the exhibits, eventually recruiting friends in other states to join us. We could talk, gesture with our avatars, and navigate everything from the familiar spaces of a virtual outdoor bar to a series of floating giant sculptures emitting showers of colored light. The range of experiences, coupled with the social elements that allowed us to share the experience together, was a major turning point in my understanding of and my ability to see the radical possibilities of this new art form – from simulating the familiar to exploding the possible.

"Joe Hunting's film 'We Met in Virtual Reality' (2021) captures a slice of the emerging possibilities of the metaverse in an incredibly compassionate, human portrait of the power and potential of the metaverse to offer new, unexpected possibilities to audiences the world over. Shot entirely in the world of VRChat, an online social VR platform, Hunting's film offers a glimpse into the many diverse things taking place in the metaverse and suggests the intensity and diversity of these experiences is only going to grow as audiences begin to adopt these new tools and independent content creators gain access to the means of production."

Calton Pu, co-director of the Center for Experimental Research in Computer Systems at Georgia Tech, wrote, "Humans have always lived in their own artificial realities, called 'subjective reality' in philosophy. The metaverse is only technologically new. Many humans, perhaps a majority, do not distinguish their personal subjective reality from a shared objective reality, which is the physical world. As long as their subjective reality has sufficient overlap with the physical world (e.g., respect for laws of physics), subjective humans can function well in the physical environment, including our society. From this perspective, metaverse is primarily a technological projection of our subjective reality.

"The main potential innovation of metaverse is a translation of previously (mental) subjective reality into physical imagery and objects, which may enable physical interactions among subjective realities. The technological challenge is how faithful a representation of the subjective reality the metaverse can achieve, vis-à-vis the power of imagination in shaping and changing our subjective reality. The answer should be obvious: The speed of thought will always be faster than the speed of light.

"Given the limitations of metaverse as a necessarily simplified projection of our subjective reality, a more constrained question would be whether the metaverse can capture a significant part of our subjective realities that can be useful for half a billion people. For the purpose of projection, we will divide the metaverse space into two subspaces: one that intersects with the physical world – called the objective metaverse – and the subjective metaverse, which is independent of physical world. The subjective metaverse would be an extension of creative space currently occupied by intellectual contributions such as books, movies and games. In this space, we are primarily limited by the creative energy of artists, not by technology. Therefore, the technological evolution of XR refinement would be a necessary condition, but not sufficient, for the production of the equivalent of blockbuster movies.

"It will take a deep understanding of human subjective reality to develop such metaverse blockbusters, which is possible, but implausible, by 2040. The objective metaverse would be an extension of digital twin technologies, which have been hampered by the distance between the evolving physical world and the ever-trying-to-catch-up digital twin. Given the huge investment

(and modest returns) of the last decade on the technologies known as IoT (Internet of Things) and CPS (cyber-physical systems), it seems unlikely that the objective metaverse would evolve sufficiently to achieve much larger impact compared to digital twins."

Karl M. van Meter, mathematician and research sociologist at École Normale Supérieure-Paris and leader with the Association Internationale de Méthodologie Sociologique, wrote, "The metaverse – just like other high-tech developments – will have its own 'teething' problems, and those problems will be addressed and in many ways resolved by individuals and institutions that have an interest in its correct functioning. This has been the case with the Internet, the web, email and the digital social media. All four have provided tremendous access to information and also previously unimaginable sources of social conflict whose future, like that of the metaverse, is far from being currently determined. The real question is whether or not the relatively open and highly developed countries responsible for these high-tech developments have the means of resolving the social conflicts that have been generated and still remain open or even democratic societies.

"Will the metaverse be different in China, in Russia, in North America, in Western Europe in the near future? I think the answer is clearly yes, and so how about in 2040? I think these countries, more than us as individuals or the high-tech developers, will be the major factors in determining what 2040 will look like and what the metaverse will be by the date.

"The U.S. National Intelligence Council (NIC) produces reports with projections into the future, looking at 'all the actors': China, Russia, North America, Western Europe, etc. Unfortunately, I have never seen one of these reports analyzing what role the NIC was going to play: telling the U.S. government that the 'police action' in South Vietnam would be successful; telling the UN and the world that Iraq had weapons of mass destruction; claiming that 'advanced-interrogation techniques' were not torture. I wonder what the NIC would say about the future of the metaverse, without – of course – saying what its role will be."

Edson Prestes, professor of informatics at Federal University of Rio Grande do Sul, Brazil, responded, "Certainly, by 2040, we will have had enough great technological advancements to have a more-fully-immersive and much more refined metaverse; however, I am a bit skeptical we will have made a lot of progress by then in regard to human development.

"Investment in technological solutions alone will not be enough to serve the best interests of humanity. It is necessary to put the entire planet at the center of future development. Are we genuinely doing that – not only talking about it but taking positive action for positive technological evolution with all of our hearts, minds and energy? There are some efforts

underway, but will they be enough to take the metaverse in the right direction for humanity in the face of powerful players whose main motivation is not global good? Not sure.

"The metaverse can bring some clear benefits in various domains, but I am concerned about how the most vulnerable people will be victims of human rights violations due to new forms of manipulation, abuse and violence. We must also consider the perils for humanity in an age with AI-powered weapons. Lethal autonomous weapons systems continue to be developed. I am pessimistic.

"Trust among stakeholders (governments, industry and civil society) is fragile. Strong regulations and international agreements must be in place. Foresight, strategic thinking, planning and strong engagement from global society are necessary now so these new technologies do not amplify current real-world problems, such as energy overconsumption, the increasing exploitation of people and of natural resources, the degradation of human relationships and so on. The metaverse has great potential to impact democracy in unthinkable ways, including leaving offline people so far out of the picture that they are totally invisible to the rest of society. Of course, this already exists in some sense today, but it will be amplified, since it is not a question of access to the internet, but the access to a whole new world."

Stewart Umpleby, an American cybernetician, professor emeritus of management and former director of the research program in social and organizational learning at George Washington University, wrote, "I work to advance the field of cybernetics, which provides a general theory of control and communication. It is clear to me that the world is moving from an industrial society based on matter and energy to an information society based on control and communication."

Jaak Tepandi, a professor of knowledge-based systems at Tallinn University of Technology in Estonia, said, "The idea of one possible positive future scenario for humanity stems from the logic of human evolution to date – the evolution of existing species and the emergence of new species, with some new species gaining increasing influence over other species and the environment. Even now, a new species may emerge, which represents the integration of humans and artificial systems, and it can eventually become dominant. Examples of important components in the development of such a species include genetic engineering (including CRISPR), artificial intelligence, cryptocurrency, metaverse and others. Some realistic developments for humanity include:

- Evolution – human integration with the artificial environment (similar to evolution from ape to human).
- Survival – humans exist alongside the developed artificial environment (comparable to humans' existence alongside the animal kingdom).

- Isolation – will the setting for humanity be more similar to a zoo or to a nature reserve?
- Destruction – an 'on-site anthill' or 'running costs.'

"These scenarios are likely to be combined. The slower the transition, the greater the likelihood of positive scenarios for humanity. So, I express wishful thinking for the transition to be slow enough to allow humanity to experience a peaceful evolution."

Tony Smith, a leader with the Kororoit Institute, a collaborative polydisciplinary research group applying complex systems and organisation knowledge theory to practice, responded, "As much as I have been invested for 40 years in the development and exploitation of virtual spaces that would facilitate not just rich interaction but also wide ranging collaboration, the proximate failure of our overstretched administrative systems, planetary hydrology and ecology is unlikely to leave space for such dreams to come true. I still see this kind of tech providing an irreplaceable platform for the transition to deeply devolved, diverse and transparent society that may be our best hope for finding viable pathways because successful devolution needs the confidence building that open transparency can deliver.

"In the interim, info tech must seriously take on board those who have a clue, moving on from human-centric notions of individual 'intelligence' to recognise that knowledge is the key foundation on which any cleverness can be built, that knowledge is a property of populations to a far greater degree, as Carl Safina suggested, extending to mother trees and the fungal wood wide web, and it now appears to water, so we really need our user-interface champions to make a start on bringing the Other Others into a species-neutral collaboration environment in a quest for the kind of solutions that clearly aren't coming from humans in self-imposed isolation.

"As beneficiaries of membership in the most-indulged generation, we have to extinguish all thoughts that the continuation of 'business as usual' is in any way good, and accelerate the collapse of the recalcitrants. I watched part one of the new film version of 'Dune' for the third time a couple of nights ago. It reminded me that we could really use our own Paul Atreides to lead our indigenous survivors to assert their always-was-and-always-will-be responsibility for Earth's land and waters."

Yvette Wohn, associate professor in informatics at New Jersey Institute of Technology and director of the Social Interaction Lab, responded, "Purely from an accessibility perspective, I do not believe that the metaverse as described by Meta and others will be something that most people will be using by 2040. It requires significantly advanced computing resources, both in terms of hardware and Internet infrastructure.

“The metaverse is neither a positive nor a negative space. Its designers have to consider the social consequences their designs will bring. For example, will activities be restricted to only those who have certain hardware or software? Will it lead to dystopian scenarios in isolated virtual spaces? If I were designing the metaverse, it would be something that seamlessly integrates with one’s offline life, that is compatible and integrated with all previous versions of the Internet, and something that enriches life as a whole instead of further deepening the divide between online and offline.

“My doubts should not indicate that I do not see merits in the metaverse. I believe the metaverse will create more jobs in ways that we cannot even imagine now. I believe the metaverse has the potential to enrich the quality of our lives, especially for people who lack physical resources. But like any new technology, the derived benefits are contingent on how the technology is designed.

“If we are not to repeat the mistakes that were made in the past, it is essential that more stakeholders are involved in the design and development of digital spaces. This includes people of diverse expertise – not just programmers, but also social scientists, educators, policymakers. If we expect the metaverse to be an integral part of life in the future, we should not expect that for-profit companies will represent all of the needs of all of society. Placing all of the accountability on companies is unrealistic and to some extent irresponsible.”

Warren Yoder, longtime director at Public Policy Center of Mississippi, now an executive coach, wrote, “The smartphone became part of daily life because it commanded foveal vision to present engaging social media stories. Its 1D sound was adequate for 2D storytelling. It was good enough then; it is tedious now. Today’s rudimentary metaverse commands binocular vision and surround sound, with some attempts at haptic touch but little development on balance, position, smell or the other senses. Meta makers will have to do better for the sensory experience of the metaverse to command sustained attention.

“An immersive metaverse will also have to command more of the human imperatives that drive our attention. We have decidedly mixed examples for the three positive imperatives. Social media has shown us how to capture the social imperative for nefarious purposes. Porn and sex toy makers are working with the sexual imperative. Education meta makers are exploring ways to truly engage our innate curiosity. Still untouched are the two aversive imperatives of homeostasis and pain. They may not seem natural candidates for the metaverse. But what humans have done in the past, meta makers will redo in the metaverse. Physical challenges have a long and storied history. Will meta makers create desert marathons for participants to run to exhaustion? Will metagroups create painful, scarifying initiations?

“Before horrific developments overtake us again, we need deeper conversations about this new mode of being. Fortunately, key philosophers are doing useful work. Not the philosophers arguing

for and against transhumanism. Look instead to those exploring the transition from postmodernity to metamodernity. Postmodernity interrogated modern power and knowledge. Useful back then. Now metamodernity recognizes the existence of multiple modes of the real and prompts one's imagination to take bits and pieces from useful practices wherever we find them.

"We have already begun constructing a new metamorphic reality not limited by old binary contradictions. The metaverse will develop in a world with a metamodern imagination. It is time for an astute foundation to bring together meta makers and metamodern philosophers to deepen this conversation."

About this canvassing of experts

This report covers results from the 14th "Future of the Internet" canvassing by Pew Research Center and Elon University's Imagining the Internet Center.

Participants were asked to respond to several questions about the tone and impact of the online environment and the trajectory of activities in the digital public sphere that have recently been raising deepening societal concerns. Invitations to participate were emailed to more than 10,000 experts and members of the interested public. They were invited to weigh in via a web-based instrument that was open to them from Feb. 11-March 21, 2022. Overall, 624 people responded to at least one question. Results reflect comments fielded from a nonscientific, nonrandom, opt-in sample and are not projectable to any population other than the individuals expressing their points of view in this sample.

Respondent answers were solicited though the following prompts:

> ***The evolution of the metaverse:*** *This canvassing of experts is prompted by emerging debates over the evolution and impact of "the metaverse" by 2040. Broadly defined, the metaverse is the realm of computer-generated, networked extended-reality spaces (XR, which includes VR, AR and/or MR) in which interactions take place among humans and automated entities, some in gaming or fantasy worlds and some in "mirror worlds" that duplicate real-life environments. While extended-reality gaming and social spaces have been in existence for decades, early 2020s tech advances have pushed the development of the metaverse to the forefront, inspiring tens of billions of dollars in investments and prompting predictions that it is "the future of the internet" or "the next internet battleground." The hope is that advanced, immersive, 3D, online worlds could benefit all aspects of society – education, healthcare, gaming and entertainment, the arts, social and civic life and other activities. Of course, as with all digital tech, there are concerns about the health, safety, security, privacy and economic implications of these new spaces. This is spurring new conversations about what the maturing of the metaverse will look like and what that means for society.*
>
> ***The question:*** *Considering what you know about the metaverse, which statement comes closer to your view about its likely evolution by 2040?*
>
> *- By 2040 the metaverse* ***WILL*** *be a much-more-refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally.*

*- By 2040 the metaverse **WILL NOT** be a much-more-refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally.*

Results for this question regarding the current evolution of XR and the metaverse:

- **54%** said by 2040 the metaverse **WILL** be a much-more-refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally.
- **46%** said by 2040 the metaverse **WILL NOT** be a much-more-refined and truly fully-immersive, well-functioning aspect of daily life for a half billion or more people globally.

The follow-up quantitative research questions were:

> ***Please elaborate on your answer.*** *Tell us how you imagine that this shift of many online activities into more-fully-immersive digital spaces and digital life is likely to take place. Regardless of how you see the timing of this, how might it change human society? What are the likely positives of this transition? What negatives may emerge? How might it change the daily lives of the connected? And how will this transition change the way we think about our world and ourselves? We are also interested in hearing your thoughts about the role blockchain and its applications might play in this evolution of online life by 2040.*

The web-based instrument was first sent directly to an international set of experts (primarily U.S.-based) identified and accumulated by Pew Research Center and Elon University during previous studies, as well as those identified in a 2003 study of people who made predictions about the likely future of the internet between 1990 and 1995. Additional experts with proven interest in these particular topics were also added to the list. We invited professionals and policy people from government bodies and technology businesses, think tanks and interest networks (for instance, those that include professionals and academics in law, ethics, political science, economics, social and civic innovation, sociology, psychology, education, wellness and communications); globally located people working with communications technologies in government positions; technologists and innovators; top universities' engineering/computer science, political science, sociology/anthropology and business/entrepreneurship faculty, graduate students and postgraduate researchers; plus some who are active in civil society organizations that focus on digital life and those affiliated with newly emerging nonprofits and other research units examining the impacts of digital life.

Among those invited to participate were researchers, developers and business leaders from leading global organizations, including Oxford, Cambridge, MIT, Stanford and Carnegie Mellon universities; leaders at many companies and organizations heavily invested in the future of XR and the metaverse (including but not limited to the following): All These Worlds, Amazon, Apple, Axie Infinity, Beamable, the Center for AI and Digital Policy, Constant Change Media Group, The Crucible, Customer Commons, the Cyber Civil Rights Initiative, Decentraland, Educators in VR, Epic Games, Google, HTC, Infineon, Inrupt, Meta, Microsoft, Nvidia, Roblox, The Sandbox, Second Life, Sony, Unanimous AI, the United Nations Office for Disaster Risk Reduction, Unity, Upland, the Virtual World Society, the XR Association and more; leaders active in the advancement of and innovation in global communications networks and technology policy, such as the Association of Internet Researchers (AoIR), IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, International Telecommunications Union (ITU), Internet Corporation for Assigned Names and Numbers (ICANN), Internet Engineering Task Force (IETF), Internet Society (ISOC) and the Organization for Economic Cooperation and Development (OECD). Invitees were encouraged to share the survey link with others they believed would have an interest in participating, thus there may have been somewhat of a "snowball" effect as some invitees welcomed others to weigh in.

The respondents' remarks reflect their personal positions and are not the positions of their employers; the descriptions of their leadership roles help identify their background and the locus of their expertise. Some responses are lightly edited for style and readability.

A large number of the expert respondents elected to remain anonymous. Because people's level of expertise is an important element of their participation in the conversation, anonymous respondents were given the opportunity to share a description of their internet expertise or background, and this was noted, when available, in this report.

In the demographics section of this canvassing, of the 272 respondents who answered the query about their region of the world 76% reported being located in North America and 24% said they are located in other parts of the world. Seventy-one percent of the 410 respondents who answered the question as to sexual identity said they identify as male, 26% identify as female and 3% identify themselves in some other way. Of the 408 respondents who indicated their "primary area of interest," 35% identified themselves as professor/teacher; 15% as futurists or consultants; 13% as research scientists; 10% as technology developers or administrators; 6% as advocates or activist users; 6% as entrepreneurs or business leaders; 3% as pioneers or originators; and 10% specified their primary area of interest as "other."

Following is a brief list noting a small selection of key respondents who took credit for their responses on at least one of the overall topics in this canvassing. Workplaces are included to show expertise; they reflect the respondents' job titles and locations at the time of this canvassing.

Charles Anaman, founder of waaliwireless.co, based in Ghana; **Avi Bar-Zeev**, XR pioneer who has developed the tech at Microsoft, Apple, Amazon, Google and more; **Rod Beckstrom**, author, entrepreneur and former CEO of ICANN and director at the U.S. National Cybersecurity Center; **Matthew Belge**, president and principal UX designer at Vision & Logic; **danah boyd**, founder of the Data & Society Research Institute and principal researcher at Microsoft; **Stowe Boyd**, managing director and founder of Work Futures; **Tim Bray**, founder and principal at Textuality Services (previously at Amazon); **Daniel D. Bryant**, Wales-based VR educator, co-founder of Educators in VR; **Eric Burger**, recently worked in the White House Office of Science and Technology Policy and as the chief technology officer at the FCC, now on the computer science faculty at Georgetown University; **Nigel M. Cameron**, president emeritus of the Center for Policy on Emerging Technologies; **Jamais Cascio**, distinguished fellow at the Institute for the Future; **Daniel Castro**, vice president and director of the Center for Data Innovation at the Information Technology and Innovation Foundation; **Cathy Cavanaugh**, chief technology officer at the University of Florida Lastinger Center for Learning; **Vinton G. Cerf**, vice president and chief internet evangelist at Google; **Barry Chudakov**, founder and principal at Sertain Research; **Aymar Jean Christian**, associate professor of communication studies at Northwestern University and adviser to the Center for Critical Race Digital Studies; **David Clark**, Internet Hall of Fame member and senior research scientist at MIT's Computer Science and Artificial Intelligence Laboratory; **Susan Crawford**, a professor at Harvard Law School and former special assistant in the Obama White House; **Amali De Silva-Mitchell**, founder/coordinator of the IGF Dynamic Coalition on Data-Driven Health Technologies; **Cory Doctorow**, activist journalist and author of "How to Destroy Surveillance Capitalism"; **Stephen Downes**, expert with the Digital Technologies Research Centre of the National Research Council of Canada; **Ayden Férdeline**, public-interest technologist based in Berlin, Germany; **Seth Finkelstein**, principal at Finkelstein Consulting and Electronic Frontier Foundation Pioneer Award winner; **Michael M.J. Fischer**, professor of anthropology and science and technology studies at MIT; **Mary Anne Franks**, president of the Cyber Civil Rights Initiative; **Batya Friedman**, professor of human-computer interaction at the University of Washington; **Mei Lin Fung**, chair of People-Centered Internet; **Oscar Gandy**, scholar emeritus of the political economy of information at the University of Pennsylvania; **Steve Hanna**, a distinguished engineer at Infineon Technologies expert on Internet of Things security; **Katie Harbath**, public policy director at Facebook from 2011-2021, now founder and CEO of Anchor Change and director of Tech and Democracy for the International Republican Institute; **Akah Harvey**, director of engineering at Seven GPS, Cameroon; **John C. Havens**, executive director of the Institute of IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems; **Peter H. Hellmonds**, founder/owner of Arete

Publica; **James Hochschwender**, futures strategist with Expansion Consulting**; Terri Horton**, work futurist at FuturePath; **Alexander B. Howard**, director of the Digital Democracy Project; **James Hughes**, bioethicist, sociologist and executive director of the Institute for Ethics and Emerging Technologies; **Christian Huitema**, 40-year veteran of the software and internet industries and former director of the Internet Architecture Board; **Elizabeth Hyman**, CEO for the XR Association; **Alan S. Inouye**, director of the Office for Information Technology Policy at the American Library Association; **Mark Jamison**, an American Enterprise Institute scholar who previously served as manager of regulatory policy at Sprint; **Frank Kaufmann**, president of the Twelve Gates Foundation; **Jim Kennedy**, senior vice president for strategy at The Associated Press; **Michael Kleeman**, senior fellow at the University of California, San Diego; **Andrew Koch**, chief executive officer at the Gardner Institute; **Jonathan Kolber**, author of "A Celebration Society; **Chris Labash**, associate professor of communication and innovation at Carnegie Mellon University; **Laurence Lannom**, vice president at the Corporation for National Research Initiatives (CNRI); **Sam Lehman-Wilzig**, professor of communication at Bar-Ilan University, Israel, and author of "Virtuality and Humanity"; **Mike Liebhold**, distinguished fellow, retired, at The Institute for the Future; **Leah Lievrouw**, professor of information studies at UCLA; **Sonia Livingstone**, OBE, professor of social psychology at the London School of Economics and special adviser to the House of Lords' Select Committee on Communications; **Dirk Lueth**, co-founder and CEO of Upland; **Winston Ma**, managing partner at CloudTree Ventures; **Keram Malicki-Sanchez**, founding president of the Constant Change Media Group; **Robert M. Mason**, professor emeritus at the University of Washington; **Giacomo Mazzone**, global project director for the United Nations Office for Disaster Risk Reduction; **Sean McGregor**, technical lead for the IBM Watson AI XPRIZE and machine learning architect at Syntiant; **Sean Mead,** strategic lead at Ansuz Strategy; **Riel Miller**, head of foresight at UNESCO; **Mario Morino**, co-founder at Venture Philanthropy Partners; **Jacquelyn Ford Morie**, VR pioneer and chief scientist at All These Worlds; **Andrew Nachison**, founder of WeMedia; **Bitange Ndemo**, professor of entrepreneurship at the University of Nairobi Business School; **Gina Neff**, professor and director of the Minderoo Centre for Technology and Democracy at the University of Cambridge; **Davi Ottenheimer**, vice president for trust and digital ethics at Inrupt; **David Porush**, writer and longtime professor at Rensselaer Polytechnic Institute; **Jon Radoff**, author of the Building the Metaverse blog and CEO of Beamable; **Albert "Skip" Rizzo**, director of Medical Virtual Reality at the USC Institute for Creative Technologies; **Howard Rheingold**, pioneering sociologist and author of "The Virtual Community"; **Louis Rosenberg**, technologist, inventor, entrepreneur and CEO of Unanimous AI; **Marc Rotenberg**, founder and president of the Center for AI and Digital Policy; **Douglas Rushkoff**, digital theorist and host of the NPR One podcast "Team Human"; **Melissa Sassi**, Global Head of IBM Hyper Protect Accelerator; **Doc Searls**, internet pioneer and co-founder and board member at Customer Commons; **Henning Schulzrinne**, Internet Hall of Fame member and co-chair of the Internet Technical Committee of the IEEE; **Toby Shulruff**, senior technology safety specialist at the

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A selection of institutions at which some of the respondents work or have affiliations:

AAI Foresight; Access Now; Akamai Technologies; Altimeter Group; Amazon; American Enterprise Institute; American Institute for Behavioral Research and Technology; American Library Association; Arete Publica; Arizona State University; The Associated Press; Australian National University; Bar-Ilan University, Israel; Benton Institute; Berkman Klein Center for Internet & Society; BigML; Brookings Institution; CANN Media Group; Carnegie Council for Ethics in International Affairs; Carnegie Endowment for International Peace; Carnegie Mellon University; Center for Data Innovation; Center for Global Enterprise; Center for a New American Security; Center for Strategic and International Studies; Centre for International Governance Innovation; Cisco Systems; City University of New York; CloudTree Ventures; Columbia University; Constellation Research; Convocation Design + Research; Core Technology Consulting; Cornell University; Council of Europe; Cyber Civil Rights Initiative; Data & Society Research Institute; Dell EMC; Digital Trade and Data Governance Hub; DotConnectAfrica; Electronic Frontier Foundation; Emerson College; European Broadcasting Union; Foresight Alliance; Fudan University, China; FuturePath; Gardner Institute; Georgia Institute of Technology; Global Guerillas Report; Global Internet Policy Digital Watch; Google; Harvard University; Hochschule Fresenius University of Applied Sciences; Hokkaido University; IBM; Infineon Technologies; Internet Corporation for Assigned Names and Numbers (ICANN); IDG; Information Technology and Innovation Foundation; Institute for Data, Democracy and Politics; Institute for the Future; International Telecommunication Union; Internet Engineering Task Force (IETF); Internet Society; Institute of Electrical and Electronics Engineers (IEEE); Interpersonal Intelligence Advisory; IO Foundation; Journal of Evolution and Technology; Juniper Networks; Liquid Intelligent Technologies; London School of Economics and Political Science; Massachusetts Institute of Technology; Menlo College; Meta; Metacognitive Technology; Michigan State University; Microsoft Research; Millennium Project; Mozilla; Nanyang Technological University, Singapore; New York University; Namibia University of Science and Technology; National

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Complete sets of credited and anonymous responses can be found here:

https://www.elon.edu/u/imagining/surveys/xiv-2022/future-of-metaverse-web3-2040/ - home page

https://www.elon.edu/u/imagining/surveys/xiv-2022/future-of-metaverse-web3-2040/credit - credited remarks

https://www.elon.edu/u/imagining/surveys/xiv-2022/future-of-metaverse-web3-2040/anon/ - anonymous remarks

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