KPMG

FUTURE OF EXTENDED REALITY

10 predictions, 15 experts

CON TENTS

FUTURE OF XR | 10 PREDICTIONS, 15 EXPERTS

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FORE WORD

Enthusiasts of XR (extended reality) have long dreamed of, experimented with and adopted the technologies that immersed them in new worlds – one beyond the limitations of physics and time. We believe the industry is at an inflection point, and the time for business to act is now. In this report, we interviewed global experts and leaders from industry to get their thoughts on the Future of Extended Reality, its impact on business, and its meteoric rise with the popularisation of the metaverse concept.

This industry is accelerating rapidly, and much has occurred during the time of the interviews until this publication. However, we believe we have captured some central themes and predictions on the Future of Extended Reality, as well as uncovering insights for business leaders around the world to act today.

GLOSSARY OF COMMON KEY WORDS THROUGHOUT THE ARTICLES:

XR – Extended Reality

VR – Virtual Reality

AR – Augmented Reality

MR – Mixed Reality

AI – Artificial Intelligence

BCI – Brain Computer Interface

EEG – Electroencephalogram

Crypto – Cryptocurrency

DeFi – Decentralised Finance

NFT – Non-Fungible Tokens

DAO – Decentralised Autonomous Organisation

CAD – Computer Aided Design

KPMG interviewed 15 global leaders and visionaries from the field of Extended Reality (XR) over a period of 4 months to derive industry insights for business today.
KPMG together with these brilliant minds from hardware manufacturers, software developers, XR community leaders, creators and academics have also looked to the future with

10 PREDICTIONS ON EXTENDED REALITY (XR) AND THE METAVERSE

(Many of the views expressed in this report may be personal and do not necessarily represent those of the global leaders and visionary organisations or that of KPMG Australia.)

1. THE MARS LANDING BY 2026 WILL BE A WATERSHED MOMENT FOR XR AS VIEWERS STEP WITH THE FIRST ASTRONAUT ONTO MARS.

2. DIGITAL REAL-ESTATE, CURRENCIES AND OTHER ASSETS IN THE METAVERSE WILL BE COMMONLY INCLUDED IN WILLS.

3. BY 2030 PEOPLE WILL SPEND MORE PHYSICAL CONSCIOUS TIME IN THE METAVERSE THAN THE REAL WORLD AND THE FINANCIAL VALUE OF THE METAVERSE WILL START TO CHALLENGE THE FINANCIAL VALUE OF PHYSICAL WORLD ASSETS. PEOPLE WILL COMMONLY APPLY FOR JOBS, EARN A LIVING, SHOP, MEET FRIENDS AND EVEN GET MARRIED IN THE METAVERSE.

4. BY 2030 THE FLATSCREEN, KEYBOARD AND A MOUSE WILL DISAPPEAR AND BE REPLACED BY WAFER-LIKE GLASSES AND CONTACT LENSES FOR SPATIAL COLLABORATION ACROSS MULTI-DISCIPLINES. A NEW CONTROL INTERFACE WILL EVOLVE.

5. BY 2030 CUSTOMER SERVICE WILL BE DELIVERED BY DIGITAL HUMANS FOR SHOPPING AND OTHER ACTIVITIES AND REMOTE SUPPORT WITH OVERLAYED INFORMATION IN XR.

6. BY 2030 SYNTHETIC DATA GENERATED FROM SIMULATED WORLDS WILL GUIDE ROBOTS TO PROBLEM SOLVE AND SAVE HUMANS FROM HIGH-RISK WORK.

7. ACCESS TO HIGHER EDUCATION WILL BE BECOME MORE DEMOCRATISED AND DELIVERED ON A VIRTUAL CAMPUS WITH DIGITISED ASSETS SUCH AS MUSEUMS AS A SERVICE.

8. BY 2030 HUMAN THOUGHTS WILL BE ABLE TO BE TRACKED, RECORDED AND INFLUENCED WITH XR AND BRAIN COMPUTER INTERFACES (BCIS) GIVING RISE TO PRIVACY FOCUSED REGULATION. BRAIN POWER WILL BE USED FOR DECISION MAKING RATHER THAN FOR MEMORISATION.

9. BY 2030 XR TECHNOLOGIES WILL ACHIEVE HORIZONTAL CONVERGENCE TO DRIVE GREATER INTEROPERABILITY AND PORTABILITY.

10. BOARD MEETINGS WILL OCCUR IN THE METAVERSE BY 2023. IN THE FOLLOWING YEARS XR WILL BE SECOND NATURE IN TERMS OF THE LANGUAGE AND OPERATION OF GOVERNMENT AND ENTERPRISES TO SHARE INFORMATION AND COLLABORATE.

THE TWO-EDGED SWORD OF THE COMING METAVERSE

MORAL ACCOUNTABILITY, INTEROPERABILITY, PRIVACY AND THOUGHT CONTROL REGULATION IN THE METAVERSE

**ALVIN GRAYLIN,
CHINA PRESIDENT, HTC**

One of the top leaders of China's National Party Congress was a keynote at the recent World Conference of VR Industry in Nanchang and said he believes that one day, VR is going to be the primary computing interface for the world. Right now, it is still a niche part of the market, but China wants to help realise that potential.

Within five years, we will get into the hundreds of millions of VR units globally, within 10 years, it will be as popular, if not more so than phones.

In 10 years, you're looking at 12 to 15 hours a day of XR screen time from a device on your head and the potential to interact, to capture data, to communicate, advertise and manipulate. It could be used for good or bad.

The system behind the global metaverse must be accountable in terms of the moral aspect of having that power. When we have electroencephalogram (EEG) sensors in our devices where we use it to send signals out to control stuff, you can also use it the other way because EEG signals can go both ways. You could actually feed signals into your brain to manipulate your thoughts. Even without EEG, people's perspectives can be manipulated just with immersive visual, audio and experiences. It could be the most effective advertising medium ever! So, there's definitely a lot of potential for good, but there's also some potential danger, and it's important for the industry and governments to be aware and get ahead of those.

REGULATORS AND GOVERNMENTS SHOULD CONSIDER INVESTING IN WIDE SCALE DEPLOYMENT AND TESTING OF THIS TECHNOLOGY, ESPECIALLY IN THE EDUCATIONAL SECTOR WHERE THERE'S HUGE PROVEN BENEFITS.

Stipulating some type of interoperability regulation is highly desired so that we're not excluding devices or brands or certain models or operating systems to ensure high accessibility and stop unscrupulous companies from creating exclusionary walled gardens.

I think we definitely need strong privacy and identity protection because if you think about how important right now your phone is in your daily life, multiply that by five or ten for the metaverse. If somebody stole your metaverse ID and then was able to impersonate you in these virtual worlds and block you out, it's much worse than losing your phone today. You can't go to work anymore. You can't go to school anymore. You can't go buy anything anymore. When somebody blocks you from your account, you are essentially put in jail, so how do we protect users from that happening?

If you look at the current VR user base, about 90 percent are adult males. It's non balanced. If we want a broader audience, it has to be smaller, lighter and more comfortable, and that's already happening with devices like the Vive Flow.

"Within 10 years, we will spend more of our waking time in the 3D world, in the virtual world than we will in the physical world."

I see most crypto as purely speculation vehicles today and the proclamation of decentralisation is often a myth as usually 80-90 percent of all coins are owned by just a few percent of token holders, which doesn't seem like a healthy ecosystem and maybe even more imbalanced than current financial/monetary systems.

CONTENT, IDENTITY, CURRENCY AND ASSET PORTABILITY IS ONE OF MY KEY REQUESTS TO CREATE A MORE OPEN METAVERSE. WHEN YOU HAVE THAT LEVEL OF INTEROPERABILITY ACROSS NETWORKS ACROSS WORLDS, THEN YOU START TO REALISE THE POTENTIAL OF THE METAVERSE.

XR together with AI will make essentially every person in the world feel like a genius because every piece of data you ever want to know is instantly available in front of your eyes. You're fully able to use your brain not to do basic recall or research, but to actually make critical decisions. I think that's going to change who we are as people.

It's going to change why we learn what we learn. If you think about how much time we waste when we're young purely memorising stuff, we don't have to do any of that anymore.

It's going to change the interactions between people because now I could actually see everything about you. I would never forget a person's face anymore because I will have your name right on top of your face when you walk by me at a conference. Having that instant information is going to change our lives.

If you think about how inefficient it is to type, but we talk at about two hundred words a minute. We can listen at about five hundred words a minute. We can think in pictures that are millions of bits a minute. We can be so much more productive in terms of communication and taking what's in our brains and sharing it with the world.

For content creation, storytelling, content consumption, every single aspect of media creation will be changing. Every way that we deliver messages, we receive messages, we find messages, we pay for messages. It will not just be messaging in terms of text, but all forms of the media that we interact with. Within ten years, we will spend more of our waking time in the 3D world, in the virtual world than we will in the physical world.

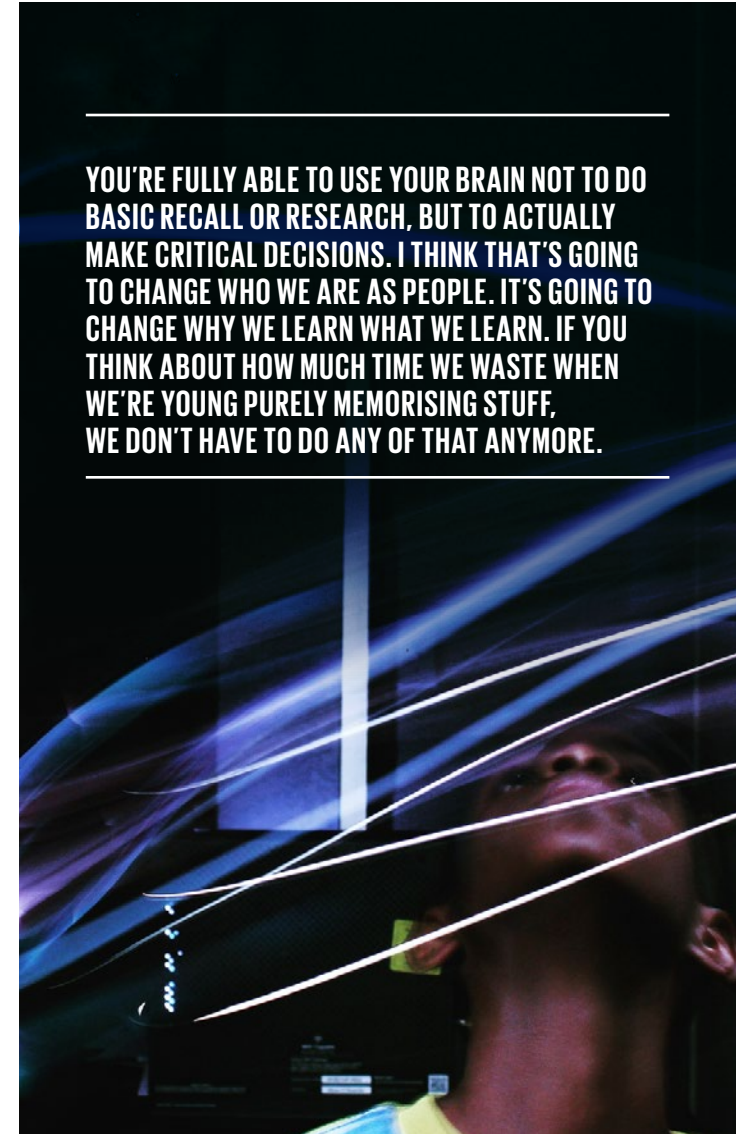**YOU'RE FULLY ABLE TO USE YOUR BRAIN NOT TO DO BASIC RECALL OR RESEARCH, BUT TO ACTUALLY MAKE CRITICAL DECISIONS. I THINK THAT'S GOING TO CHANGE WHO WE ARE AS PEOPLE. IT'S GOING TO CHANGE WHY WE LEARN WHAT WE LEARN. IF YOU THINK ABOUT HOW MUCH TIME WE WASTE WHEN WE'RE YOUNG PURELY MEMORISING STUFF, WE DON'T HAVE TO DO ANY OF THAT ANYMORE.**

"I think we definitely need strong privacy and identity protection because if you think about how important right now your phone is in your daily life, multiply that times five or ten for the metaverse."

ALVIN GRAYLIN,
CHINA PRESIDENT, HTC

FULL TIME JOBS WORKING IN SPATIAL ENVIRONMENTS AND HOW A LANDING ON MARS WILL BE A WATERSHED MOMENT FOR THE INDUSTRY

COVID has really pushed people online into remote teams, and this has accelerated the adoption of immersive technologies. Almost all of my meetings are actually inside our ENGAGE 3D spatial platform. 70 percent of our revenue is also now coming in from our enterprise clients for collaboration, meetings and events.

All our daily stand ups are inside ENGAGE. I meet my developers, sales people and my CTO, inside ENGAGE. It's actually a lot easier than Teams or Zoom when you are on camera where I have to focus on the camera and be dressed up. When you're in virtual reality, you could be in your pjs and your avatar would look professional. I think in the next 3 to 5 years, over 50 percent of the global workforce who work in offices today will be working fully remote inside platforms such as ENGAGE.

There will also be full time jobs in virtual reality worlds, and we're actually going to be hiring for those jobs very, very soon. When we have our always-on persistent plaza, we will have full time people working in there full time inside virtual reality, welcoming people, showing them around and providing them with spatial services. That's going to happen more and more.

The internet became popular when e-commerce came about and that's when the internet really took off. That's where we're at now with virtual reality. Our enterprise users are now using VR for communication and very soon, people will be using VR for purchasing products. As an example, let's say you want to book a hotel for the summer. You can visit the hotel virtually and look out the window in the room that you want to book. Or maybe you're going into a retail shop like Nike, and you're looking for a pair of sneakers.

You pick up a pair of sneakers and look at your avatar and go, right, I want the real version of these sneakers. That's where virtual reality is now.

THE LARGEST GAMING MARKET IN THE WORLD IS POWERED BY WOMEN AS THEY PLAY MOBILE GAMES LIKE CANDY CRUSH AND OTHER PUZZLES. PEOPLE DON'T REALISE THAT WOMEN MAKE UP THE MAJORITY OF THE GAMING MARKET AND FEEL THAT GAMING IS ALL ABOUT SHOOTERS LIKE FORTNITE. IT'S NOT. THE MAJORITY OF REVENUE IS MADE FROM GAMES LIKE CANDY CRUSH AND PUZZLE & DRAGONS.

I think the industry is more male dominated because of the form factor of the headsets being uncomfortable for smaller heads. When they're more like glasses, I do see VR being adopted more by women. I do think you'll see more women using it and they're not averse to adopting technology.

**DAVID WHELAN,
CEO, ENGAGE**

The largest gaming market in the world is powered by women as they play mobile games like Candy Crush and other puzzles. People don't realise that women make up the majority of the gaming market and feel that gaming is all about shooters like Fortnite. It's not. The majority of revenue is made from games like Candy Crush and Puzzle & Dragons.

In relation to privacy, we should consider the data that can be recorded in VR. So, by the time you take a 5-minute walk down a virtual city road, we're going to know, what your sexual preference is, what your favourite colour is, what brands you associate yourself with and this is without you even saying a word by utilising eye tracking and biometric data. This is some of the type of data that's emerging from immersive technologies, which I know is a scary concept and is something that's going to need to be regulated. The real issue is regulation is always 10 years behind the tech.

In 1969, when Neil Armstrong took that first step, everybody was running to the TV to watch the event and then TV adoption really blew up with many households getting a TV set for the first time. So, let's say in five years when we have somebody walk on Mars, one of the ways this major event is going to be broadcast is through virtual reality 360 cameras placed on the surface of Mars. And when that first person takes that first step, it's going to be broadcast in VR. So your choice is going to be, am I going to watch this event on the telly or am I going to put on a headset and stand next to the person as they take that historic step? And I think a lot of people will actually take the leap and say I'm going to get a headset and get that experience first-hand. I also predict that the first person to walk on Mars is going to be a woman.

SO, BY THE TIME YOU TAKE A 5 MINUTE WALK DOWN A VIRTUAL CITY ROAD, WE'RE GOING TO KNOW, WHAT YOUR SEXUAL PREFERENCE IS, WHAT YOUR FAVOURITE COLOUR IS, WHAT BRANDS YOU ASSOCIATE YOURSELF WITH AND THIS IS WITHOUT YOU EVEN SAYING A WORD BY UTILISING EYE TRACKING AND BIOMETRIC DATA. THIS IS SOME OF THE TYPE OF DATA THAT'S EMERGING FROM IMMERSIVE TECHNOLOGIES, WHICH I KNOW IS A SCARY CONCEPT AND IS SOMETHING THAT'S GOING TO NEED TO BE REGULATED. THE REAL ISSUE IS REGULATION IS ALWAYS 10 YEARS BEHIND THE TECH.

SYNTHETIC DATA AND STANDARDISING ZERO, ZERO, ZERO IN IMMERSIVE EXPERIENCE

NICK FACEY,

AUTOMOTIVE, TRANSPORTATION & MANUFACTURING LEAD, GLOBAL SOLUTIONS, UNITY

There are three challenges: problem statements, data volume and standardisation but the game changer is the use of synthetic data.

The first challenge is problem definition, the first thing I do and it's every time, regardless of whether I am speaking to an executive or engineer or student, I get rid of all the buzzwords, I throw them away. Problem definition is possible when I ask what are you trying to do? Digital Twin has been the buzzword for three years. Everyone's building a digital twin. No one's really sure what that means until you try and say, what do you want to do with it? So, do you want a digital representation or a geometrically accurate representation of your factory that is fed from real time sensors? And is this a one-way relationship or is it two? When someone tells you what they want it to do, they're also telling you what their problem or opportunity is.

WE FOUND THAT A MILLION SYNTHETIC IMAGES, EVEN WHEN YOU ADD IN THE PROCESSING TIME, ARE WAY BETTER THAN A THOUSAND REAL WORLD IMAGES TO HELP A CAMERA LEARN TO RECOGNISE A MODEL.

The second challenge is the data volume that arises when we want to move without cords. Movement without a whole aspect download results in several types of data problems in that moment. For example, in VR the hardest thing in my experience is how light travels and bounces on different surfaces. You can't carry that much surface data around. You end up baking textures and different objects in. Textures on surfaces however don't know how to react to different types and volumes of light or refractions of light yet that's what the human eye picks up. Water is a really bad one and trees are impossible. Somehow your eye, even in the shadow knows a tree is green and concludes that the tree is green, whereas on the screen it stays black because it's got a shadow and there's no light in there.

The third challenge is the standardisation of data on the front end to make pipelines handle all sorts of data regardless of the device. Whether it's a representation of a hydro dam, an automotive plant or my home construction, we need standardisation of how the data was created – what layers are in it and what materials it's in, what measurements it's in, how hard, how deep it is, meters or feet or inches or something else? We need to standardise on the engineering side some non-defined measurements. We need one measurement within the experience, where 'zero, zero, zero' is.
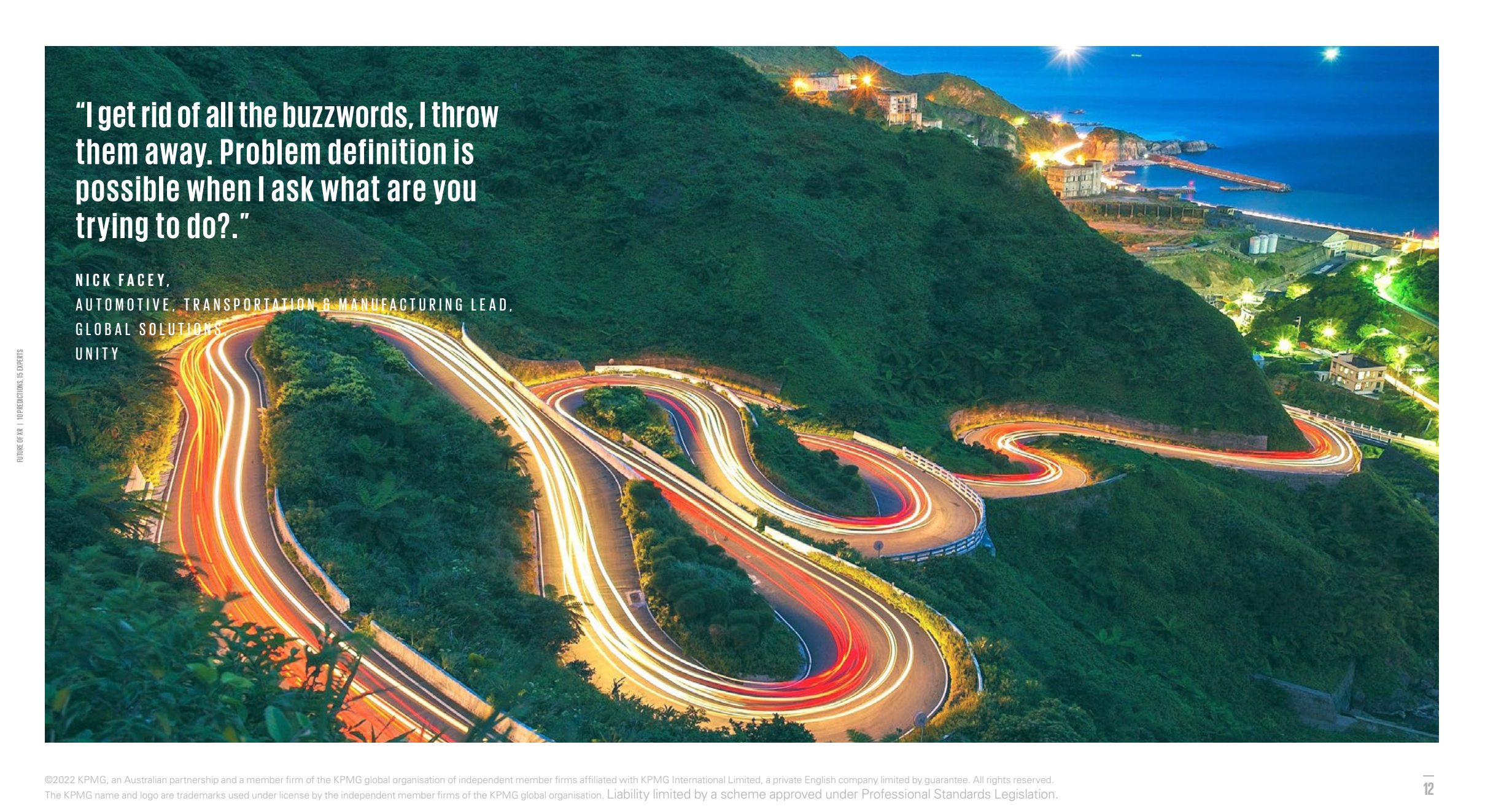
Standardisation for security will also be an important requirement for wearables. With glasses there'll be a camera facing into your eye that constantly verifies that you're still you. A camera that verifies that someone else doesn't take your glasses and now has access to your bank account.

MEETINGS WILL CHANGE, THIS IDEA OF EVERY BOARDROOM NEEDING A BIG SCREEN THAT WE CAN ALL SEE WILL CHANGE. ANYTIME YOU WANT TO SEE A GRAPH, YOU CAN JUST PULL IT UP AND PUT ON GLASSES AND YOU KNOW THAT EVERYONE ELSE IN THE ROOM WEARING GLASSES CAN SEE THE SAME GRAPH. THAT'S A PRETTY SEISMIC SHIFT IN OUR LIFE.

Another standardisation challenge is how to anchor a model when a person walks around it. For example, how does a camera recognise somewhere within an aeroplane? While you can give a camera the geometry model straight from the manufacturer, there are many variables – paint, light, reflection. It gets even more complicated when Apple and Android give you different camera feeds. So, you run into all these different technical problems to solve the same opportunity. To get data quality up, synthetic data can solve many of the XR experience problems. We found that a million synthetic images, even when you add in the processing time, are way better than a thousand real world images to help a camera see where it is.

Synthetic data and simulations are going to be big tools to make AR and VR experiences more real and more impactful to the non-technical. This is especially relevant for robotics where I see a lot happening right now. I love the physics combined with the technical problems. Right now we're working with Boston Dynamics on the Spot robot. Spot navigates by constantly creating its own mesh network of where it is and it knows how to get home. Right now you have to walk it everywhere it goes. So you can't pre-plan its mission. It must be walked once and then it can repeat it. I think that's this world where synthetic data, robots and spatial planning all come together. You trick the robot to make it think it's already been there with synthetic data, and now it can go on and walk it. And then the next time around, you get it to start problem solving via the synthetic data for how it's going to walk around.

In the corporate sphere business meetings will change. This idea of every boardroom needing a big screen that we can all see will change. Anytime you want to see a graph, you can just pull it up and put on glasses and you know that everyone else in the room wearing glasses can see the same graph. That's a pretty seismic shift in our life.

"I get rid of all the buzzwords, I throw them away. Problem definition is possible when I ask what are you trying to do?."

NICK FACEY,
AUTOMOTIVE, TRANSPORTATION & MANUFACTURING LEAD,
GLOBAL SOLUTIONS,
UNITY

MAKING A LIVING IN THE AR CLOUD, THE NFT CLUB AND THE DIFFICULT CONVERSATION ABOUT USER DATA

During the past six months the rise of NFTs has been a really interesting driver for people to start using virtual environments.

On the consumer side, attention is shifting toward blockchain and cryptographic based asset technologies. In the future, blockchain technology will be the mechanism to verify trust, identity and authenticity of assets in the physical and virtual environments – those worlds have collided.

People are engaging with NFTs like digital basketball cards as a digital collectible. NFTs enable internet users to collect and own inventory, and that's the shift, having an inventory of online assets.

Brands are also going to be leading and following organic communities. Companies will need to make sense of this NFT space and gain a robust strategy around community building because that's really what NFTs are, a mechanism for aggregating a community. It's inventory, but it's really a community management tool.

Imagine online spaces that you can only access because you have an NFT. An NFT becomes like an admission ticket. With NFTs you're part of a club and with that comes membership and access to real world events. There are some particularly interesting and rare cases where each person that owns an NFT also owns the copyright. So we're going to see entire brands around art series like Bored Ape Yacht Club, you'll see bars, nightclubs and lifestyle brands built around specific NFTs. But if you're a company trying to get in this space, it's important to understand how communities are forming as a result of these NFTs.

**AARON FRANK,
FACULTY, SINGULARITY UNIVERSITY**

"There will be new jobs that are created where individuals spend the majority, if not all of their time inside of a virtual environment."

"Your behaviours inside of a virtual environment, should perhaps not qualify or be classified as traditional user data. Instead, it might better be considered biometric, behavioural health data, which is regulated in completely different ways than to regular user data. That's a question that regulators need to take a look at."

Platforms like Decentraland, The SandBox, Cryptovoxels and Somnium space are also driving NFT adoption for virtual environments. These are NFT-native platforms because the platforms themselves are built on the Ethereum blockchain.

A play-to-earn NFT game like Axie Infinity is a self-contained, standalone virtual world and because it's now backed by NFT technology, it's become a robust, transaction-based economy. Axie Infinity is doing over a billion dollars in volume a month, only one example of a virtual economy taking shape today. One of the co-founders of Coinbase describes NFTs as internet native property rights. NFTs are technological infrastructure to support digital-first economies online.

THE AR CLOUD WILL BECOME THE TECHNOLOGICAL SCAFFOLDING TO ALLOW CONTENT CREATORS TO CREATE VERY MEANINGFUL, SEMANTIC BASED AUGMENTED REALITY EXPERIENCES.

There will be new types of income earning opportunities that are created where individuals spend the majority, if not all of their time inside of a virtual environment. This also makes me very nervous because if a virtual economy is purely built on user growth and when user growth runs out, how do you keep the value of the in-game assets?

I've also been really fascinated with the development of VR fashion. There's a VR fashion brand RTFKT (pronounced artifact and acquired by Nike in 2021) and they create a gaming-centric based fashion brand. They're trying to become the Louis Vuitton of the metaverse. They release products that are native to virtual environments for people who want to have high end fashion for their avatars. These kinds of concepts are very new and emerging.

Niantic acquired a company 6D.ai, a tool for robust 3D scanning of the entire planet. They are really focused on this concept of the AR cloud. In similar terms, Facebook acquired a UK company called Scape Technologies. Pretty soon we'll have robust digital twins of the entire planet. The AR cloud will become the technology scaffolding to allow content creators to create very meaningful, semantic based augmented reality experiences.

User privacy will be a concern because anything you do inside of a virtual environment is inherently trackable. What you look at and how long you're looking at it. Your behaviours inside of a virtual environment, should perhaps not qualify or be classified as traditional user data. Instead it might better be considered biometric, behavioural health data, which is regulated in completely different ways than to regular user data. That's a question that regulators need to take a look at.

One of the biggest trends at the moment is the growth and rise of Web XR, just like an internet browser native experience. Today standalone application-based products and services that require you to step outside your normal web browsing experience is a big barrier. When we look back in 10 years on the software side we'll see that web driven experiences will really win out in this landscape.

"Companies will need to make sense of this NFT space and gain a robust strategy around community building because that's really what NFTs are, a mechanism for aggregating a community. It's inventory, but it's really a community management tool."

AARON FRANK,
FACULTY, SINGULARITY UNIVERSITY

THE GAP BETWEEN LEARNING AND DOING, AMBIENT COMPUTING EXPERIENCES AND TOTAL FRICTION OF OWNERSHIP

RYAN NADEL,
FOUNDER AND DIRECTOR BIBA VENTURES,
PRESIDENT 8 LEAF DIGITAL PRODUCTIONS,
CO-CHAIR ACADEMY OF INTERNATIONAL EXTENDED
REALITY STEERING BOARD, DIRECTOR GREAT
NORTHERN WAY CAMPUS, CENTRE FOR DIGITAL MEDIA,
PRINCIPAL PRODUCT MANAGER MICROSOFT.

This article represents Ryan's personal opinions and not those of Microsoft.

I'm a Principal Program Manager at Microsoft and worked in the HoloLens business applications program from zero to commercialisation and launch. Now I own the intelligence portfolio for Teams which includes any feature that utilises machine learning AI in the core collaboration platform.

Outside of Microsoft, I'm on various boards and am the founder of a start-up called Biba Ventures, which launched in 2010 to explore how we can use AR to inspire real world physical play focused on kids in playgrounds. It now has about 5,000 playgrounds deployed around the world and was selected as one of TIME Magazine's 100 Inventions of the Year in 2019.

Communication is a continuum because you're going to use the different tools depending on the context and needs of that scenario. The scenarios that I think will start to demand more immersive experiences are the ones that are extremely complex or deeply social.

IF YOU'RE BUILDING AN ENGINE, YOU NEED COLLABORATION SIMULATION EXPERIENCES, TO BRING TOGETHER ENGINEERING AND PRODUCT DESIGN. YOU WANT TO BE ABLE TO LOOK AT HIGH FIDELITY 3D RENDERINGS OF THE COMPLICATED PARTS, A GREAT SCENARIO TO JUMP INTO A 3D IMMERSIVE ENVIRONMENT AND LOOK AT THAT TOGETHER.

The other use case is something experiential, like Burning Man in a VR immersive experience, to foster and create a very specific type of a feeling, more on the creative social side of things.

I think the most exciting part is when there's a true problem-solution fit between the technology and the user need. In the HoloLens program we explored the training and work instructions context. We sat with aeroplane mechanics on night shifts and talked through the challenges of how you learn to fix an aeroplane and visited truck assembly plants to learn about how hard it was for a new employee to get up to speed. What we saw and observed was a lot of hands-on work scenarios. There's a ton of complexity in mapping current work instructions and current training materials to a physical space and hands on work.

There's a weak correlation between sitting in a classroom, trying to learn how to fix an aeroplane and then going into the hangar to fix that aeroplane. XR tools, mixed reality or HoloLens type experiences are really well-suited to bridging the learning and the doing gap because now we can bring information into context spatially, annotated where you need it, when you're doing your work.

A major friction point is content creation. Creating content for 3D immersive environments is technically hard, and it requires a certain skill set. For the application I worked on, Guides, one of our goals was to enable anyone who's currently creating work instructions, training materials, and going with PowerPoint level skills to be able to create mixed reality content that utilises the full capabilities of 3D. We put a lot of effort into ensuring that the authoring of the content could be done by anyone without any specialised immersive skills. If you want the usage to grow, it's got to be easy for everyone to both create and consume content.

XR TOOLS, MIXED REALITY OR HOLOLENS TYPE EXPERIENCES ARE REALLY WELL-SUITED TO BRIDGING THE LEARNING AND THE DOING GAP BECAUSE NOW WE CAN BRING INFORMATION INTO CONTEXT SPATIALLY, ANNOTATED WHERE YOU NEED IT, WHEN YOU'RE DOING YOUR WORK.

Then on the flip side of it, if there's 3D content that exists within the enterprise. In the industrial engineering setting, you have 3D CAD content but it's not designed for real time rendering environments.

There is a huge challenge in converting and optimising existing 3D content that companies do have within their IP portfolio so it is suitable to use in an immersive environment in a real time rendering context. There are companies that are trying to solve that problem, but it's not a simple problem to solve at all. So that's where we would see a lot of friction points emerge from the content side of things.

Technology will become more invisible with ambient kinds of computing experiences. Alexa as an example, it's just always on and always there.

I predict more immersive experiences will be honed to specific use cases and scenarios by 2030. As we put on a VR headset for a monthly all-hands meeting, underlying all of it will be an intelligence layer that will be personalising, pre-empting and removing a ton of the clicking around that we do to find what we need for a given context.

That could be a semantic understanding of what are we talking about and to surface contextual information, whether that's in a text chat or in an immersive environment.

The first wave of the IT boom was all about total cost of ownership. It was about making sure that that the tools we were delivering were versatile enough and robust enough that the total cost of ownership made sense. Both from a deployment perspective and from a usability perspective, we're in a similar situation with XR, but it's more like total friction of ownership. How much friction is someone willing to put up with to use immersive technology? For XR to really take hold it needs to live up to that Swiss Army knife promise where it's not just a single purpose tool because there's way too much friction to put something on your face for it to be just for a single use otherwise XR will remain a specialised and niche solution set.
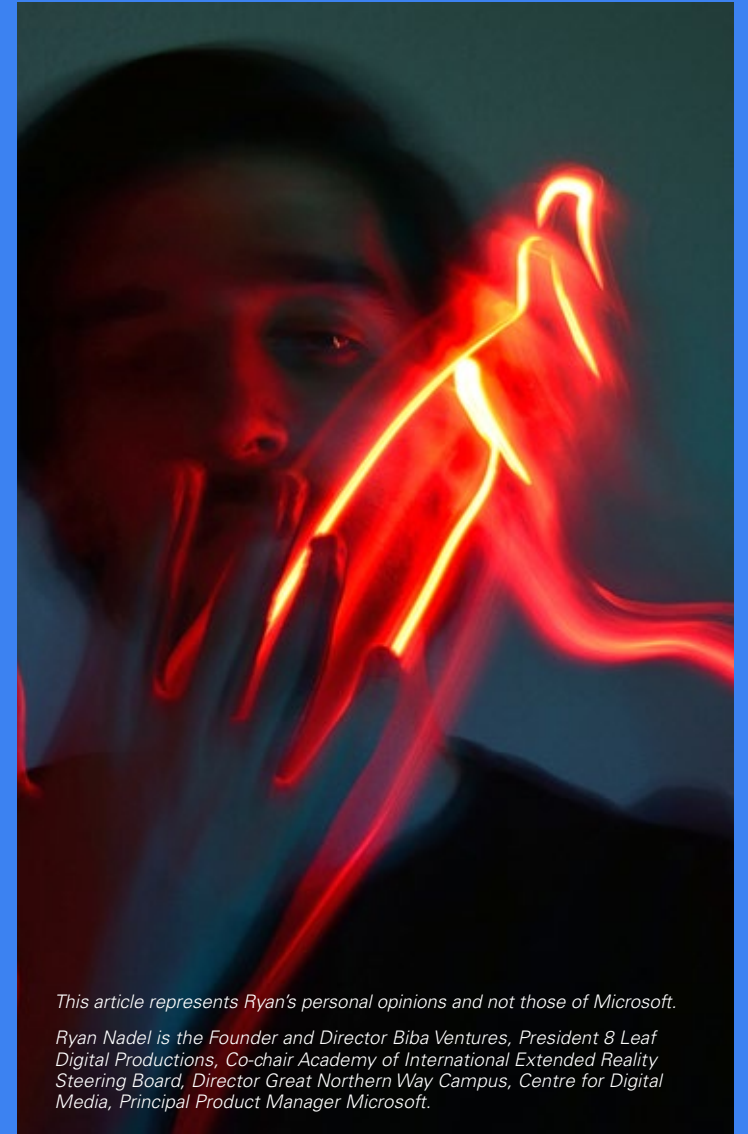
This article represents Ryan's personal opinions and not those of Microsoft.

Ryan Nadel is the Founder and Director Biba Ventures, President 8 Leaf Digital Productions, Co-chair Academy of International Extended Reality Steering Board, Director Great Northern Way Campus, Centre for Digital Media, Principal Product Manager Microsoft.

BREAKING THE LAWS OF PHYSICS THROUGH DIGITAL ART AND AVATARS FOR FREEDOM OF EXPRESSION

**ALEXANDRA NEVILLE,
ARTIST AND RESEARCHER AT UTS**

I'm a 3D artist & researcher focused on creating immersive and interactive experiences.

My background is in Visual Effects (VFX) for film and gaming. I used to work for a blockchain company that are big into NFTs and generating games that can be on the blockchain. I started developing an interest in XR, which led me to pursue a masters degree at UTS, researching the merging of VFX tools and processes with XR works. This involves developing automated systems to generate computer graphics procedurally within XR platforms. The results of this research are then used as a creative medium to produce installations and experiences.

The major challenge in this study area involves the technical incompatibilities between VFX programs and XR engines. I'm still trying to find an efficient combination of programs to build the experiences I want to create. Currently, this involves assorted loopholes, which can be frustrating to navigate; however, I'm sure the industry will address these issues in the coming years.

There's a wealth of career opportunities for creatives who are willing to learn XR as a medium as it has a lot of commercial relevance. My recent projects range from building an interactive AR installation for children to working with data visualisations. People seem to engage more with the interactivity of these 3D works rather than scrolling or clicking through 2D images. The novelty of 3D can enhance things like data visualisation as it invites people to become more immersed in the work.

I think accessibility is a significant theme regarding the future of the XR industry. More people will be able to create their work without the need for specialised skills, widening the commercial scale of the XR landscape. We're going to be seeing XR become a popular creative medium, being used more commonly in museums, installations and festivals.

> **AVATARS WILL ALLOW PEOPLE TO REPRESENT THEMSELVES BEYOND THE LIMITATIONS OF STATUS. THERE'S THE OPPORTUNITY TO ALLEVIATE PEOPLE'S IDENTITY BEYOND THEIR WARDROBE OR HOW MUCH MONEY THEY HAVE IN THEIR BANK ACCOUNT. THERE'S MORE FREEDOM TO EXPRESS THEMSELVES BEYOND GENDER, REPRESENTATION AND SOCIAL CONVENTIONS.**

Currently, I am working with traditional artists like Alex Seton, a Sydney based marble sculptor who also produces various digital works. Seton loves working with AR to create sculptures as it allows him to produce work that would have never been physically possible to create. One of the works involves a series of animated marble NFT's, where the medium can contort and move, granting the artist to engage with his medium beyond the laws of physics.

I THINK ACCESSIBILITY IS A SIGNIFICANT THEME REGARDING THE FUTURE OF THE XR INDUSTRY. MORE PEOPLE WILL BE ABLE TO CREATE THEIR WORK WITHOUT THE NEED FOR SPECIALISED SKILLS, WIDENING THE COMMERCIAL SCALE OF THE XR LANDSCAPE.

THE REAL APPEAL OF THIS IMMERSIVE TECH AS A MEDIUM IS THIS ABILITY TO CREATE BEYOND THE CONSTRAINTS OF REALITY, ENABLING PEOPLE TO CONVEY STORIES LIKE NEVER BEFORE. THIS TYPE OF WORK ALSO ALLOWS THE ARTIST TO BE VIEWED IN A WIDER MARKET, BYPASSING MORE TRADITIONAL CONTEXTS IN WHICH ART IS TYPICALLY VIEWED, INVITING A MORE DIVERSE AUDIENCE AND A BROADER DISCUSSION AROUND THE WORK.

The lack of representation of women in this space isn't just an XR problem but a broader issue in tech. Around twenty-five percent of people in the tech industry are women, and they're twice as likely to leave the industry. Without more women in tech, people can't be what they can't see. Yet there are many women trailblazers in the XR space; artists like Tamiko Thiel and Heather Dunaway Smith have created bodies of work that have innovated XR as a creative medium.

Avatars will allow people to represent themselves beyond the limitations of status. There's the opportunity to alleviate people's identity beyond their wardrobe or how much money they have in their bank account. There's more freedom to express themselves beyond gender, representation and social conventions.

"The lack of representation of women in this space isn't just an XR problem but a broader issue in tech... Without more women in tech, people can't be what they can't see."

ALEXANDRA NEVILLE,
ARTIST AND RESEARCHER AT UTS

FACING FORWARD IN THE METAVERSE AS THE FRONTIER TECHNOLOGIES CONNECT HORIZONTALLY

We're at the precipice of a technological revolution. We're seeing it play out right in front of us. VR, AR, the metaverse, NFT's, Web3. This is all going to drive the future of communication, connection and how we interact in general.

We can look at it with a dystopian lens, but I feel that VR and AR will only connect us in a deeper way than we ever have before. It's the next level of the internet, but eventually it will be bigger than the internet.

In explaining the metaverse to executives or companies or governments, they've got to look at it as this next iteration of the internet. So Web3 is all going to tie into what the metaverse looks like. This is a new world that they can essentially build a completely new business.

I helped build and grow Vancouver's VR/AR ecosystem to be the second largest in the world for VR and AR, with over three hundred and fifty companies in the metaverse space. And a lot of the ecosystem has been developed because we have a strong visual effects animation and games industry that have been here for over 40 years, and a lot of that talent has spilled into the VR industry and are building a wide gamut of solutions such as surgical training, therapeutic use cases, virtual events and virtual humans.

I'm a co-founder of Shape Immersive and we build VR and 3D experiences for the world's top brands. We're having some fun in the NFT space. I look at the whole metaverse through a Web3 lens because I don't just see it as a VR thing. All these frontier technologies are going to connect to each other. It's a horizontal technology, so you can't have a blockchain NFT world without virtual reality and augmented reality at some point. So, it's all going to intersect. We're seeing our community just expand drastically in new realms that we've never seen before.

It's also incredibly important to get different perspectives into the industry, we need to encourage more women and BIPOC representation to get inspired with this technology and that's from the high school level up. Some of the most dynamic companies in the world are created by female led founders and some of our best founders in VR and AR and the metaverse will come from females. So, it's about really inspiring them to want to participate and building programs to empowering a diverse future of builders who want to get in the game.

IT'S NOT GOING TO BE ANY ONE INDUSTRY AS WE'VE SEEN IN THE PAST VERTICALLY. IT'S GOING TO BE HORIZONTAL. BLOCKCHAIN IS GOING TO EMPOWER VR, AND AR IS GOING TO BE POWERED BY AI TECHNOLOGIES IN THE FUTURE.

I spoke at Web Summit this year with 42,000 people and there is a change in the tide. There were 57 percent female attendees at that event and it's conferences and events that need to get more females represented. If we can do a metaverse conference and really focus on the female demographic, that'll change everything. I'm seeing a lot of female artists come into the NFT space and you're seeing a lot of these really cool NFT or Web3 technology companies being founded by women. But it's still too Bro-Ey. Balance is everything, whether its gender or race, we become better, more vibrant and more innovative. Let's elevate a diverse new frontier!

**DAN BURGAR,
CO-FOUNDER AT SHAPE, CO-FOUNDER AND
CEO AT FRONTIER COLLECTIVE, FOUNDER AND
PRESIDENT AT VANCOUVER VR/AR ASSOCIATION**

If you have a board, team or are putting on a panel, always look at it with this lens!

I'm seeing a lot of investments going into training and education within VR and tools created within VR and AR. We've seen huge investments into digital economies and virtual worlds. Niantic are now valued at over seven billion. There's a lot of investments going into surgical training, 3D commerce, metaverse land development, digital fashion, virtual avatars and gaming.

By 2030, we'll have glasses that look like Rayban wayfarers and we'll be able to communicate with the world around us. It'll be mainstream and most people will have some sort of interaction with these devices. A lot of people are scared within the whole metaverse conversation that people will only want to live in the metaverse or only want to live in these virtual worlds but I look at it from the lens of connecting us in a deeper way both in our physical world but also in our metaverse lives, being able to sit on my couch and be able to connect with any one of my friends around that world and then hop into the metaverse and explore these worlds will be profound.

We've always looked down at our phones, not facing forward, but with glasses, you're able to just enhance the world around you and that's the kind of physical interaction that I'm really excited about.

By 2030 most people will be using VR and AR at some point and be able to toggle VR and AR together. AI is going to really feed into VR. That's why I'm really bullish on frontier tech as a whole because it's not going to be any one industry as we've seen in the past vertically. It's going to be horizontal. Blockchain is going to empower VR, and AR is going to be powered by AI technologies in the future.

I think 2030 is really that right time where all of this is going to be part of our everyday lives.

WE'VE ALWAYS LOOKED DOWN AT OUR PHONES, NOT FACING FORWARD, BUT WITH AR GLASSES, YOU'RE ABLE TO JUST ENHANCE THE WORLD AROUND YOU AND THAT'S THE KIND OF PHYSICAL INTERACTION THAT I'M REALLY EXCITED ABOUT.

JAVIER BELLO RUIZ,
CEO & CO-FOUNDER AT IMVERSE

# REAL-TIME HOLOPORTATION IN THE ENTERPRISE METAVERSE AND THE CREATIVE ECONOMY

VR has overpromised and underdelivered for the better part of a decade. For the metaverse to truly come to life, we need Hardware, Software and Content to come together and the underlying Infrastructure and Architecture to support it, each of which has accelerated significantly over the last few years. We also need real-time authentic (self-)representation in addition to animated characters and photorealistic avatars which is where Imverse comes in.

We are seeing a significant ramp-up in the interest for our real-time volumetric solutions which I attribute both to improvements in the underlying technology, functionalities, interoperability and the bigger Enterprise Metaverse and Creative Economy wave.

The metaverse is already enabling collaboration between different companies that was largely missing during the early VR years. Microsoft, Meta, Apple, Epic are all betting on seamless 3D multi-sensory experiences and building underlying architectures for the metaverse. At Imverse, we aim to power its real-time incarnations with our holograms and provide live visual effects tools for Creators to augment and differentiate their content. There are thousands of companies across the Blockchain and NFT space that are adding their bricks to the structure. So, the pieces are coming together, helping us build new applications, vastly differentiated content and meaningful experiences together, collaboratively.

The Creator Economy will play a very important role and there will be a need to adapt these new trends and technologies coming from Entertainment and Gaming to Business.

Different companies will power the big wave and I am sure Microsoft Mesh will be one of the main engines. It will enable access to virtual experiences from any device – laptop, smartphone, tablet, from VR and AR headsets. We consume 3D content every day on our 2D displays including our phones yet Mesh will make 3D content more broadly accessible and more meaningful for companies and individuals.
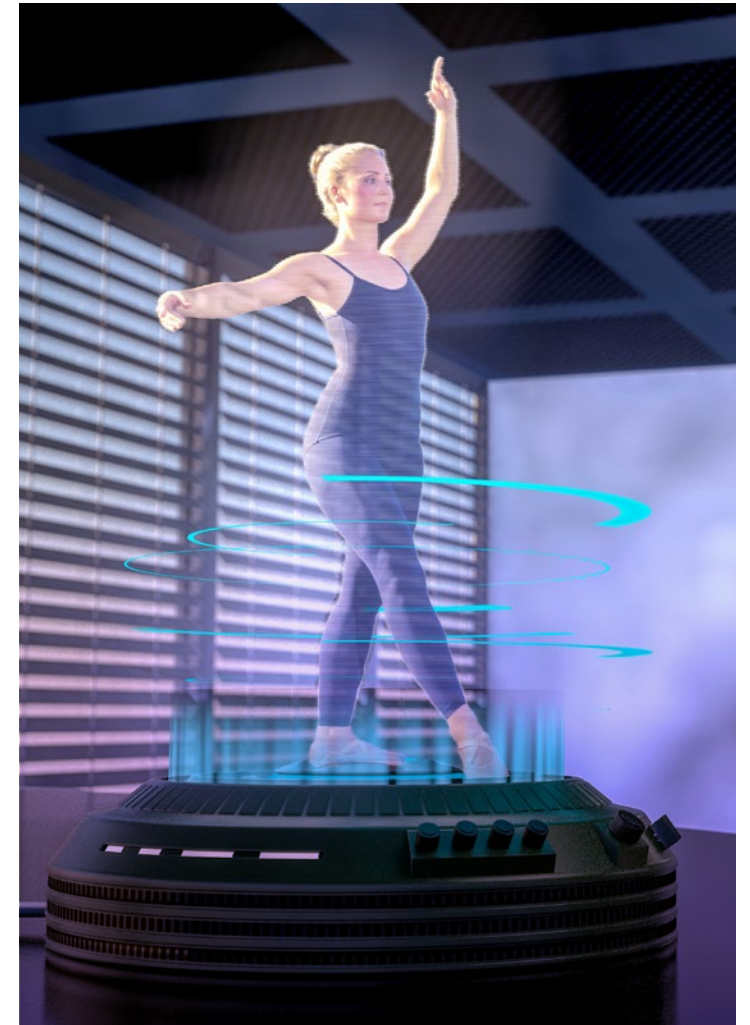
> " CORPORATES AND INVESTORS ARE FINDING IT'S NOT A MATTER OF WORKING WITH OR INVESTING IN A SINGLE COMPANY THAT WILL CREATE AND BUILD THE 3D MULTI-VERSE. YOU MAY ACTUALLY NEED TO WORK WITH FIVE DIFFERENT COMPANIES AND COLLABORATE ACROSS TO BUILD DIFFERENT USE CASES. META, MICROSOFT, UNITY, NO ONE FOR THAT MATTER, COULD DO THIS ALONE. MICROSOFT SEEMS TO UNDERSTAND THIS. THE FACT THAT WE ARE COLLABORATING TO BRING REAL-TIME HOLOPORTATION SOLUTIONS IS AN EXAMPLE. "

Mesh will be a new 3D environment, an operating system and a gateway to the metaverse for enterprise, consumer and gaming. I believe it will become Microsoft's biggest product within a few years.

In the Creative Economy, Gamers and Streamers will be the early adopters (since they have experience with 3D worlds and already own some of the necessary hardware) showcasing to the rest of us the power and benefits of volumetric video. In business, this is going to be especially relevant for remote work and collaboration, training, live events and broadcasting.

In training, for instance, you can 'holoport' an instructor, replicate his or her movements accompanied by real-time guidance and instructions, helping task and skill learning happen at a much faster pace. We've talked to educators about inserting them into contextualised 3D worlds further amplifying the experiences by adding virtual environments, 3D objects, and white boards.

Businesses and companies will be hiring creators to develop and enhance these applications for business. You cannot simply be a computer scientist. You cannot simply be an engineer. You have to be creative. You have to be able to understand what people and organisations will need, benefit from and enjoy and solve for that.

At home, these technologies will enhance how we live. Instead of the living room furniture pointing to the TV, you will have a freer space to use as a working room, engage with your family, colleagues and friends or hold a virtual gathering because you will have them in front of you. Home spaces will serve multiple purposes and also becoming socialisation and collaboration hubs.

Despite globalisation, a large part of the worlds's population still doesn't have the opportunity or means to travel, access proper education or healthcare. With our technology virtual applications and experiences, if deployed properly in underdeveloped countries and areas, will serve to level the playing field and give people more opportunities. Imagine this – if you have access to the internet and knowledge resources, you can attend an interview from an underdeveloped area wearing a virtual suit instead of

the real fancy one you can't afford, work and collaborate with peers that won't necessarily need to know where you come from or where you live. What will matter is what you know and how much you contribute.

We are at an inflection point in this. Corporates and investors are finding it's not a matter of working with or investing in a single company that will create and build the 3D multiverse. You may actually need to work with five different companies and collaborate across to build different use cases. Meta, Microsoft, Unity, no one for that matter, could do this alone. Microsoft seems to understand this. The fact that we are collaborating to bring real-time holoportation solutions is an example. The future of the spatial web will be very collaborative. It will be open. The alternative of many self-contained 3D worlds and applications which don't really connect, doesn't live up to the vision and paradigm shift that the Metaverse promises.

MESH WILL BE A NEW 3D ENVIRONMENT, AN OPERATING SYSTEM AND A GATEWAY TO THE METAVERSE FOR ENTERPRISE, CONSUMER AND GAMING. I BELIEVE IT WILL BECOME MICROSOFT'S BIGGEST PRODUCT WITHIN A FEW YEARS.

From this point on, I believe that the adoption of AR and VR will happen much faster than the adoption of smartphones. Within the next four years, most people will own some sort of AR or VR device.

In 10 years' time I don't think many people will buy mobile phones and 2D screens will disappear.

You'll be able to manipulate 3D objects in the virtual space that you see through these glasses or displays or lenses. XR will offer a multi-sensory experience that is going to change how we perceive and do things.

INSTITUTIONS WILL FINALLY REALISE THEY ARE NO LONGER "BUMS-ON-SEATS" BUSINESSES

Hybrid and work from home is clearly not going away. We see head mounted displays as part of a standard toolkit for a connected workforce. You'll be able to jump into a virtual environment, to dial up your virtual meetings, go and visit your factory in Brazil. In the future there'll be careers in virtual architectural design and virtual training to cater to demand.

User interaction in virtual environments and translating learning methodologies into immersive environments is a whole art-science that's yet to be fully explored.

We are yet to get answers to questions such as:

- Do you use voice controls?
- Do you use eye tracking to track gaze?
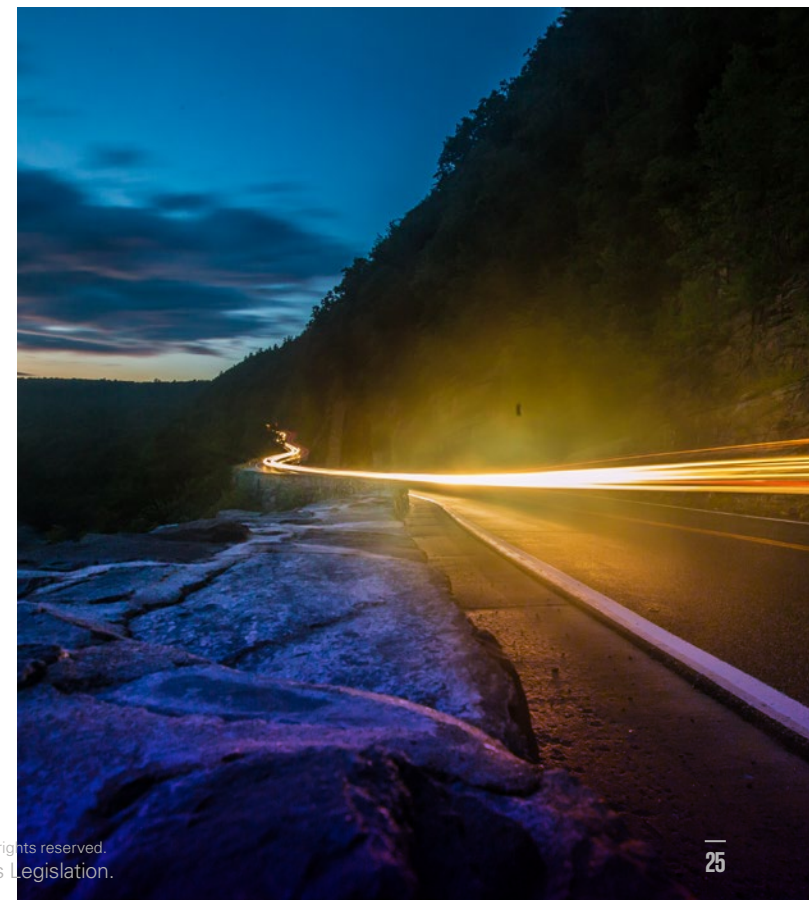- Do you use haptic feedback?
- Do you use controllers?
- Do you use hand tracking?
- Do you create environments which are dynamic and open or linear?

MURRAY JAMES SNOBAL,
CO-FOUNDER / CEO OF SNOBAL

"There's an opportunity here to really challenge the way they are currently doing things."

The big area for disruption will be in universities. We are seeing a huge shift in where and how people work and study and the adoption of digital technologies such as VR. And some of the more innovative universities are looking at organisational wide transformation of how they deliver content and classes leveraging VR/AR. They know there's an opportunity to hugely extend their student numbers across geographical boundaries. We're already seeing many university courses being channelled to online but there's a realisation students will demand more. They will choose providers that offer richer and more engaging learning experiences.

Using Snobal's enterprise VR/AR platform for example, universities can enable students to meet, discuss, collaborate and learn together in collaborative virtual spaces despite diverse physical locations. Imagine diving into molecules or exploring an exploded 3D model with fellow students living hundreds of kilometres away. Imagine tutors easily creating content, creating a course curriculum, and then inviting students into a virtual space to collaborate internationally. Experts then take you on a Jurassic Park-style tour or whatever it might be. And this use of VR isn't something that will happen in some distant future, it's happening now.

With VR you can sell the best seat in the house to everybody to live sporting and music events. You could have stereoscopic live streaming video and unlimited stadium sizes. This gets serious after you've got volumetric capture. You could create virtual environments and have people that are scanned in real time with high fidelity. 3D volumetric, real time streaming environments are going to be really exciting.

AT SNOBAL WE'RE ESPECIALLY EXCITED ABOUT HOW CLOUD VR/AR GETS VASTLY ACCELERATED WHEN YOU PAIR WITH DYNAMIC 5G NETWORKS THAT ARE STREAMING REAL TIME HIGH FIDELITY RENDERED CLOUD VR/AR EXPERIENCES. THE INNOVATION AND NEW BUSINESS MODELS THAT ARE GOING TO OCCUR AROUND RETAIL, THE WORKPLACE, ENTERTAINMENT AND EDUCATION IS GOING TO GET REALLY INTERESTING, VERY, VERY QUICKLY.

"We see head mounted displays as part of a standard toolkit for a connected workforce. You'll be able to jump into a virtual environment, to dial up your virtual meetings, go and visit your factory in Brazil."

**MURRAY JAMES SNOBAL,
CO-FOUNDER / CEO OF SNOBAL**

Friction still exists for the first-time user in current XR solutions around both hardware and software usability and this is a big barrier to entry. Oculus/Meta has done a good job making VR hardware/software accessible with the introduction of Quest 1 and 2 and mobile XR seems to be their focus with aspirations of developing consumer AR/XR devices soon. Their recent Ray-Ban | Meta sunglasses are an interesting step toward functional digital connectivity in a fashionable consumer product.

Of course, the long-awaited Apple XR product offering will likely disrupt all the current players due to Apple's very loyal global customer base. Microsoft have clearly gone after enterprise, industrial and defence sectors from the outset with HoloLens 1 and 2. Most user adoption in VR has been through games and entertainment with Valve and arguably Oculus/Meta leading the charge.

Headsets like HTC Vive, Oculus Rift-S, HP Reverb G2 and Valve's Index provide a good user experience at an affordable price given you have a gamer level PC to drive them. Content is increasingly sophisticated for the seasoned gamer to step into and enjoy. My experience with first-time users is to put them into what's called an onboarding experience of which Oculus does this well.

In there the first-time user learns how to use the controllers and play with the physics in various environments with objects to interact with. I have found that the elderly users often don't like being cut off from reality whereas younger people immediately can be delighted and wowed.

Following on from COVID, I think being immersed in a metaverse of sorts with your colleagues provides a much more engaged working session with less external distractions. The spatial audio experience is much more fluid without the stop/start nature of people waiting to talk or being interrupted with a question and not hearing it properly. In various XR collaboration software platforms like Rumii and Horizon Workrooms, the use of spatial audio provides a sense of your place in the room and people can talk over each other like in the real world, huddle in small groups, whisper in someone's ear so with all our human senses coming together we can make sense of it all. Even the fact that the avatars currently are mainly cartoon like or could represent any mythical creature, this somehow gives everyone the feeling of presence with body, hand movement and voice. It creates a feeling of connection. Connection is what people crave in these extended lockdowns which must be a factor to account for a rapid growth in the US of 150 million XR users over 3 years.

THE CONCEPT OF A DIGITAL TWIN AVATAR OF YOURSELF THAT IN XR TRIES ON CLOTHES TO MIX AND MATCH, SEE HOW YOU LOOK THEN PURCHASES ONLINE, IS QUICKLY BECOMING REAL.

RIC HOLLAND,
FOUNDER/MANAGING DIRECTOR,
EXTREME DIGITAL

XR FOR ART AND SCIENCE AND THE RISE OF THE AI DIGITAL TWIN

OUR PERSONAL AI DIGITAL TWINS WILL HAVE DEVELOPED TO BE REPRESENTING US IN THE METAVERSE, COMPLETING TASKS AUTONOMOUSLY OR CONTROLLED DIRECTLY AS A DIGITAL PROTHESIS SYSTEM TO OUR PHYSICAL REALITY.

In what's being called the 'Fourth Wave' of digital transformation I have embraced design tools like Tilt Brush, Quill, Medium, SculptrVR, Gravity Sketch, etc. The complexity of data is simplified and profoundly understood when presented as a 3D visualisation and particularly when it can be viewed and manipulated in XR. Mathematical concepts can be explained, hypothetical worlds and scenarios can be explored, the known universe can be travelled. Some of our greatest achievements in science have been imagined long before by artists. I'm sure Leonardo Da Vinci would have used XR to its greatest potential for both art and science as one in the same.

When you consider XR as a new standalone channel for sales of products, there has been massive growth for online fashion purchasing. With technology for body scanning to be almost as simple as pointing your iPhone camera around your body, the concept of a digital twin avatar of yourself that in XR tries on clothes to mix and match, see how you look then purchases online, is quickly becoming real.

In 2030 the world will constantly be digitally mapped by self-driving vehicles, personal sensors and drones, so the virtual digital twin of our world will be very rich. XR will be ubiquitous, and we'll have many interface options to interact, communicate and collaborate with. Our personal AI digital twins will have developed to be representing us in the metaverse, completing tasks autonomously or controlled directly as a digital prothesis system to our physical reality. Virtual travel and robotic interfaces to physical experiences such as space travel, undersea exploration and working in dangerous environments will be commonplace. Quantum computing and the advancements in science and technology will have been exponentially accelerated due to the interface barriers between humans and technology having practically vanished.
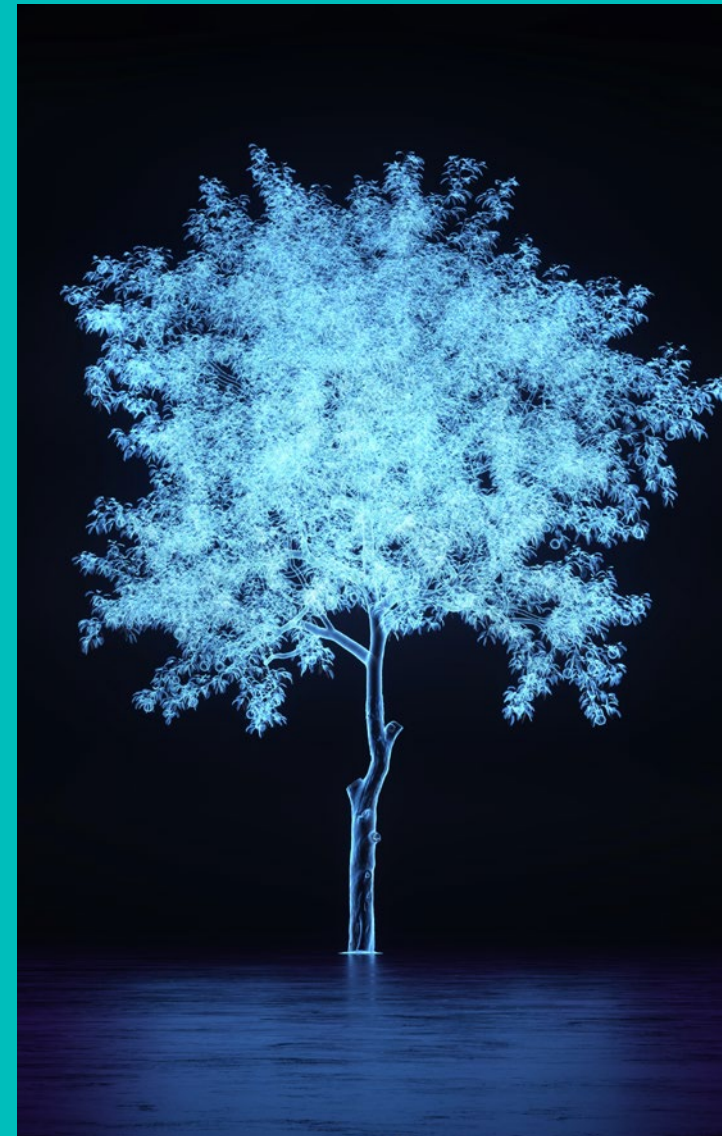
THE NEW CHIEF METAVERSE OFFICER MUST USE 3D TRUTH TO DELIVER TRUST, LOYALTY, PERSUASION AND BONDING

"The best way to describe the metaverse is a marriage of the world we know and a world where the laws of physics and space-time aren't a limitation."

SCOTT O'BRIEN,
COFOUNDER AND CEO AT HUMENSE

My focus is on volumetric video that is reality agnostic. The logical go-to-market application for us is with sport, a soft culture, low apprehension vertical with many adjacencies. Low apprehension in onboarding is essential for XR to cross the chasm in a more human relatable sense. Sport, like for many business use cases, is by definition a spatial activity and we lose a lot in translation transmitting a 2D abstract of it today whether on TV remotely or on the replay screen onsite.

AR agencies since 2010 have created AR face filters, then popularised at scale via Evan Spiegel at Snap and fast followed by Facebook (Meta). They developed the selfie camera to offer new ways to reinterpret our faces. This behaviour and profound commercial proof point is reinforcing the high value of the soft culture, low apprehension uses of AR and VR eyewear. In a way, five hundred million people a day have been having a mask party amplifying their own 'lead' character traits or escaping them.

Maturing from the mask parties, the inevitable next step is the authentic skin and bones 'meat suitcase' presentation. Now we have the bandwidth and the compression algorithms, it is possible to exhibit your true dynamic 3D self because when we're capturing a person with volumetric video, we're not putting an artificial rig and bones in the body.

Invariably, our brain needs to get to the 3D truth of things to elicit trust, loyalty, persuasion and bonding which makes the whole world go round, whether it's business, sport or whatever else.

To combat deepfakes in the future, there is a prime argument for coupling blockchain with volumetric video.

"INDUSTRY LEADERS WILL NEED TO NOW HAVE "REALITIES" PROFESSIONALS IN C-SUITE SENIOR POSITIONS. THE CHIEF METAVERSE OFFICER OR CHIEF REALITIES OFFICER WILL SET THE TONE FOR THE LANGUAGE THROUGHOUT THEIR WORKFORCE REDESIGNING, OPTIMISING AND MONETISATION CORE SKILLS BECAUSE EVERY INDUSTRY, EVERY LIFESTYLE WILL BE TRANSFORMED INCLUDING GEO-ECONOMIC CLUSTERS OF PREVIOUS INDUSTRIAL AGES.

A study in video conferencing found low-quality video and high-quality audio was perceived more professional than high-quality video and low-quality audio, as the brain performs better visual reconstruction than audio reconstruction. We widely know it is critical that visuals and audio match otherwise it is jarring. In the 3D AR VR world, it is also critical that audio, visual, human form and spatial positioning match otherwise you're getting a divorce in the brain. Clusters, context and congruence of data to the brain are critical for trust, loyalty, persuasion and bonding, as they are for AR VR adoption.

> "Corporate leaders need to understand a great reality architect needs to combine with a 'realities' strategist for a holistic understanding across operations, sales, marketing, legal, soft skills, hard skills."

SCOTT O'BRIEN,
COFOUNDER AND CEO AT HUMENSE

The best way to describe the metaverse is as a marriage of the world as we know it combined with a world where the laws of physics and space-time aren't a limitation. XR or 'the realities' needs to be approached in a time elastic way. Someone recently asked me how old I was, so I gave them three answers: 147, 47 and 7. I can be all those ages at once through the lens of realities. There will be use cases, times and places for the masked person, just as for anonymous Twitter handles, whilst the unmasked authentic persons will be more appropriate in many business circumstances.

For business, corporate leaders need to understand it's not just about having a great reality architect. It's with a realities strategist that has a holistic understanding across operations, sales, marketing, legal, soft skills, hard skills.

Industry leaders will need to now have professionals in C-suite senior positions, the Chief Metaverse Officer or Chief Realities Officer, set the tone for the language throughout their workforce to redesign how they monetise their core skills because every industry, every lifestyle will be transformed.

The realities reinvent cross border capabilities and challenge deeply entrenched geo-economic frameworks and above all else, distance bias. Influence dynamics are therefore set to change dramatically with spatial data more authentically presenting conduits for trust, loyalty, persuasion and bonding.

A holographic topological representation of business focus items between our faces will help risk mitigate and accelerate the best decisions, whether it be about property, surgery, or sports, preplanning or match review. Every industry, every workplace will be impacted by this.

I see massive opportunities for business and government for provisioning AR and VR eyewear to every household, just as phone books were provided once upon a time. The gains in GDP would be immediately in the double-digit percentages without question.

In a business context the big question is: how do we enable an empowered inclusive work environment to minimise social friction of commutes, physical wastage in commutes, and physical limitations to use "the realities" to come to the happy optimum instead of a happy medium.

UNLOCKING THE NEXT GENERATION OF LEARNING AND COGNITIVE CAPABILITY THROUGH VR

This decade will be remembered as the time when society truly started to transition from flat screens to spatial computing. Our mission at Axon Park is to provide people with access to high quality experiential learning throughout this shift, no matter their location in the physical world. We're currently integrating with university systems to utilise VR within their curriculum to empower students, and we believe that learners should be able to get their academic credentials whilst simultaneously working professionally to advance their careers. Alongside universities, we have been working with hospitals and health systems, and recently received approval to provide official AMA Category 1 continuing medical education credits to doctors, advanced nurses, and other medical professionals learning within the Axon Park VR campus. We believe that learning should be fun, engaging, effective and accessible from anywhere.

People in the US currently have more than 1.6 trillion dollars in student debt. Over the last 40 years, the inflation of college tuition has gone up by over 1,375 percent. This is 4x more than total market inflation, which has only gone up by 324 percent during the same time. Talk about a bubble. Research from Harvard suggests that more than 50 percent of U.S. based universities will be bankrupt in the next 10 years. The amount of physical infrastructure and operational cost to deliver traditional higher education is simply unsustainable. In 2030, I believe a large portion of students will be attending higher education through a VR campus empowered by AI tutors. There will also be a huge amount of productive work happening in virtual spaces and a variety of subcultures will likely start to emerge. We'll start to have new fields of social science born from the vast amounts of data being captured in virtual spaces. Psychohistory anyone?

Research published by Jama recently showed that institutions who are leveraging VR are saving 3,400 percent on the cost of surgical simulation[1]. Yale also showed that surgeons who train in VR make six times fewer errors[2]. There is an abundance of new research flooding the market which continues to substantiate similar claims. On top of this ROI driven research, there's a tremendous amount of opportunity to further explore how VR affects the brain. How can we unlock new levels of cognitive capability which has previously laid dormant due to our inability to access certain experiences? For example, being able to immerse ourselves inside a Tesseract, to experience a four-dimensional space, or at a quantum scale to observe a quark. One thing that has really stuck with me is the speed and frequency with which people are reaching an 'aha' moment while using VR.

**TAYLOR FREEMAN,
CEO AT AXON PARK**

1 https://www.precisionostech.com/jama-network-open-publishes-groundbreaking-vr-surgery-study/
2 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1422600/

We recently had a physician attending one of our courses in [BodyMap](#), the VR anatomy software, who just randomly yelled out, 'Yes! I finally understand how this bone connects! I've been trying to figure this out for years!"

WHEN YOU LOOK REALLY FAR INTO THE FUTURE, I BELIEVE WE'LL HAVE YOUNG KIDS WHO HAVE COGNITIVE CAPACITY ON PAR WITH EINSTEIN, DUE TO NEW AND ENHANCED HUMAN COMPUTER INTERFACES WHICH PROVIDE THE ABILITY TO IMMERSE MINDS WITH IDEAS AND EXPERIENCES THAT WOULD OTHERWISE HAVE BEEN IMPOSSIBLE. AFTER AN EXTENDED PERIOD OF BEING IMMERSED IN A SIMULATION DESIGNED TO TEACH THEORY OF RELATIVITY, THE STUDENT'S MIND MAY FUNDAMENTALLY SHIFT TO COMPREHEND THE VAST COMPLEXITY OF THE SUBJECT WITH EASE.

As we cultivate a deeper understanding of the brain and develop more advanced technology, we will likely also be able to directly translate our thoughts into input. People will have the ability to think a virtual world or object into existence. This is a far more pure and streamlined input modality than writing or speaking, since both of the former require an abstraction of the pure through into written or spoken form. It will likely demand tremendous mental capacity to think this clearly. Writing does a great job of helping us to streamline our thoughts while crystalising our ability to think, yet pure thought input will likely take this to another level.

As the industry continues to mature, and the adoption curve steepens, I believe we'll see a new sociopolitical landscape unlike anything in our past. Much like fire, VR technology has the power to enable strides in human advancement, while simultaneously having the potential to be wildly destructive and dangerous. We must tread carefully and be deeply thoughtful about the virtual (and real) worlds we create.

"In 2030, I believe a large portion of students will be attending higher education through a VR campus empowered by AI tutors."

TAYLOR FREEMAN,
CEO AT AXON PARK

TERRANCE STROM,
VP, VUFORIA BUSINESS STRATEGY, PTC

CHANGING THE CONVERSATION FROM RO-WHY TO ROI

THE INTERSECTION OF TRANSFORMATIVE XR TECHNOLOGIES AND REALISED BUSINESS VALUE IS THE FUEL TO DRIVE THIS MARKET FURTHER INTO THE STRATOSPHERE.

The hype cycle in this market looks a bit like a roller coaster as we move from hype to hope – and it's really about why do you want to do this and how. When I'm pitching to customers and prospects, I'm describing what it means to move a market across the chasm, from sizzle to steak. The conversation changes. The sizzle works for everyone around a table except the CFO who is entirely focused on maximizing value and ROI.

The pandemic brought remote assistance use cases into hyper focus due to our inability to be in the places where we had traditionally been. So, if you go over the shoulder, you see what I see. Allowing a remote expert to aid someone with less expertise in a remote way is very meaningful, tangible use case with a significant ROI.

When you then combine video with persistent augmented reality and annotations, you're talking about something new where it's all about precision. So, if I were to say to you, cut the red wire and you say which red wire, you could make a persistent and precise annotation in that space that allows for clarification. That's much more tangible than just using something like FaceTime. PTC is also continually trying to push the boundary on ever larger environment scans where you're able to annotate the space in an AR experience.

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Beyond that, in the manufacturing and service world there are fantastic guided-work instructions. Your car comes with a paper-based manual and the evolution of that to augmented reality can put the answers where the questions are. Contextual information where you need it and when you need it changes numerous use cases. We see most traction for this in the manufacturing, service and training industries.

I would be looking at an inflection point for the XR industry in the next three years to move beyond a very fast-growing market to a rocket ship. Two dependencies include a continued evolution of AR hardware and continued maturation of the software process to make it easier to develop content. You need these two pieces to see the market move in a compelling way.

At the heart of any kind of XR and AR is computer vision. The combination of AI and AR together is really powerful in terms of training models and again increasing its aptitude for recognising different objects in different states. The combination of AI and training computer vision is critical, not just for analysis of a picture of the vision but also for a real time video analysis. This is a trend I would see us heading towards.

If the internet democratised learning, then you might think about XR in a way that democratises human transportation. In this sense, you have the ability to feel like you're somewhere, but not to feel like it's artificial. As this evolves it won't feel like you're having a conversation with someone that looks like a talking emoji, it'll feel more like you're talking to a human.

By 2030 XR and VR will become a mandatory part of the language and operation of enterprises. It will be a mandatory part of the way they do business and an expectation of their employees and customers to interact as digital natives.

For business thinking about this space, you need to quantify the value drivers for your busines. The conversation needs to move and has moved from why should I do this to what is the ROI? Our approach is to lead with value and it's a value centric approach. Look for tangible business outcomes that move the needle and create champions by the realisation of business value. Use this journey and find proof points. Start small, scale fast and use established KPIs. Don't let technology drive the conversation, let business value drive it.

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What gets an economist excited is not the technology itself, but the application of that technology. I love seeing the evolution and mainstream adoption of this technology. When I'm sitting there seeing the reaction to our technology from key business leaders it gives me fantastic belief in the future state of the market. Seeing their light bulbs go on as they start to apply this technology to their business problems is amazing. When you combine better decisions with speed, suddenly you've got two vectors there. That's what I love seeing.

THE GOLDEN TRIANGLE OF SIMULATION, ARTIFICIAL INTELLIGENCE AND PHYSICS FOR DIGITAL TWINNING, FORENSICS AND MEMORY RETENTION

**TOMASZ BEDNARZ,
MULTI-INSTITUTIONAL XR RESEARCHER***

"You could imagine, going to a space where a crime happened, 3D scan the room and then bring the data into the visualisation facility. We call it digital twinning of the crime scene."

The EPICentre is a collection of the best visualisation labs in the World, all located in one building. Our main state-of-the-art system is called EPICylinder and is a 340-degree cylindrical screen that can display almost 120 million pixels in 3D (which is ~50x of traditional VR devices).

The difference here lies in the quality and sharpness of this image capability compared to traditional head mounted displays that also have limited resolution, and pixel real estate. The Ultra-high resolution EPICylinder allows us to expand research into areas that require a massive data understanding, for instance in the genomics space. Massive network analytics visualisations can also be applied, for instance to use cases for cyber security evaluations, social networks analysis and business operations optimisations.

One use case we implemented (in collaboration with colleagues from the School of Medicine) was for enhanced drug discovery, using microscopy image data with different cells. Image processing computational algorithms were used to extract around 56 parameters being mapped into a multidimensional space. Then using dimensional reduction algorithms the multidimensional space could be converted to a three-dimensional space to clearly visualise outcomes, e.g., the clusters in data. With a system like that, you can detect outliers, very, very quickly and use these to change a drugs development strategy.

Using modern immersive visualisation systems, forensics is something which can be done in quite an effective way, especially if you're looking at the forensics of a crime scene, for instance. You could imagine, going to a scene where a crime happened, 3D scan the room and then bring the data into the visualisation facility. We call it digital twinning of the crime scene. You may have different AI and computer vision pipelines, allowing you to detect different anomalies in the data, especially if the same space was captured before the crime as well. This way you could then detect more anomalies and explain better what has happened.

I PREDICT IN THE VERY NEAR FUTURE THERE WILL BE A CONVERGENCE OF SIMULATIONS, PHYSICS, AI MODELLING AND PHYSICS INFORMED AI (OR PHYSICS INFORMED NEURAL NETWORKS). THIS IS SUPER EXCITING WHEN YOU'RE ACTUALLY APPROXIMATING REAL-WORLD BEHAVIOURS – THE GOLDEN TRIANGLE OF PHYSICS EXPERIMENTS IN THE REAL WORLD, TRADITIONAL NUMERICAL SIMULATIONS, AND AI DRIVEN MODELS.

In EPICentre, we are not only looking at the visualisations per say, but link activities also through high performance computing pipelines. We are active in a research area called Explainable AI. In a traditional Machine Learning sense, the layers are trained to identify several patterns and each layer has different feature sets, detecting different characteristics from trained data. Using an Explainable AI approach, you can go inside the network and change a couple of parameters to understand why this decision is happening, understanding a bit more about the black box structure of ML pipelines. As you know, the AI pipelines today are massive, and Deep Learning models have thousands and thousands of parameters to be trained, and it's impossible to display them on just a traditional desktop system. Then, the visualisation facility like ours is coming to the rescue when you can actually start looking at these datasets coming from the AI training pipelines in completely new ways, unfolding the unexplainable in new visual ways.

I predict in the very near future there will be a convergence of simulations, physics, AI modelling and Physics Informed AI (or Physics Informed Neural Networks). This is super exciting when you're actually approximating real-world behaviours – the Golden Triangle of physics experiments in the real world, traditional numerical simulations, and AI driven models.

In my personal opinion, VR is just a transition technology (a building block) and I believe the future lies in situated analytics and of course AR and MR on a large scale (aka metaverse). In the future, imagine shopping at a supermarket and you see products and you know instantly where they're coming from, by information displayed in the front of your eyes. You would be able to use your voice to say the product you are looking for, and visual cues will guide you towards that product on the shelf. Traditional mobile devices will soon be a thing of the past.

A FINAL THOUGHT IS THAT WHEN YOU READ A BOOK, YOU REMEMBER 10 PERCENT OF IT, WHEN YOU GO TO A LECTURE IT'S 20 PERCENT. BUT IF YOU EXPERIENCE IT YOURSELF YOU RECALL 75 TO 90 PERCENT, SO THAT CHANGES EVERYTHING.

I really believe and know that VR and MR can be effectively used for health and safety training, but also cybersecurity training. Immersive experiences can train our brains in simulated environments, with those experiences directly translating to real-world behaviours and improved decision making. Properly using the technology like AR/MR and AI can actually help us to make this universe a better and safer place.

Tomasz Bednarz is the Director of the Expanded Perception and Interaction Centre (EPICentre) at UNSW, and Modelling and Simulation Cross-Cutting Capability Lead at CSIRO, member of the Digital Grid Futures Institute within UNSW.

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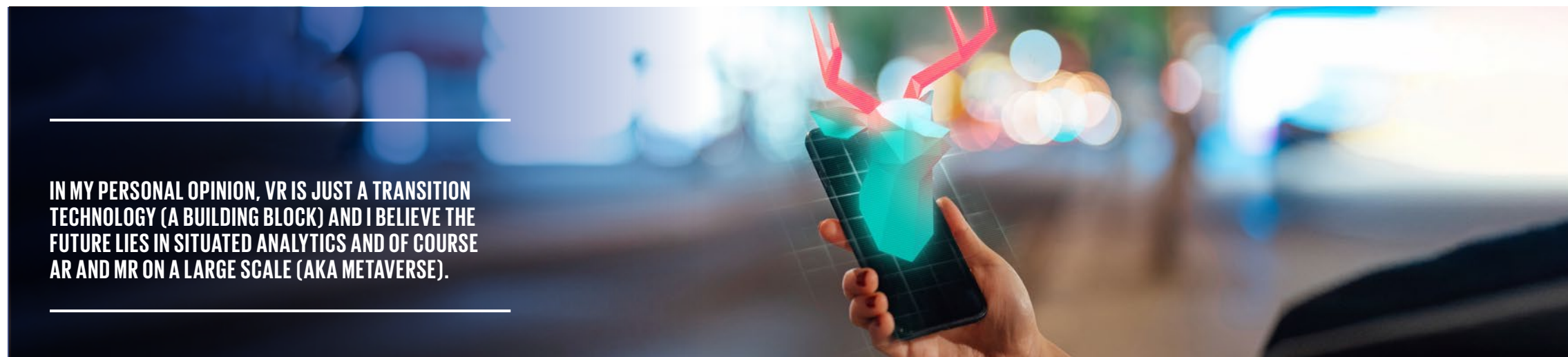
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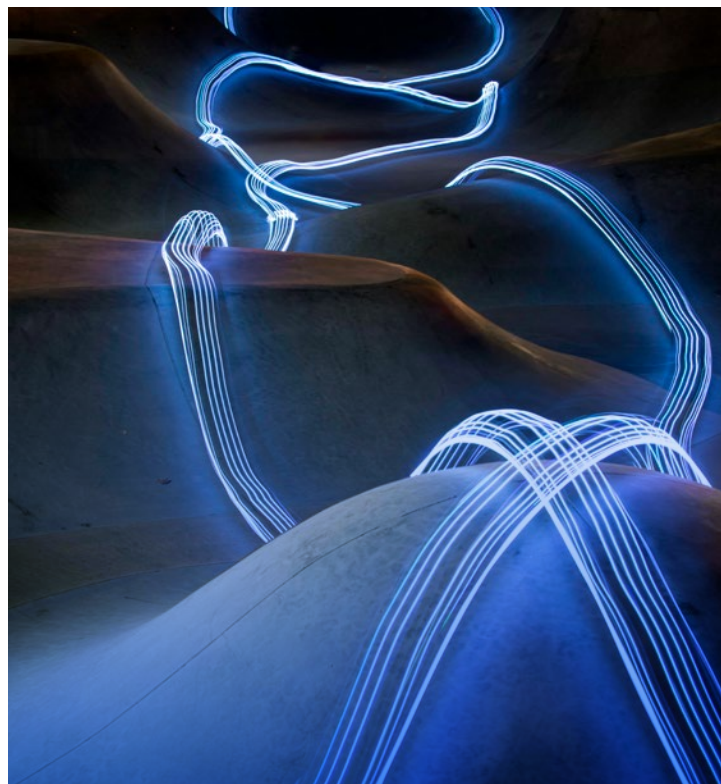
I think the gender gap in different technologies is still quite big in general and it is going to take more time to bridge it. If the metaverse will be inclusive of everyone, there are huge opportunities for women working in this field and a strong need for applications that cater to diverse audiences.

In the early years of VR, headsets weren't as affordable as they are today, and companies providing VR solutions to individual consumers often targeted users in developed countries, primarily in the Western and Asian markets. A tech-savvy male individual might have been perceived as the ideal target audience. As gadgets are becoming more affordable and approachable, we are seeing companies develop both all-inclusive and niche solutions with a wide range of users in mind.

Some solutions that don't require specific high-spec devices have gained worldwide popularity and are already being utilised on a daily basis by a wide range of people. For example, young girls using AR filters within their social media apps actually play a significant role in the progress of this industry, and there are many other short yet important interactions where technology enhances our experience so casually that users often wouldn't even define it as XR.

XR has the potential to bridge the gender gap and other inequalities. Firstly, by offering solutions at any price point, for any experience level, but also by giving us an opportunity to be whoever we want to be and eliminating others' perceptions and biases based on our appearances.

**UNA SOFTIC,
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It can also literally put us into another person's (virtual) shoes and let us experience a moment in the life of someone else. Such an immersive experience can help us understand each other better and empathise inside the virtual worlds, and even further, within our daily reality.

Identity within the XR is a very complex topic, because the way we interact and the embodiment within the metaverse provides possibilities to remain anonymous, share one's own identity, or create an entirely new one. This empowers individuals and also companies to create new interactive embodied personas, giving freedom, but also presenting a certain risk that would require regulation at an entirely new level of complexity for certain use cases. The enthusiasm for decentralised infrastructure on one side and centralised tendencies of major tech enterprises on the other will be another interesting dynamic to observe in the following months and years.

It is fascinating to see how general trends and also the perpetual changes of UI push the boundaries and require constant improvement of XR. At the same time there are some incredible use cases where technology hasn't gotten major upgrades and still remains as relevant from one generation to another. For example, the motorcycle riding simulators used in Japanese driving schools as part of the mandatory training have remained basically the same for decades. They put future riders into dangerous, unpredictable situations in a memorable, yet safe manner.

And since the handling of motorcycles hasn't really changed, the simulator experience is still a highly efficient training tool today with a bright future ahead.

I SEE THE FUTURE AS GOING FROM PREDOMINANTLY STANDALONE DEVICES TO VERY LIGHTWEIGHT AND COMFORTABLE BUILT-IN SYSTEMS THAT WILL SEAMLESSLY INTEGRATE INTO OUR DAILY LIVES. CLOUD SOLUTIONS WITH CROSS REALITY APPLICATION WILL REQUIRE MANY SENSORY FEATURES ON DIFFERENT LEVELS TO FULFILL USER'S GROWING EXPECTATIONS.

I THINK THE GENDER GAP IN DIFFERENT TECHNOLOGIES IS STILL QUITE BIG IN GENERAL AND IT IS GOING TO TAKE MORE TIME TO BRIDGE IT. IF THE METAVERSE WILL BE INCLUSIVE OF EVERYONE, THERE ARE HUGE OPPORTUNITIES FOR WOMEN WORKING IN THIS FIELD AND A STRONG NEED FOR APPLICATIONS THAT CATER TO DIVERSE AUDIENCES.

But as the needs of other industries are changing, we will gradually interact with XR in a more natural way, switching between the virtual and real components of our daily lives seamlessly. There will be a major shift when user interfaces that we are familiar with today (such as keyboards) get replaced entirely with fully intuitive solutions that will understand and respond to our natural body language and execute tasks without requiring us to learn any commands.

I see the future as going from predominantly standalone devices to very lightweight and comfortable built-in systems that will seamlessly integrate into our daily lives. Cloud solutions with cross reality application will require many sensory features on different levels to fulfill user's growing expectations.

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Contacts

Gerasimos Ntouskas
Board Member
Technology Consulting MC
+357 22 209041
gerasimos.ntouskas@kpmg.com.cy

Sotiris Prokopiou
Senior Manager
Digital Transformation Lead
+357 22209214
sotiris.prokopiou@kpmg.com.cy

We can assist with your Extended Reality and metaverse exploration by helping you:

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  Extended Reality and the metaverse

– Structure your business in the metaverse

– Form partnerships and alliances in the metaverse

– Build your presence in the metaverse

– Run executive training on extended reality
  and other emerging technologies.

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