New realities
Risks in the virtual world

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Amelia Kallman is a leading London futurist, speaker, and author. As an innovation and technology communicator, Amelia regularly writes, consults, and speaks on the impact of new technologies on the future of business and our lives. She is an expert on the emerging risks of The New Realities (VR-AR-MR), and also specialises in the future of retail.

Coming from a theatrical background, Amelia started her tech career by chance in 2013 at a creative technology agency where she worked her way up to become their Global Head of Innovation. She opened, operated and curated innovation lounges in both London and Dubai, working with start-ups and corporate clients to develop connections and future-proof strategies. Today she continues to discover and bring attention to cutting-edge start-ups, regularly curating events for WIRED UK.

Coming from a non-traditional technology background she has a unique talent for making the complex accessible. Since going freelance in 2017 she has become an in-demand international speaker. As an independent futurist, clients often find her frank, unbiased, and ethical assessments a refreshing contrast to speakers who endorse, sell and market.

She's lectured at Cambridge University, written an award-winning book, and directed the first burlesque show in 360° video. In 2016 she led an experiment that measured the emotional data of people ages 3-80 as they experienced virtual reality for the first time. Her writing is often featured in WIRED UK, IBC365, and The Big Reveal, her popular monthly innovation newsletter. She is currently working on her next book.

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Lucy Stanbrough MSc, BSc, is an Associate in the Innovation team at Lloyd's. Subjects covered in recent years include: cyber scenarios; future city resilience; and disaster risk finance. Prior to joining Lloyd's, she worked for over 10 years as a natural hazards and GIS consultant, alongside working at the UCL Hazard Centre. Lucy has contributed to a number of books on the use of technology and online systems pre, during, and post-disaster. She maintains an interest in the integration of scientific knowledge to business applications, and connecting knowledge to people, and people to knowledge.

Acknowledgements

Contents

Executive summary

'The new realities', a term coined by futurist and author of this report, Amelia Kallman, covers augmented reality (AR), virtual reality (VR) and mixed reality (MR) technologies. While gaming has been a focus of these technologies thus far, businesses are increasingly looking to use them.

This increasing uptake by businesses, and the new risks the technologies pose to them and society in general, represent a potentially substantial new market for insurers, as well as a means by which they can improve their own products and services.

This report identifies the risks and opportunities associated with these technologies, giving insurers the information they need to move into this rapidly growing market and offer their customers using new realities technology the right coverage, solutions and protection.

The report also helps risk managers assess how these technologies could impact their businesses, and what they can do to mitigate any risks associated with it.

A growing market

It is estimated that by 2019, at least 20% of large businesses[a] will have adopted new realities' solutions *(Forni, 2017)*.The new realities industry itself is growing rapidly and looks likely to continue to do so.

Industry research suggests that AR/VR start-ups raised more than $3.6bn in funding during a 12-month period up to the end of Q1 2018[b], with half the funding concentrated in five companies (*Digi-Capital, 2018*). Revenue is expected to increase from 2019 onwards and mature over the next decade *(Sag, 2018)*. Future market size estimates range from $108bn by 2020 to $1.3trn by 2035 (*Digi-Capital, 2018 & Citi Financial, 2016*).

Currently, most new realities technology is being developed for consumer markets – video games, for example - but there are an increasing number of applications aimed at the commercial sector. These include the ability to conduct medical operations remotely, simulating disaster scenarios for engineering companies and building virtual hospitality boxes for fans to enjoy entertainment with friends.

From new types of training and enhanced decision-making to 'holoporting'[c], teleoperations and additional commercial opportunities, the new realities and the metaverse[d] will create new markets, transforming entire sectors and the way they do business. Examples include:

- Sales and marketing: the technology could be used to build virtual office branches, create new services, share expertise remotely, create advertising campaigns, enhance customer interaction and increase brand awareness.

- Collaboration and communication: improved data analysis and building shared understanding through virtual reality could transform business and consumer relationships

- Training and risk reduction: new realities technology could be used to prevent and reduce losses through better risk identification and assessment, as well as deliver remote training and guidance.

- Inclusion: the metaverse has the potential to make life easier for millions of people who experience mobility challenges. Employers could harness the technology to ensure all employees have the same access, regardless of their physical condition.

[a] Gartner's definition is 1,000 employees upwards, and/or $1bn > annual revenue

[b] In the last 12 months to the end of Q1 2018, as reported by Digi-Capital (2018)

[c] Teleporting a real-time, life-size, 3D, interactive hologram of a person to another location.

[d] The metaverse is a virtual 'white space' that acts as a blank canvass where people can interact with computer-generated environments, objects and scenarios, as well as other users

New technology, new risks

As these technologies become more widely adopted, new risks to human health and data security are emerging. KPMG estimates these risks could cost business £20bn annually *(KPMG, 2016)*, caused by things like injuries to customers or data breaches. Insurers could develop innovative products and services to help businesses manage these risks.

Risks include:

- Human risks: including physical risks, mental risks, and digital consent

  - Physical risks: people using new realities technology may become disorientated in their real-world environments and injure themselves. Users may also become so used to making consequence-free actions in the metaverse – walking into traffic, for example – they could become desensitised to potentially fatal real-world risks.

  - Mental risks: because these are relatively new technologies, there are currently no available long-term studies on their physical and mental impacts. Side effects vary dramatically from person to person but some of those associated with immersive gaming may include depression, isolation, reclusive behaviour, and even suicide and violence. Employers are going to have to consider the impacts of physical and mental risks from an employer's liability perspective.

  - Digital consent: laws and legal jurisdiction in the metaverse, which has no physical boundaries or borders, have not yet been developed. Liability is unclear and has yet to be broadly tested in law.

- Data risks: including inaccuracy, cyber security, identity, intellectual property

  - While new realities technology will lead to great insights and fresh possibilities, it also means a wide range of data - from financial and personal information to biometric and emotional data - may be more susceptible to fraud, hacking or malicious acts.

  - The metaverse is increasing the number of vulnerable places that can be attacked; however, underlying legacy systems remain the most vulnerable to data and cyber breaches. This may change as metaverse platforms become more popularised.

Improving insurance processes

As well as creating new demand for insurance products, new realities technology could also be adopted by insurers to develop new products and processes. Areas that could be affected include:

− Claims: AR and MR headsets could be used to carry out property assessments by overlaying new damage information over pre-damage images to verify claims information.

− Talent: new realities technology could bring all aspects of the claims profession to life, helping the sector tackle its skills shortage by attracting new talent into the profession.

− Underwriters: property and casualty underwriters could use the new technology to examine assets without needing to be on site, thereby reducing costs.

− Brokers: brokers could analyse a client's risk profile and needs in a virtual representation of their premises. They could use this information to create risk management strategies, which they could then apply to real-world assets.

− Product developers: innovative insurance policies, such as Seguro GO (developed specifically for Pokémon Go players), which target specific demographics could help insurers reach a new generation of customers.

− Exposure managers could use the technology to visualise models and scenarios; insurers could use AR, VR and MR to bring real scenarios to life, adding emotional engagement to sales or marketing experiences.

− Loss adjusters: training using new realities technology could help agents, adjusters and risk assessors develop skills wherever they are based, reducing the dependency on the availability of experts as well as lowering administration costs.

Opportunities for businesses

− Senior leadership: new realities technology could be used by boards to communicate and understand risks, view global markets and explore investment portfolios.

− Risk managers: emergency response teams could train in a virtual world with the added realism of extreme temperatures, noise and smells, which would improve responses in real-world situations.

Next steps

As the sophistication of new realities technology increases, many new benefits and opportunities that go beyond gaming and entertainment will emerge. Insureds and insurers should act to take advantage of them in the following ways:

1. Think beyond traditional products and services. Insurers should work with software and hardware manufacturers to support the responsible development of new realities technology and solutions.

2. Establish partnerships with companies that are developing new realities products. This will help insurers understand future distribution channels and mean they can work closely with their customers to develop relevant products and services.

3. Keep up with new developments. New realities technology will allow entirely new worlds to be created that will be vulnerable to cyber risks. The rapid development of digital technology is already having an impact on risk exposure, so insurers must ensure they fully understand the risks, and their potential aggregation, and price policies accordingly.

4. Work closely with risk managers. Risk managers must be aware of and act on these new risks. Insurers must do the same, and help their customers identify current and future challenges, and use that information to create appropriate products and services.

5. Consider how new realities technology can enhance the way insurers currently do business. They should work with technology providers to develop solutions to current process, systems and training challenges, while remaining alert to the risks the technology poses.

Conclusion

The new realities are opening up a new world of commercial and sensory possibilities for developers, suppliers, users and insurers, while at the same time creating new physical, mental and reputational risks, some of which may be unknown today.

The insurance industry has an opportunity to work closely with developers and all businesses using the technology to minimise risks for all stakeholders and ensure the new realities sector develops in a considered and responsible way.

It can also use the technology itself to enhance all aspects of the ways it currently does business to reduce costs and provide a more bespoke, responsive service to policyholders.

To achieve these goals, insurers must immerse themselves in this new sector to stay on top of new developments, anticipate and react to new risks and invest in innovation and new product development.

Introduction

Today's technology and the development timeline
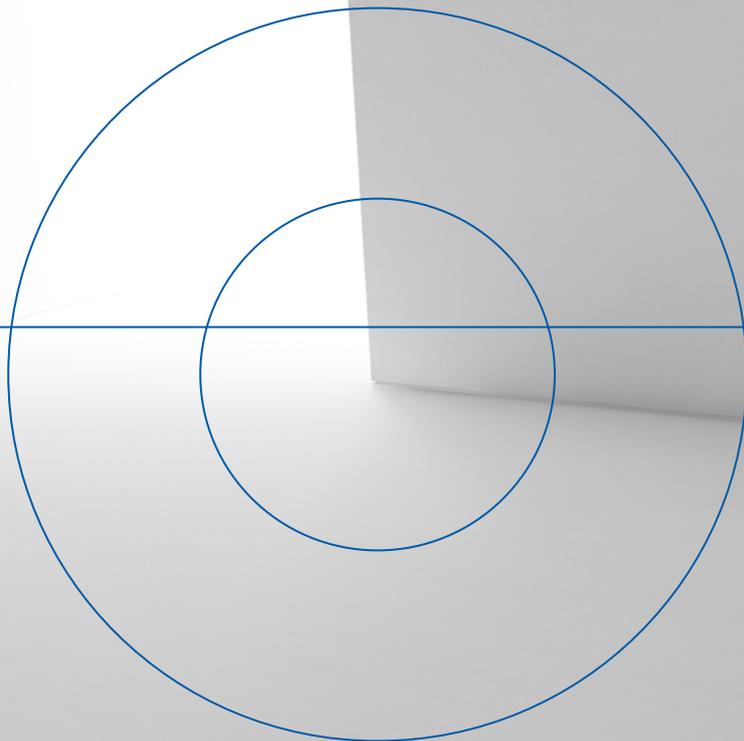
1. Introduction

– 'The new realities' is a new term that covers augmented reality (AR), virtual reality (VR), and mixed reality (MR). These new realities have the potential to democratise training, skills and experiences, like the way in which the internet opened up sharing information.

– These technologies will give users the opportunity to experience things that are maybe too dangerous, expensive, or exclusive to experience in real life, and will open up new ways of experiencing and interacting with data. These characteristics of the technology will significantly impact other emerging markets, such as autonomous vehicles, with the ability to train autonomous devices in virtual space, and could also lower the value of current specialty industries and insight services, such as data analytics where visual interpretation might be favoured over technical skillsets.

– At the same time, the widespread adoption of new realities technology will increase the number of digital and data environments exponentially, concentrating online risk much the same way as cities have concentrated risk in the real world. Issues in virtual worlds are already starting to become real-world legal cases.

– While the main commercial developments of the new realities are taking place in consumer-focused sectors such as gaming, more and more development is being carried out by established companies and start-ups. Examples include healthcare using the new technology to conduct medical teleoperations[e], simulating disaster scenarios for engineering companies, and building virtual hospitality boxes to experience events with friends.

– It is useful to see how these technologies and capabilities have developed to understand:

– Common definitions and key terms

– What activities and developments fall into the new realities sector

– Why there is increasing interest in the sector

– Why insurers and risks managers should keep a watching brief, for clients and their own use

As more people use new realities technology, the insurance industry must adapt its products and services to ensure it can cover any new risks its customers need insurance cover for. As new markets and products emerge quickly, with early detection, new risks become business opportunities for insurers. The technologies also offer new ways for insurers to enhance their training, and visualise scenarios, products, and bring new context to insureds risk environments.

1.1 Common terminology

To understand the technologies and the possibilities they offer, it is important to be clear about the differences between augmented reality, virtual reality, and mixed reality and recognise their unique characteristics, uses and limitations.

While most headsets today are currently only capable of featuring one of the new realities, in the future these will likely be featured on one headset, and eventually, become human augmentations.

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[e] Remotely run operations where doctor and patient are not in the same physical location.

Box 1: New realities terms and acronyms

Augmented reality (AR): relies on a device such as a smartphone, tablet or smart glasses to overlay digital 2D content onto physical objects, people and environments. The most popular examples are Pokémon Go, and Snapchat or Instagram filters. This interactive technology can unlock additional information based on location and context.

Virtual reality (VR): requires a headset that completely immerses users' senses of sight and hearing into an artificial, 3D, digital environment. The stereoscopic images trick the brain into believing the simulation exists tangibly in the spatial landscape of a user, and images instantly adjust based on head position and movement, as they would in real life. It also allows users to view the world from new perspectives, such as seeing through the eyes of a child, athlete, or an animal, or experiencing what it is like to be a crime victim or refugee.

Mixed reality (MR): is sometimes classified under AR but is has differentiating features that are key to why it is likely to become the most important of the new realities. MR is characterised by interactive 360°, 3D imagery, or virtual 3D holograms, overlaid onto real environments.

This is more inclusive than VR because you can still see your natural environment and the people around you, only with additional layers of holographic digital content that is sharable and interactive. Users aren't going to trip over anything or get motion sickness.

Metaverse is a portmanteau of the Greek word 'meta' meaning 'beyond' and universe, creating 'beyond universe'. In this study, it is the name given to the infinite environment in which new digital creation can take place.

The metaverse is a virtual 'white space' that acts as a blank canvas where people can interact with computer-generated environments, objects and scenarios, as well as other users. Accessed only through AR, VR and MR, the metaverse has unlimited real estate, infinite geographic borders and at present no regulations beyond self-governance and societal acceptability.

360° video: It is worth noting the difference between 360° video and VR, as they are often confused. 360° video is actual footage of a real place and time that offers surround viewing. Though often viewed through a VR headset, the content can also be viewed in 2D and is not stereoscopic. The viewing experience is relatively passive with limited interaction capabilities.

Content is readily accessible through channels such as YouTube, as it is easy for anyone to film this content via consumer 360° cameras. When merged with other technologies, such as drones or robots, 360° imagery can be a powerful business tool, with use cases in areas such as damage assessment, and attending recorded or live events.

'HUD glass' or Head-Up Display (HUD): a computer-augmented wearable or interface screen that presents information, images, and data to a user's focal viewpoint. HUDs project digital imaging and visual data onto a transparent glass screen, which is popularly used in inspection processes, and in cars with voice activation to provide local information and directions.

Digital twins: use existing datasets to create highly visual, interactive, and real-time visualisations. They have the potential to provide real-time tracking of key assets, productivity, and planned versus actual progress.

Teleportation/holoporting: the transportation of a real-time, life-size, 3D, interactive hologram of a person to another location.

Simultaneous location and mapping (SLAM): allows mobile devices to detect walls and surfaces around a user to allow virtual objects to be placed in their surroundings and is one example of developments that are bringing forwards the scalability of new realities technology that will unlock commercial viability.

1.2 The development timeline

The first instance of augmented reality can be found in a 1901 short story by *The Wizard of Oz* author L. Frank Baum about electronic spectacles that overlay data onto people and their environments *(Baum, 1901)*. Virtual reality was first referenced in Laurence Manning's 1933 series, *The Man Who Awoke (Manning, 1979)*, which described people connecting to machines to live a virtual life of their choice.

While these scenarios may have begun as science fiction, they are now real-world technologies that could transform the future in ways we are only just beginning to grasp. They are already changing the way we live and work. For example, in March 2018, VR made its first appearance in a Beijing courtroom. During the homicide trial a witness wore a headset to re-enact events leading up to a murder, while the jury was able to watch the re-enacted crime from his perspective as his VR experience was projected on a big screen *(Chenyu, 2018)*.

These types of simulations can provide new insights and perspectives on events and circumstances that people could not gain otherwise, and in doing so, can significantly affect the process of human judgment and decision-making. These possibilities for decision-making, knowledge transfer and entertainment are providing the driving force for adoption.

The first consumer virtual reality headset, the Oculus Rift, was introduced via Kickstarter in 2012 *(Kickstarter, 2012)*. Purchased by Facebook in 2014, the headset wasn't officially released until 2016, the same year Microsoft shipped its first developer kits for their mixed reality headset, HoloLens *(Robertson, 2018)*.

At the entry point of the market, many people are having their first 360° video and new realities experiences through 'cardboard', DIY headsets that rely on smartphones to view content. With its low price point, Google Cardboard has helped to introduce many people to AR, VR and 360° video with over ten million units sold since 2014 *(Vanian, 2017)*. Meanwhile, start-up Zappar has introduced a 3-in-1, AR-VR-MR cardboard experience.

In the more specialist market, current headsets and those scheduled for release are setting new benchmarks for improving the overall experience the new realities can offer. The growing number of AR, VR and MR companies and the availability of different headsets is a clear indication of the industry's growing momentum.

Worldwide sales of standalone headsets are expected to continue to grow over the next five years from 9.6m in 2017 to 59.2m in 2021 *(IDC, 2017)*. This is in addition to mobile devices having simultaneous location and mapping (SLAM) capabilities built in (*Smithson et al, 2018*). Apple's AR framework (ARKit) is expected to enable an estimated 300m devices and Google's ARCore will enable a further 1.3bn devices (*Smithson et al, 2018*).

Insight

While gaming has been a focus of consumer sales thus far, there has recently been a repositioning of the new realities as necessary tools for business growth. For insurers, it is this emerging business uptake that holds the most potential for new commercial opportunities.

It is estimated that by 2019, over 20% of large-enterprise businesses will have adopted AR, VR, and MR solutions *(Forni, 2017)*. There are examples of such uses throughout this study, and insureds and insurers should consider how they might use them in their own operations.

Core companies and services are emerging, but it is the capability of headsets to display any content that is a good indicator of how the technology is maturing. Manufacturers will need to avoid formatting disagreements seen in previous technology roll outs, such as PC verses Mac, and video/audio formatting.

Augmented reality (AR)
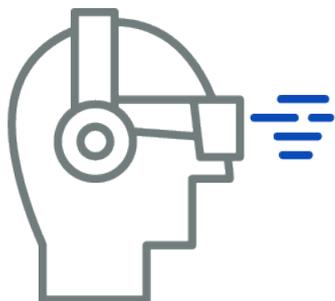
Relies on a device such as a smartphone, tablet or smart glasses to overlay digital 2D content onto physical objects, people and environments. The most popular examples are Pokémon Go, and Snapchat or Instagram filters. This interactive technology can unlock additional information based on location and context.

Examples include:

ODG R-7

These AR smart glasses are an enterprise product meant for professionals who work in fields including transportation, health care, energy and utilities, logistics and security and hazardous environments *(Kleinman, 2018)*.

Available now, these Android powered AR glasses feature specs similar to a premium smartphone and don't require a computer to power the experience. Features include a Qualcomm Snapdragon 805 quad-core processor, 3GB of RAM, 64GB of storage, dual 720p see-through displays, Bluetooth, dual 650-mAh batteries, accelerometer, gyroscope, magnetometer, autofocus camera, magnetic swappable lenses and magnetic stereo earbuds.

North Star

Leap Motion has unveiled a prototype development kit for a new AR headset, 'Project North Star'. While the prototype is not expected to be scaled to market, the company has open-sourced its schematics and says that the headset can be built for less than $100 *(Lang, 2018b)*.

The headset offers a wide field of view at 100 degrees, low latency and high resolution, and was developed to meet the needs of its own hand-tracking software and hardware.

Open source software and other collaborative projects benefit from the harnessed, collective skills of the community (*Open Source Initiative, 2017*). Because of this feature, popular open source software projects are often described by industry experts as being "on the cutting-edge of technology" (*Noyes, 2010 & Zivtech, 2015*). On the other hand, most third-party and open source components do not undergo the same level of security scrutiny as custom-developed software.

Virtual reality (VR)
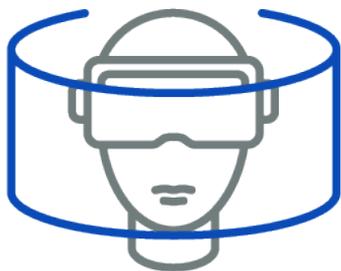
Requires a headset that completely immerses users' senses of sight and hearing into an artificial, 3D, digital environment. The stereoscopic images trick the brain into believing the simulation exists tangibly in the spatial landscape of a user, and images instantly adjust based on head position and movement, as they would in real life.

Examples include

HTC Vive

Pro version

The 2018 release of the HTC Vive Pro sets a new current standard for virtual reality.

The display offers greater pixel density than their previous headsets with 78% more pixels and a 2,880 × 1,600 resolution (1,440 × 1,600 per display) (Lang, 2018), making it the clearest resolution on the market.

Early reviews state the headset is also notably more comfortable and less bulky than previous Vive headsets, and an additional camera has been added for a wider field of view and 3D vision.

This headset works within a fixed environment as it uses sensors to map user movement and positioning, and the headset is tethered by a long cable to a computer so users can walk around within a diagonal area of up to 5m (Vive, 2018).

Focus version

The Vive Focus is an untethered version of the Vive Pro, meaning headsets are free from cables connected to a computer for freer movement and flexibility. This also reduces trip hazards.

First released in China in 2018, the developer's kit is now available in the UK and US, and the company plans to release the consumer version later this year (Painter, 2018). By creating a community and giving developers tools and frameworks to create and advertise content, Vive is facilitating content creation.

Varjo VR

Start-up Varjo is producing a VR headset that is being marketed as the first to offer the same resolution as the human eye. The device does this with two internal displays, one that shows a full view of the virtual world in a standard resolution, and the other, a micro OLED display, which covers only a small fraction of the field of view in a much higher resolution, as our eyes only focus on a small area at one time.

The displays are merged into one for crisp and detailed viewing. The company plans to add 'gaze-tracking' so wherever a user looks will automatically be rendered in high-resolution.

Improving the user experience with clearer images is anticipated to set a new standard of visual precision the industry has been waiting for. In the stages of beta development, Varjo's development partners include Airbus, Audi, BMW, Volkswagen, and entertainment firms Technicolor and 20th Century Fox *(Turk, 2018)*.

Occulus Go

Facebook has pitched what it describes as "an affordable, all-in-one standalone VR headset that doesn't need a smartphone or computer".

Priced at $199 and launched in May 2018, features include integrated audio, a wide field of view, reduced glare, use of the same app platform as Gear VR, and compatibility with current mobile Oculus apps (Matney, 2017).

Oculus Go headsets are used by Lloyd's Global Development Centre (GDC) to provide an immersive VR experience for those new to, or unfamiliar with, Lloyd's. It brings them into our iconic market to experience how risks are transacted, highlighting the expertise and diversity of our underwriters and brokers, and show electronic placement in action.

The headsets will be used at GDC programmes and Lloyd's events, as well as in regional offices and platforms. They will also be used to help the onboarding of Insurtech firms and start-ups in the Lloyd's Lab, as part of PPL events and other Lloyd's market initiatives.

Mixed reality (AR)
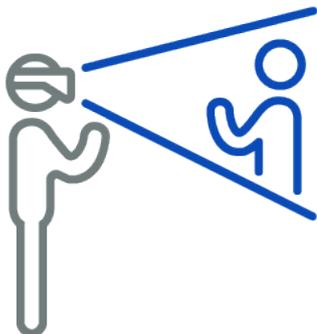
Is sometimes classified under AR but is has differentiating features that are key to why it is likely to become the most important of the new realities. MR is characterised by interactive 360°, 3D imagery, or virtual 3D holograms, overlaid onto real environments.

This is more inclusive than VR because you can still see your natural environment and the people around you, only with additional layers of holographic digital content that is sharable and interactive. Users aren't going to trip over anything or get motion sickness.

Examples include

HoloLens 2

Microsoft recently announced it is working on a new version of the HoloLens that will contain its own neural engine, custom artificial intelligence (AI) chips known as a "HPU" (holographic processing unit) *(Vincent, 2017)* built into the device. An AI coprocessor means the HoloLens won't be reliant on the cloud for analysing visual data *(Forrest, 2017)* and becomes a more powerful device for edge computing.

The HoloLens 2 is scheduled to be released in early 2019 *(Roettgers, 2018)*.

Insight

With the increased capability of being able to process data on the headset itself, the device gains advantages including speed, increased security, and a truer perception of environment and object understanding that will deliver a better user experience. Microsoft has also developed a prototype that looks like a pair of sunglasses, sparking rumours that its next unit may look and feel more aesthetically pleasing to consumers *(Tung, 2017)*.

Magic Leap

Due to launch by the end of 2018, the Magic Leap One prototype has been in development for over five years, backed by investment from companies such as Google and Alibaba. It comprises two components: 'Lightwear' glasses and a 'Lightpack' computing platform with remote.

Similar in concept to the HoloLens, it is thought to be lighter and more comfortable to wear, with a larger field of view. The company has spent years developing these glasses in secret but has recently given clues to why this device may be disruptive to the new realities industry.

Insight

In February 2018 the company announced a partnership with the NBA, working towards changing the future of how people view sports. Magic Leap CEO Rony Abovitz has said that instead of multiple cameras, the new way of broadcasting sports would require multiple, smaller, super high-resolution fixed cameras around a venue that would send all the data to a backend computing stack *(Mills, 2018)*.

Current tech and future developments

Innovation now and beyond the horizon

Emerging Risk Report 2018

Technology

2. Current tech and future developments

To reach the long-term forecasts of becoming a trillion-dollar industry by 2035 *(Brightman, 2016)*, there must first be a tipping point that leads to mass interest and adoption. In predicting this evolution, it is helpful to remember just how young these technologies are, and how significant their growth has been over such a short time period.

Industry research suggests that spending on new realities-related products and services is forecast to reach $27bn in 2018 *(IDC, 2018)*, and this is expected to continue to grow with improving quality and falling entry costs, as the technology become more accessible to a mainstream market. Affordability also makes these technologies attractive for incorporation into long-term business strategies, but rapid obsolescence will be a constant threat.

One publically available estimate states that, "In general, to create and make your app known, you should be prepared to invest at least $100k-$200k" (*Kyselova, 2018*). With the rise of software development kits from device producers including Google and Apple, alongside enabling technology from groups such as Amazon Web Services who offer production and deployment environments with a low skill requirement, we should expect to see more applications as companies look to differentiate themselves to consumers and build new value propositions.

New innovations are constantly evolving the capability of the technologies, and transformative breakthroughs are expected to assist in cementing new realities in our lives, businesses, and throughout society over the next few years.

These include:

− Current innovations: happening now
  - Sociability: interactions in the metaverse
  - Haptics: the addition of virtual touch
− Developing innovations: expected to become standard within 5-10 years
  - 5G: increased bandwidth increases quality experiences
  - X-Commerce: linking finance in the real world and the metaverse
  - Artificial intelligence: real-time data processing and smart headsets
− Innovations beyond the horizon: complex developments that are currently being explored
  - Hyper-personalised reality: using bio-feedback to generate unique experiences
  - Neuroreality: eliminating headsets by integrating technology into the body

The following section sets out Amelia Kallman's thoughts on what is coming next and provides new terminology to describe new frontiers.

2.1 Current innovations

Sociability

The ability to socialise with people in the metaverse, removing restrictions of space and geographic boundaries, is a key enabler to reaching the tipping point of adoption. 36% of executives cite removing distance barriers as the primary driver of increasing adoption of the new realities *(Nanterme and Daugherty, 2018)*, and new realities technology could play a pivotal role in a shift towards a globalised workforce. This includes international offices feeling disconnected from the head office, the need to fly out to different locations to have constructive conversations, and the ability to collaborate on projects and documents as if all the parties where in the same room.

This presents opportunities and risks for communications and human resources teams. New realities technology can enable decentralised working, but also create a systems dependency that will need to be considered in business continuity planning.

'Face-to-face' meetings across geographic locations in the metaverse are becoming increasingly more immersive and life-like. Instead of just sight and sound, physical, 3D, 360°, life-like avatars that share a space in the metaverse could help to increase engagement, becoming a more attractive option than a 2D telecommunications experience.

With platforms like AltspaceVR, Facebook Spaces, VRChat, and vTime giving people the opportunity to be whoever they want to be, the metaverse may host the greatest social experiment of the 21st Century and has the potential to create whole new industries along the way.

Examples include:

- AltspaceVR is a social VR network that invites people to come together to attend everything from political debates and comedy shows, to industry meet-ups and yoga classes. It has approximately 35,000 monthly users from more than 160 different countries *(Brennan, 2017)*, but almost failed as a business in July 2017.

  The company was acquired by Microsoft in October 2017 *(Warren, 2017)*, indicating that while it may not have had the market and user numbers to sustain itself during the birth of consumer VR, there is significant confidence that with lower headset price points, and increased adoption of the new realities that the value of such networks will only increase.

- VRChat currently has 7,000 daily users *(Wagner, 2018)*, which is considered impressive within the sector, but is still fewer than Second Life's 600,000 active users *(Lee, 2017)*, a reach that VR would like to eventually overtake.

- Recently, social VR sports start-up, LiveLike, raised $9.6m in investment *(Spangler, 2018)* for its live-streaming platform that uses AR, VR, and MR to produce a "virtual suite" where people can hang out with friends to watch a game. It allows fans to access unique features, from selecting different camera angles and stats, to interacting with highlights and requesting instant replays.

  LiveLike has hosted more than 76 events on the platform since 2017, including the UEFA Champion's League Final, the French Open, and the NCAA Basketball Big East Tournament. It has plans to introduce Fantasy Sports leagues *(Livelike, 2018)*.

Haptics

Adding artificial touch, or 'haptics', into virtual experiences can trick the mind further into having truly immersive experiences. With the industry predicted to be worth more than $3bn by 2028 *(Hayward, 2018),* integrating haptics into experiences in the metaverse can benefit sectors such as retail, allowing brands to offer customers new experiences they can't currently get on home systems.

Examples include:

- Headsets that come with controllers that vibrate or build tension in sync with content

- Wearables, such as vests and gloves, can be integrated into VR and MR experiences, letting people feel virtual objects, textures, shapes, dials and buttons, temperatures and weight

- Omni-directional treadmills that allow users to explore VR worlds while being stationary in the real world. These are also becoming a popular way of making VR experiences more physical *(Velykholova, 2016).*

Ultrasound haptic technology uses airwaves to project sensations on a user's bare skin, without the need for wearables (*Innovate UK, 2018*). Developments in this area are centralising in a small number of companies. For example, Ultrahaptics holds around 150 patents filed using ultrasound as part of the technology (*Pers. Comm. MacDonald in Innovate UK, 2018*).

With this technology there is no need to physically touch tangible objects, as the sensation of touch is simulated by a series of tiny pressure points that are moved and controlled through complex algorithms. This complexity has been enabled by increasing mobile bandwidth, decreasing data latency and developments in processing power.

Multi-sensory experiences, like start-up Sensiks' 'Sensory Reality Pods' (*2018*), are also being developed. These are personal-sized cabins where people sit and have a VR experience with added elements of temperature, smell, taste, airflow, and light frequency simulated in sync with content, creating a more life-like, immersive and impactful virtual experience.

Focus on the future

In the medical industry companies such as FundamentalVR and Open Simulation offer haptic feedback integrated into virtual medical training. These training solutions use haptic feedback to accurately replicate the feeling of performing real medical procedures at a low cost, while eliminating many safety concerns.

This application could also be adapted for training in hazardous environments or day-to-day business continuity planning to provide more realistic experiences. For example, complex and expensive machinery could be simulated in virtual reality to facilitate improved safety and reduce training costs.

Companies could train and test oil rig engineers in simulated severe weather without any risk to workers.

Today's technology is also allowing data to be recorded simultaneously, so the risk manager of the future might present statistics on compliance and safety records to their broker, allowing their risk mitigation activities to be quantified. This in turn could lead to lower premiums.

Haptics could also be used to test and train autonomous drones and robots. Current testing involves physical environments, but virtual reality could be integrated with haptic feedback to create a virtual testbed environment that could simulate multiple futures.

A version of this is being tested at MIT under the name Flight Goggles where drones navigate an empty room, avoiding objects displayed in a virtual room (*Chu, 2018*).

2.2 Developing innovations

5G

Fifth generation wireless broadband technology promises data-processing speeds 100 times faster than its predecessor, fourth-generation LTE *(Ramirez, 2018)*. 5G is thought to enable better quality AR, VR, and MR experiences that include lower latency, higher speed of services and activations, advanced data collection, Internet of Things (IoT) integration, and increased voice-interaction capabilities.

Intel introduced its 5G capabilities earlier this year in Seoul, South Korea during the 2018 Winter Olympics *(Ramirez, 2018)*. In a recent report by CTIA, representing the US wireless communication industry, China is slightly ahead of South Korea and the US in the race to develop 5G networks, with a second tier that includes France, Germany and the UK, and a third tier that includes Singapore, Russia and Canada *(AFP-JIJI 2018)*.

5G roll-out in Seoul was a costly investment, and it is likely adoption will be slower in other cities. While many network providers are testing 5G, and 5G-ready devices are slated to hit the market in 2019, many believe it will take several more years before 5G is offered to consumers *(Reynolds, 2018)*. 5G integration is likely to begin with industries such as oil, gas and infrastructure, before trickling down to consumers.

According to Kwak Phil Geun, a researcher at the Korea Testing Laboratory, 5G will be the core infrastructure technology that drives adoption of other technologies such as autonomous vehicles, IoT, the new realities and drones *(Reynolds, 2018)*.

The metaverse is going to require insurers to think beyond traditional products and services to effectively meet the needs of people using it. The insurance sector should work with manufacturers to support the responsible development of new technologies and solutions.

Insight

New realities technology could become an integral part of events and sports viewing in the future. This will bring about interesting changes in several areas, from what event insurance looks like, to how insureds will be using the technology and the potential for risks to aggregate.

There is already a vast array of risks associated with hosting events, such as the Olympics, that may require further consideration. Forms of insurance coverage include event cancellation, property, liability, terrorism and personal accident. Customers are numerous and include the organisers, sponsors, hospitality, merchandisers and broadcasters to name but a few.

Current perils include predominantly real-world risks such as windstorms, stadium collapse, civil unrest and terrorism. For example, property insurers often encounter new and unique structures that require consideration during construction and use. If event spaces of the future involve virtual construction, innovative insurance products will need to be developed to incorporate novel risk assessments and risk appetites.

Cyber risks have risen to the forefront in recent years, and there are a multitude of scenarios that could arise should a virtual event be targeted by malicious actors. These may include tampering that could impact election results, ticket sales, or athletes' and spectators' personal information.

With the potential for innovations such as 5G to enable greater data transfer, risks could accumulate across multiple insurance classes. For example, media centres will need to consider property, liability and personal accidents, as well as equivalents for the metaverse in sports and events that are entirely based in the virtual world.

The new realities could also reduce risk. If spectators don't have to physically travel to a location, the conditions for passing infectious diseases are avoided. If an event takes place in the virtual world and participants do not have the same exposure to accidents in practice or in competition, that could change the perils that underwriters need to consider.

Box 4: Sports and live events

Customers are demanding more behind-the scenes experiences when it comes to sports and entertainment. The new realities can put you in the shoes of an athlete, let you experience their bio-emotions, bring full-size players into living rooms and offer live interaction through virtual meetings. These new experiences offer new commercial opportunities for things such as events, digital ticketing, merchandise, branding and gambling.

> *"[It will] move from standard 2D television broadcasting to full volumetric capture. That's probably going to take a decade before you see it happening across multiple sports and news, but you'll see early adopters."*
> *- Rony Abovitz, CEO, Magic Leap*

Live events may start to offer new value to attendees by providing content that can only be accessed through AR, VR or MR apps, encouraging people to bring their own devices or to rent devices. The more real and social AR, VR and MR experiences become, with more features that are only accessible in these worlds, the more people may prefer to stay at home to watch sporting events or live concerts. This could lead to virtual tiered ticketing packages, as well an eventual decrease in stadium sizes.

E-sports are multiplayer video games played competitively for spectators. It is expected to turn into a $1.5bn industry by 2020 *(Dunn, 2017)*. The world's first VR e-sports league was established in 2018, and this could mean that many of the legalities of traditional sports may soon be applied to e-sports as well.

TheWaveVR is said to be "a mesmerising and trippy take on the future of music festivals" *(Matney, 2017)*. It is a free app for VR where you can experience music in a new way. Users can learn how to deejay and host parties, and can experience their favourite artists in this immersive, vibrant social VR experience. Music creators can customise audience experiences by transforming the venue and creating synched light shows. This means fans don't have to travel to see their favorite musicians or festivals; they can experience live events in the metaverse with friends from around the world.

Experience commerce

Within the context of this study, x-commerce, a term coined and used by Amelia Kallman, is short for 'experience commerce'. This refers to payment systems in the metaverse, which will be an integral part of enabling virtual worlds to become financially viable and competitive with real-world environments. As the metaverse expands, so will x-commerce opportunities, making it easier for people to make purchases from within the new realities. From buying real and digital goods, to advertisement space and product placement, this emerging marketplace could create new jobs, while building new audiences.

For example, MasterCard recently partnered with Wearability to create a game where consumers can make purchases without leaving the virtual space, enabling a seamless experience for customers. The virtual reality experience called Priceless Golf integrates with e-commerce, allowing a user to play a virtual game of golf with Tiger Woods where users can instantly buy the club he is using or the clothes he is wearing, without having to leave the metaverse *(Sawers, 2016)*.

In 2017, Worldpay developed a prototype that uses Europay, MasterCard and Visa in VR. Similar to contactless payments, a shopper taps a virtual card across a virtual card machine for purchases of less than £30; for amounts of more than £30, users enter their PIN number into a virtual keypad *(Sawers, 2017)*. eBay has also been trialling virtual reality shopping in Australia, allowing consumers to interact with products and test them in VR, an experience that was previously unavailable for online shopping *(Sherbahn, 2016)*.

These emerging commerce areas are opening up new opportunities for insureds, but they are also new digital systems that may be susceptible to cyber-attacks by malicious individuals or groups. The nature of the threat is evolving so fast that it is becoming more and more difficult for organisations to counter it. Businesses will need to consider new realities technology within their operations, and monitor developments constantly to ensure their security systems are up to date to protect themselves more effectively from cyber-attacks (*Lloyd's, 2017*).

Globally, cybercrime is now estimated to cost businesses $400bn a year, meaning cyber risks is one of the top issues businesses must consider when it comes to their resilience and continuity planning.

Insight

As biometric security becomes more prevalent in real-world transactions, it has the potential to raise standards for payments in the metaverse as well.

Biometric security systems use fingerprint, iris, voice, and facial recognition to increase security, as these are each very difficult to falsify. They could add additional layers of security and enable greater resilience to cyber-attacks in the metaverse

It is also important to remember that new innovations around quantum computing and artificial intelligence could offer mechanisms for malicious actors to break some current forms of encryption.

Within the sharing economy several platforms have mechanisms to protect users, ranging from transaction-embedded insurance to guarantee schemes. Protection and security are likely to become a key consideration, in addition to the experiences on offer.

Establishing partnerships with companies developing security solutions offers an opportunity for insurers to understand future distribution channels and to work with customers to develop relevant products and services. See Lloyd's report, 'Squaring risks in the sharing economy' for further thoughts in this area.

Artificial intelligence

The convergence between the new realities and AI is already beginning to take shape, as headsets are starting to be designed to include custom AI chips that give the technology new capabilities, such as Microsoft's HoloLens 2 *(Forrest, 2017)*.

From instant translations to more voice-activated services, AI offers the potential to learn customer preferences, customise suggestions and anticipate their needs.

Insight

As wearable computers, headsets may also integrate with the internet of things (IoT). Smart headsets could allow consumers to connect to all the other smart items in the home, allowing users to control the physical world from within the virtual one.

In the commercial world they could allow employees to manage robotic production lines and automate transport within goods warehouses.

AI can assist with tasks such as virtual prototyping: taking known data and inputting new data to suggest designs that could save companies time and accelerate processes.

VR and AI are also converging in training applications to generate scenarios based on previous experiences *(Matthews, 2018)*. Virtual customer service agents in the metaverse will leverage AI to respond to customer inquiries and issues, and virtual companions may also come to exist.

When integrated with biosensors, AI may determine when new realities users need to take a break or have a drink of water, even pausing the experience as a result.

This will be explored further in the forthcoming report on AI and IoT in Lloyd's 'Digitalisation' innovation series, to be published over the next six months.

2.3 Innovations beyond the horizon

Hyper-personalised reality

There have been many recent innovations in collecting and processing real-time biological data, including information such as heart rate, blood pressure, sweat response and brainwaves. This personal data could be processed by artificial intelligence (AI) algorithms to generate completely new and individual experiences for users in the metaverse. This means that no two people would have the same digital reality experience and would experience 'hyper-personalised reality', a term coined and used by Amelia Kallman.

Previously mentioned sensory reality pods incorporate biosensors that measure heart rate variability, skin conduction and respiration. Based on this data, AI learns about the user and makes relevant content suggestions based on their real-time reactions, feelings and moods. The Mill has created a VR experience called Strata that uses biosensors to generate visuals *(The Mill, 2017)*. The developers state that they aim to encourage users to relax by reflecting their inner state back to them through the visualisation of an imagined environment, which becomes more peaceful the calmer their biorhythms become.

As the technology develops biosensors may be integrated into headsets and controllers, so people have the option to turn on hyper-personalised reality experiences, as the next level up from standard experiences.

Insight

Hyper-personalised reality introduces new complexity as individual experiences, visions and scenarios will be completely unique to the user. As they are developed organically instead of designed, the effect of an experience on a user becomes undefined.

Expectations of service delivery and customer experience will need to be explored to ensure they are considered within consumer product expectations.

Personalised environments also have interesting health and safety, and diversity and inclusion aspects. For example, if environments could be tailored to lower barriers for dyslexic employees or those on the autism spectrum by manipulating surroundings through VR, AR or MR this could open up new worlds and perspectives for both employers and employees

Neuroreality

While technologies supporting the new realities continue to progress and become more ergonomic, they are still not advanced enough to make virtual experiences indistinguishable from the real world. Users can feel the headsets – they have an obvious physical presence despite manufacturers using new materials and designs. To bridge this gap would mean the elimination of headsets and wearables entirely, replacing them with 'neuroreality'.

Neuroreality refers to brain-computer interface (BCI) - the use of brainwaves to generate and navigate experiences through thought alone. Whether through implants or external electrodes, some experts predict that advances in BCIs are the next era of human evolution *(Lant, 2017)*, and companies are already starting to experiment in this area.

Elon Musk's Neuralink is developing an implantable electrode chip that would connect a person's brain to the digital world *(Houser, 2017)*. Musk predicts this technology would engage all senses and eventually the computer simulations will be indistinguishable from reality *(Gohd, 2017)*.

Boston-based start-up Neurable is tracking brainwaves and using the data to determine a person's intention to control games in VR *(Metz, 2017)*. This means it can also process subconscious responses, as well as conscious reactions.

Insight

BCIs and neuroreality will challenge basic human rights, as thoughts and privacy will no longer be inseparable, and people could become vulnerable to exploitation in new ways.

A recent paper published by the National Center for Biotechnology Information found that while the ethical issues of BCIs have been enumerated, few concrete recommendations have been expressed. The report concluded there needs to be a:

"focus on remedying a lack of practical solutions to the ethical challenges of BCI, alongside the collection of empirical data on the perspectives of the public, BCI users, and BCI researchers" (Burwell, Sample and Racine, 2017).

BCIs will also raise the need for improved cyber security. One of the most challenging aspects of mitigating cyber risk is keeping up with the pace of change. The rapid advancement of digital technology is already having an impact on business risk exposure, and businesses must stay on top of these challenges.

Insurers must also do the same, as well as help their customers identify current and future challenges. And while BCIs are yet to be realised, ensuring high standards and strong risk management will be essential.

Uses and impacts

Transforming industries
and how society does
business
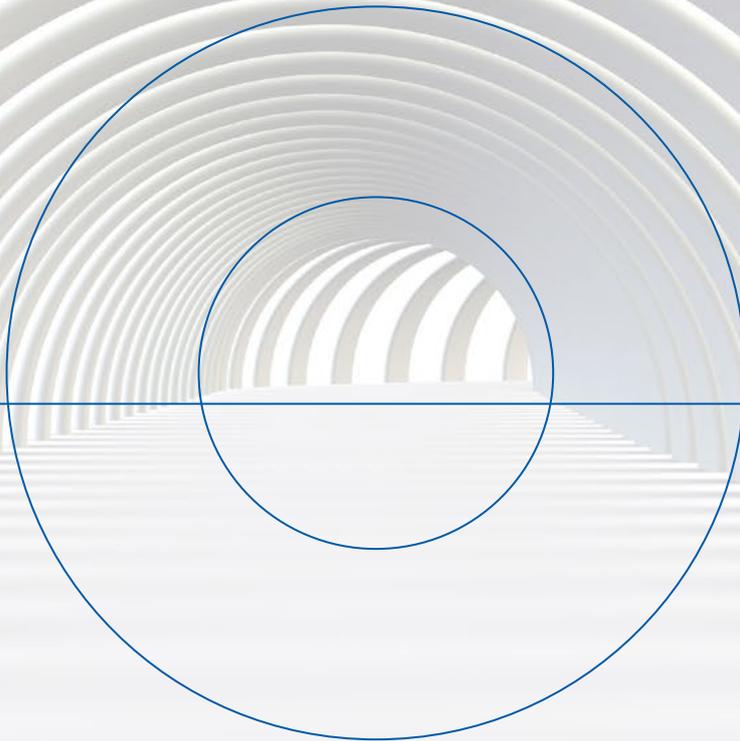
3. Uses and impacts

As the sophistication of augmented reality (AR), virtual reality (VR), and mixed reality (MR) improves, many new benefits and opportunities for insureds and insurers will emerge that go beyond gaming and entertainment.

From helping to eliminate physical and geographic barriers, to redefining training and opening up new marketplaces, these technologies will transform industries and change how society does business.

Transformation opportunities include:

– Sales and marketing, including virtual branches and new services and expertise

– Collaboration and communication, including data analysis and building shared understanding

– Training and risk reduction, including loss prevention and reduction

3.1 Sales and marketing

Since the emergence of the consumer headset, many brands have been experimenting with the power of the new realities to engage customers. Charities have found that virtual experiences can create "a shortcut to empathy" *(Bailenson, 2018),* and these days it is not uncommon to see brands offering VR experiences on the High Street.

Marketers across industries are leveraging these technologies to make headlines, and create targeted campaigns that capture the attention of influencers and specific demographics.

Examples include Converse producing an AR app that lets customers virtually try on and customise shoes they could then purchase through the app *(Leach, 2017)*, and VR being used during Mercedes-Benz Fashion Week in Australia to let people go behind the scenes and experience the show from the perspective of the paparazzi, visitors and even the models *(Kirkpatrick, 2016)*.

Insight

Industries that rely on client and account-focused marketing, annual meetings or road shows can also use new realities technology to demonstrate value to customers. The new realities offer an immersive way to present and advocate company practices, innovation, benefits and industry records.

Insurers can use the new realities to bring real scenarios to life, adding emotional engagement to sales or marketing experiences. In a recent survey of insurance executives on technology (*Costonis et al. 2018*), Accenture reports that, "85% of insurance executives believe it will be important or very important to leverage extended reality solutions to close the gap of physical distance when engaging with employees and customers."

This is already happening. For example, Allianz Insurance has created an AR app to show customers the potential for accidents in the home *(Velykholova, 2016).* When users enter a specially designed home they can use a tablet to uncover hidden dangers. For instance, when one views a toaster through the app, an AR overlay shows sparks and smoke.

In 2016, Liberty Mutual Insurance ran an engagement campaign on Facebook using a 360° video to highlight its roadside assistance offering. While not truly virtual reality (*see Box 1, p9 for the difference between 360° and VR*), the video was used in a quiz-style format where four scenarios were simulated in a choose-you-own adventure format (*Liberty Mutual, 2016*).

Virtual branches

Instead of getting into a car and traveling to a store or business, the new realities will allow companies to offer virtual branch locations. Virtual shopping branches could enhance companies' global reach while making them and their policies more accessible to a wider range of potential customers.

These metaverse locations will be available when and where customers want them and may feature AI representatives in addition to human representatives. We can expect they will allow customers to explore brands, personalise options and make decisions in their own time.

Not only is this experience helpful and convenient for customers, but it also reduces costs for businesses, as they no longer need to invest in physical locations. It could also mean a reduction of employees, flights and shipping costs.

New digital innovations could also be linked. For example, PNB MetLife India's ConVRse solution enables customers to speak with a virtual assistant in a virtual 3D room (*Costonis et al. 2018*).

Insight

People who don't know much about insurance might feel embarrassed to visit a physical office or would be bored by reading about products online, could instead learn and become familiar with policies and options in a more entertaining way through the new realities.

This interaction could demystify complicated concepts and accelerate the sales process, allowing customers to explore what is important to them at their own pace, in an immersive, engaging and comfortable way.

Combining AR with AI, both insurers and potential customers could simply point a smartphone at a car or home to get an insurance quote, or submit an insurance claim *(Lo, 2018)*. In the valuation process, data and visual representations could utilise the technology to present and compare visual records of the valuation.

As the technology progresses, this could move beyond image recognition and matching to pulling in multiple data sources to compile a loss history, safety standards, weather for the day and biometric readings, all of which would enable policies to dynamically respond to real-world conditions.

AR and MR headsets could also be used for physical inspections of property damage assessments, making it easy to take measurements and overlay information or previous images to identify damaged portions of a building.

When used with drones and robotics, AR can help claims adjusters make estimates remotely, measuring dimensions and capturing digital 3D images *(Velykholova, 2016)*. With the inclusion of AI, this strategy could provide quicker and more accurate estimates than those possible with non-enhanced 2D imagery.

New niche service opportunities may also emerge. Jiro y Asociados Seguros, a Mexican insurance company, launched a policy for Pokémon Go users *(Butenko, 2017)*. The insurance policy, 'Seguro GO', offered policy holders protection for Pokémon Go gamers from accidents, injuries and death while playing.

Innovative policies that target specific demographics, such as this one, could help insurers reach a new generation of customers.

New services and expertise

In Lloyd's 2017 report, 'Future Cities' we raised the potential for the insurance sector to work with insureds to identify threats, and evaluate and mitigate risk across entire infrastructure systems. Complex assets can take years of planning and may last 50 years, yet frequently insurers are not involved until the end of the process. In the future risks should be addressed at the earliest planning phases, then assessed and reassessed throughout operations (based on accurate data and probabilistic modelling), and action taken accordingly. Contingency/scenario plans and processes are tested, evaluated and updated regularly.

This could be achieved using new realities technology. For example, CityEngine VR Experience is a solution designed by ESRI for Unreal Studio (*Arisona, 2018*). The system replicates a planning office and allows users to visually interact with a 3D city model to collaboratively review and compare planning scenarios, analyse sun shadows throughout the day, and teleport themselves around the landscape. This is an expansion from ESRI's 360° solution, which was based on static viewpoints and demonstrates the development companies are taking in service provision.

Insight

Insurers' risk modelling of a range of risks in the design phases of infrastructure could allow assessment of assets to hazards and conversations with insureds about assessing resilience and potential actions that might be taken to enhance it.

These scenarios could be used to discuss claim responses, and technology such as IoT sensors could be integrated within structures to create data sources that could trigger parametric policies. This could be of particular use for disaster risk finance and could allow governments to explore and communicate their risks and have conversations with insurers where the outcomes could be played out in front of each other.

These virtual spaces could also open up new industries such as virtual architects, who will need to design and maintain assets in the virtual space, as well as all the goods and services that exist in the physical world.

They will also require strong cyber security as the safety and security of structures will require equivalents to building codes, and bring a new digital dimension to business continuity if a company and its products exist entirely in virtual spaces, and are dependent on platform technologies and software as a service.

Digital art and installations already exist, and will need further consideration around asset ownership for intangible goods and intellectual property. Specie underwriters have strong expertise in this area and should consider how current products and policies might respond or be adapted.

Brand and intellectual property infringement will also need to be considered, but technology such as machine learning could be used to identify infringements and flag them for evaluation.

3.2 Collaboration and communication

The new realities have the power to remove geographic barriers, which could fundamentally change global society. The impact of this new sociability could change the future of work, meetings, collaboration, sports, events, recreation, social interaction and travel.

Human resources

As the new realities become adopted across businesses, there could be a significant impact on airlines, infrastructure and the entire transportation industry, as people will need to travel less frequently. In extreme future scenarios this could lead to the decentralisation of cities and a move back towards ruralisation, which would affect every industry and sector.

36% of executives cite removing distance barriers as the primary driver in the new realities adoption *(Nanterme and Daugherty, 2018)*, and new realities technology could play a pivotal role in a shift towards a globalised workforce.

Increasing people's ability to work remotely could mean more flexibility in the workforce, cutting down on recruitment and human resources costs, as well as outsourcing responsibilities. This could allow international office branches to collaborate in real-time, as well as a new way for companies and clients to communicate. By harnessing skills from anywhere in the world, companies can draw on the best talent, and remote working could also be good for talent retention.

Insight

Use of new realities technology has the potential to decentralise the workforce, and enable employees to work anywhere by switching their connecting device to 'in the office'. The commonly cited concern is that company documents will be accessible in potentially unsecured environments.

Employees are frequently exploited as the weakest link when a company is attacked. Social engineering vulnerabilities are an important consideration for any underwriter offering cyber risk insurance, as are the network access rights provided to tech and admin personnel, and the level of staff training on these issues.

Companies that demonstrate a culture of cyber security awareness and have in place the right cyber security technologies could benefit from lower insurance premiums.

New realities technology could also offer a dynamic aspect to training in this space, with users being able to experience the results of attacks to communicate the importance of compliance with company policies.

Any training must consider the needs of employees, and as the new realities are inherently visual formats, companies will need to consider the experience of those with visual impairments to ensure a level playing field.

Communication spaces

Start-ups are moving into this space, offering customisable environments in the metaverse where people can come together to share, amend and capture documents and media in real-time, and interact as they would in the real world. The concept of connecting pieces of the business model together to allow innovation and insights to be shared is very attractive.

For example, Immersive VR Education's platform, Engage, is designed to make it simple to share education and training content within virtual environments. There are also dedicated VR conference solutions emerging, such as MeetingRoom, which offers enterprise-level security to allow companies to bring people together in virtual spaces.

As displays, capture systems, body tracking and bandwidth improve, so will new conferencing systems, and we can expect to see more growth in this area in years to come. Adoption rates for this technology may remain low as they do for current video conferencing solutions, however. According to a recent insights report by Forbes, 30% of people interviewed felt video conferencing is currently "too difficult", while 29% felt insufficiently trained, and 28% cited a general lack of awareness of the benefits *(Forbes Insights, 2017)*.

Microsoft has introduced and coined the term 'Holoportation', which uses its MR HoloLens headset to teleport a real-time, life-size, 3D, interactive hologram of a person to another location. Using multiple depth-sensing cameras, a person can be captured to create a 3D holographic model that is compressed and transmitted in real-time anywhere in the world.

Also in this space, DoubleMe (*2018*) provides a novel 3D-capture system called HoloPortal™ that converts 2D videos into dynamic 3D models in real-time for 3D content markets including gaming, animation, the new realities and 3D printing. Its system captures still and moving people, and objects that can be interactive in real-time inside the metaverse.

Insight

In the risk placement process, currently a risk manager is likely to present their information in a slide-deck or report. In the future they may bring a digital world to illustrate their position, risk profile, and the geographic aspects of the risk.

Large industrial facilities, construction projects taking place over multiple years, or assets in complex environments could become more accessible and trackable. For example, underwater installations or space risks could be explored up close and on-demand.

These digital twin spaces could update in real-time and capture live loss information, the results of risk management and mitigation. This could allow claims to be tracked live, eliminating site access delays and facilitating conversations between the insured, insurer, and loss adjuster.

By linking other digital innovations, such as drones, IoT and AI, the entire interaction could take place in the metaverse. Drones might monitor shipping containers being unloaded, while IoT sensors report back the state of cargo to a distributed ledger of goods that is accessible to the dependent supply chain.

New realities technology could bring significant reduction in cost for property & casualty insurers, as underwriters could examine an asset without the need to physically be at the location. This could use virtual reality or 360 video.

Telepresence

Much like virtual branches, telepresence has the potential to bring people together and allow expertise to be applied when and where needed. For example, there is a high need for precision and safety in service and repair operations, especially when it comes to large machinery such as compressors or gas turbines. Using new realities technology, remote specialists can see what the person onsite sees with the use of AR or MR headsets, and can instantly share instructions from a manual, overlay drawings, or send images and videos.

Insight

These types of innovations are already in use by companies. In 2015, in partnership with Reflekt, Bosch introduced a VR repair system where a technician holds their phone or tablet over a car engine and it walks them through the repair process (*Bosch, 2015*).

There are also use cases in health and medicine, with Augmedix providing a way for physicians to record, store and recall patient information in a hands-free way using AR and Google Glass. This forms only a part of work being done by Google to provide customised enterprise solutions for fields including manufacturing, logistics, field services and healthcare (*Nosta, 2017*).

In one example, a healthcare provider is reported to have said the system "reduced the time they spend typing up patient notes and other administrative work from 33% of their day to less than 10%, while doubling the amount of time they interact with patients" (*Lee, 2017*).

These examples have interesting implications for insurers in a number of areas, including how additional data is being gathered by insureds to generate risk profiles; how they might use it in the event of a claim to evidence losses; and how they might use it in their own processes.

For example, in field risk assessments insurers could record visual and auditory notes with AR and MR headsets to make the inspection process less time consuming and more accurate *(Velykholova, 2016).*

This could also capture expertise and knowledge to help with the claims process, especially in extreme loss events that may not be seen again within a generation to prepare future insurance professionals. Recruiting a new generation of claims professionals is a key concern for insurers and new realities technology provides a viable solution. Using drones or smaller teams with cameras, remote inspections could be carried out from a central base, allowing insurers to focus on improving their efficiency, reducing travel expenses, and speeding up claims payments.

Understanding

The new realities' capacity to visualise data could be transformative for services such as wealth management and insurance, making the complex more engaging and easier to grasp. Training in the new realities, combined with data and AI algorithms, could produce generative scenarios that mimic real experiences, as well as 'choose your own adventure' type options.

By turning data and numbers that are difficult to explain into an interactive multi-sensory experience, companies are able to convey their ideas and plans in ways that are accessible, enjoyable, more efficient and more effective.

This could be of use for communicating information to boards, and for providing new perspectives on scenario analysis. For example, if a business continuity scenario was simulated in the virtual world the effects could be viewed from entirely new perspectives and this could provide new insight into old problems.

In conjunction with other emerging technologies such as artificial intelligence and machine learning, the new realities also offer the potential to process and analyse data to reveal insights and predict trends. By lowering the barrier for entry, it could open up data analysis to more visual thinkers rather than the traditional actuaries and data scientists.

Insight

Insurers can use AR, VR or MR to bring real scenarios to life, adding emotional engagement to a sales or marketing experience.

For example, Liberty Mutual Insurance ran an engagement campaign in 2016 on Facebook using a 360° video to highlight its roadside assistance offering (*Shorty Awards, 2017*). See section 3.1 on p 25 for further details.

While not truly virtual reality (*see Box 1, p9 for the difference between 360° and VR*), the video was used in a quiz-style format where four scenarios were simulated in a choose-you-own adventure format (*Liberty Mutual, 2016*). It resulted in 25m impressions and 4.5m views.

Focus on the future

The investment manager of the future might walk the virtual streets of their portfolio, making decisions supported by a new perspective of their allocation.

This is happening already with StockCity, which has been created by Fidelity Labs to deploy on Oculus Rift devices. The tool combined virtual reality with data visualisation to display an investor's stock portfolio into a city without showing any figures. *(Fidelity Labs, 2014)*.

For insurers, the exposure manager of the future might holoport around scenarios, watching as their portfolio is subjected to simulated events. This would highlight potential risks and opportunities where clients might share risks or be impacted by one-another's losses. This could be useful to identify supply chain risks.

By using new sources of data, insurers may be able to alert clients to potential losses before they occur, assess damage in real-time, speed up the claims process, prevent false claims, reduce administration through automation, and allow more personalised products and services to be developed (*Gasc, 2016*), enhancing insurers' overall response.

In return, insureds might also be able to track maintenance, manage responses and model impacts for more integrated decision-making.

3.3 Training

Training employees in the new realities can save companies time and money, increase precision and knowledge retention, provide safety and create opportunities for remote learning. Industries such as manufacturing, education, construction and medical are already seeing benefits from this new type of training.

With enabling solutions such as Amazon's Sumerian that lets developers create and run VR, AR, and 3D applications quickly and easily without requiring any specialised programming or 3D graphics expertise (*Amazon Web Services, 2018*), we can expect to see more companies consider developing their own solutions.

AR glasses, a type of Head-Up Display (HUD), give users hands-free access to relevant visuals, text and live communication when and where they need it, overlaying digital information onto the physical. This also means someone can remotely see what the person on the ground is seeing, allowing for a new, enhanced form of collaboration.

Decentralising learning

The new realities have the potential to democratise training, skills and experiences, similar to what the internet did for sharing information. This feature has the potential to help emerging economies by making information accessible, although access to technology and costs will be an initial barrier. Easier access to knowledge could also lower the value of current specialty industries.

At the other end of the scale, information can be accessed on-demand when and where it is needed, and this is happening today. GE Renewable Energy has been equipping field technicians with AR glasses, which has improved productivity in wiring wind turbines by 34% (*Kloberdanz, 2017*). Meanwhile, GE Aviation division reported an average increase of 8% to 12% in its mechanics' efficiency while using the smart glasses, and the reduction of errors at key points in the assembly and overhaul of engines resulted in millions of dollars in savings in its pilot programme (*Shay, 2017*).

Insight

Healthcare researchers are incorporating VR into patient rehabilitation, while workers' compensation insurers are using it to train loss adjusters and underwriters.

Areas where use cases are being examined include spinal cord injuries, phantom limb pain after amputation, burn victims and rehabilitation *(Walsh, 2017)*.

Incorporating sensory reality environments, haptics and simulators into training could significantly mitigate risks while benefiting both the insurer and the insured.

Emergency response teams could train with the added realism of extreme temperatures, noises and smells, all in a replica of the space, which could benefit real response situations and help just-in-time interventions.

Farmers Insurance developed a VR app to train property claims representatives. It can generate up to 500 possible scenarios of damages and customer interactions, and lasts about 15 minutes *(Ben-Hutta, 2017)*. The VR experience can be watched by others on a big screen to make it an inclusive training experience.

Knowledge pools

New realities technology could be used to gather data from training practices for the first time that can create a universal data pool out of which the best practices can be distilled, leading to collective breakthroughs in efficiency, safety and cost-effectiveness.

For example, a training provider may incorporate the new realities into its course offerings, broadening the scope of who can attend globally and allowing companies' economy of scale as employees from around the world could meet in the metaverse.

Insight

Training in the new realities may help agents, adjusters, or risk assessors develop the right skills at a lower cost, reducing the dependency on the availability of experts, as well as lowering the cost of enterprise administration.

As the technology develops, the loss adjuster of the future might be able to pull up real-time and objective visual information with the claim history, legal precedents, validated third-party information and historical records of similar scenarios to inform the decision-making process.

This could speed up claims settlements, increase customer satisfaction and reduce fraud (*AR/VR Journey, 2018*).

Teleoperations

Virtual teleoperations allow you to remotely operate a robot using the new realities. Researchers from MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) have developed a system that puts people in a VR control room where they can see through the robot's eyes and control its actions *(Gordon, 2017)*. Using hand controllers, the robot's movements match the person's, allowing tasks to be completed remotely. Digital layers may be added to gamify tasks to encourage productivity and efficiency.

In places where tasks are physically difficult to reach, whether it's underwater or outer space, this represents a major breakthrough. However, latency, internet interruptions and other interferences could mean system delays, so monitoring real-time accuracy could prove vital.

"The biggest benefit of training in the new realities for insurers may be in loss prevention. Personal injuries and larger losses from 'hazardous infrequent tasks' could be reduced by offering more frequent, less costly training in the new realities.

Those specialising in HIT could provide their up-to-date, practiced training as an added value service, offering insurers more confidence that high-value machinery is being properly maintained."

John Munnings-Tomes, Chief Risk Engineer, Navigators Group
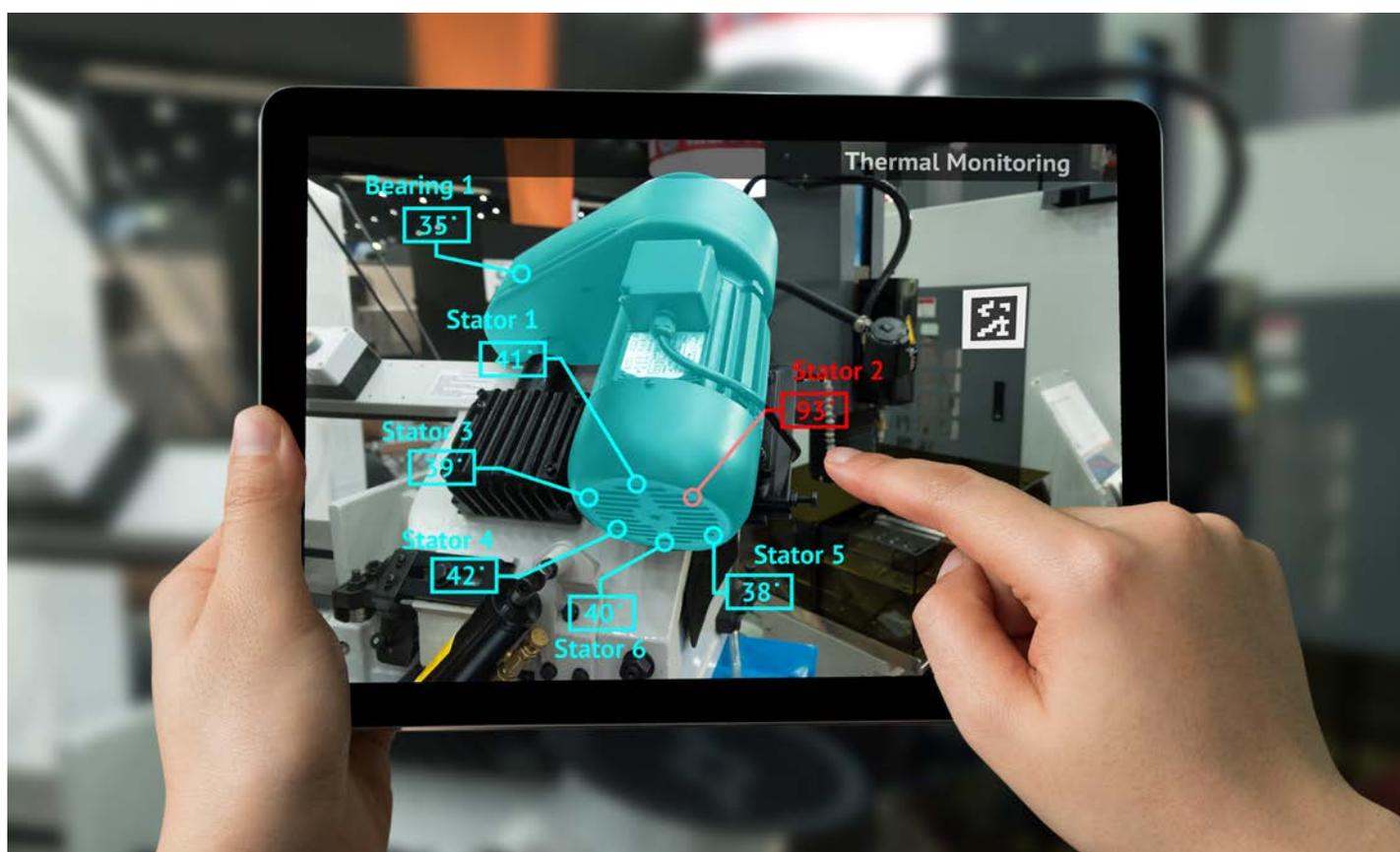
Loss reduction

Safety training in VR can minimise workplace fatalities and is already being used to make industrial, manufacturing, and construction sites safer. For example, in the extractive sector, MineLife VR provides a three-dimensional digital twin of a mine that can be explored from exploration through to closure, allowing users to interact with the site through its lifecycle.

Digital twins use existing datasets to create highly visual, interactive and real-time visualisations. They have the potential to provide real-time tracking of key assets, productivity, and planned versus actual progress (*Bonasio, 2018*).

In the construction industry it is estimated that employers pay almost $1bn per week for direct workers' compensation costs alone *(US Department of Labor, 2018)*. This has prompted the development of VR construction technologies with building information modelling that provides a fully immersive simulation designed to give users different perspectives on potentially hazardous site situations. The goal is to provide a holistic understanding of the entire construction site to prevent on-site accidents *(Ethosh Digital, 2018)*.

Similar training simulations are also being used in mining, deep-sea drilling, power stations, chemical plants and by the military *(Ethosh Digital, 2018.* There is the potential to reduce operator error through enhanced training that could reduce risk for companies, whether this is in preventing events or defending legal challenges.

Insight

These types of applications could allow more proactive conversations with risk managers, track training compliance and uptake, and evidence due diligence *(ArgoGlobal, 2017)*.

Insurance companies are already considering opportunities to integrate new realities technology into their service provision and this will be an interesting area to watch. Examples are included throughout this study for those looking to learn from current developments.

There are also risks to using the new realities that should be considered by businesses and insurers, and these are outlined in the following section.

"In our retail practice, repetitive motion claims are some of the most frequent and costly. VR may be able to provide workers with required stretching before, during, and after shifts directed through VR training. With motion sensors, we will be able to make sure that these are completed as we know this is an excellent way to prevent these type of injuries. It is really about measuring the desired behaviours within their day-to-day activities that we know mitigate the risk of employee injury."
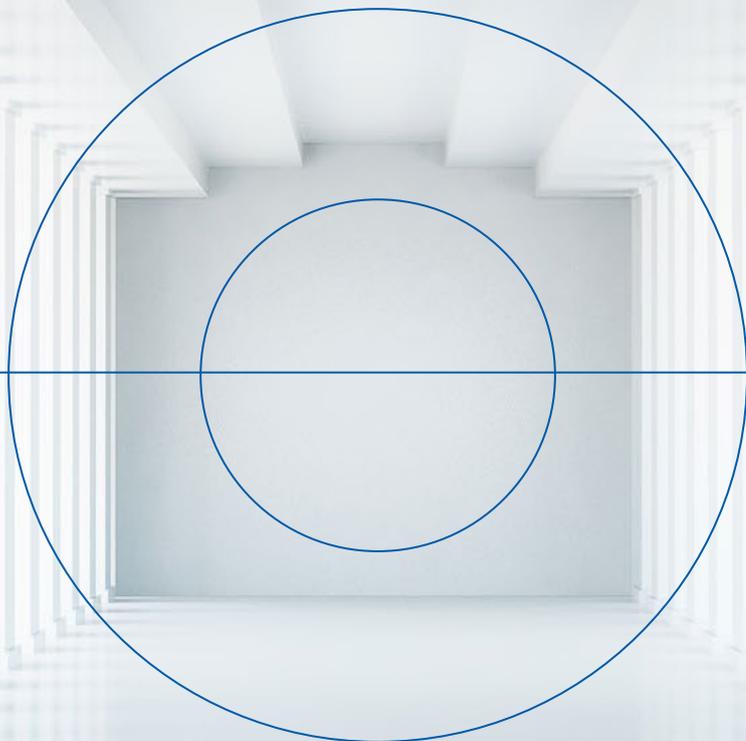
Rooney Gleason, President-Argo Insurance-US Grocery & Retail

Emerging risks and liabilities

Exposure and opportunity for insurers

4. Emerging risks and liabilities

The new realities will increase the digital and data surfaces of our world exponentially. As more and more people are embracing augmented reality (AR), virtual reality (VR), and mixed reality (MR), the insurance industry must adapt to cover new risk possibilities. Issues in virtual worlds are already starting to become real-world court cases.

With early consideration, these risks could become business opportunities for insurers, with new markets and products emerging quickly that will require innovative insurance solutions. While eventually some risks may be mitigated through regulatory measures, laws and governments are not keeping pace with developments and there are questions still to be answered, such as how jurisdiction is going to be dealt with in virtual world's that have infinite space.

Current individual, corporate and government insurance toolkits and practices will need to be reconsidered when it comes to new forms of misuse, crime, and potential disasters introduced by the new realities. This will not just affect enterprises and governments, but also individuals and providers of the hardware and software solutions that power the industry.

The insurance industry has a role to play in providing customers with the foresight they need to manage and transfer their personal and corporate losses.

The two main areas of emerging risks are: human risks and data risks.

4.1 Human risks

Because these are relatively new technologies, there are no long-term studies yet about the physical and mental implications. Every person is different so reactions can vary dramatically.

Headsets and content quality are also variables in how a person experiences the new realities. It is easy to conclude that VR has more physical and mental risks than AR and MR, as the technology is completely immersive, while AR and MR allow users to stay oriented in their natural environment.

There are working examples that should be considered as templates for anyone looking to utilise new realities technology, and scenarios we have yet to imagine that insureds and insurers should keep an open mind to.

4.1.1 Physical implications

In VR, physical injury and accidents could incur due to disorientation and impaired judgments. A perspective by Kennedys Law LLP on personal injury states that several devices currently include warnings that draw attention to the potential for:

– Seizures

– Tripping and movement hazards

– Repetitive stress injury

– Danger of electrical shock, skin irritation, contagious conditions, loss of awareness, eye strains, altered vision, dizziness and disorientation; along with numerous other symptoms.

(*Kennedys, 2017*)

While visual and audio senses are signalling to the brain that a user is moving in a VR experience, the inner ear doesn't always detect the corresponding motion *(Boddington, 2017)*. Therefore, the brain senses a conflict and assumes one is hallucinating from ingesting a toxin, causing the body to feel ill. These short-term side effects are already being addressed through design, improved screen resolution and refresh rate.

Environments should be clear of furniture, cables, animals, small children, or other things one could trip on, run into or knock over. Makers of the Oculus Rift and HTC Vive VR headsets recommend only using their headsets for up to 30 minutes at a time and taking at least a 10-15-minute break in between sessions.

Spending more than the recommended 30 minutes may cause short-term loss of spatial awareness that could result in slips, trips and falls. The current record for time spent in the metaverse is 36 continuous hours *(Fagan, 2018)*. Record holder, Jack McNee, claims he didn't experience any extreme side effects. Further research will be needed in this area.

People who are prone to motion sickness or vertigo are more likely to experience uncomfortable disorientation and nausea, also known as 'cyber-sickness', especially in games involving flying, high-speed movement, heights, or falling *(Fagan, 2018)*.

According to the Oculus Rift instruction manual, an estimated 1 in 4,000 users may experience severe dizziness, seizures, eye or muscle twitching, or blackouts triggered by light flashes or patterns, even if they have never had a seizure or blackout before, or have no history of seizures or epilepsy.

One issue that has been raised is whether the headsets are bad for eyes, but research thus far has found that it is equivalent to any digital surface, with eyestrain and fatigue possible with extended exposure *(Hill, 2016)*. However, some experts believe that *"Age limitations for VR technology might make sense for content, but as far as we know this technology poses no threat to the eyes." (Mukamal, 2017)*.

As more data becomes available it may be possible to establish baselines and derive insight that would allow systems to safely shutdown if biofeedback reaches damage thresholds.

Insight

While applications of new reality technology are likely to be novel, the gaming industry has a history of cases of personal injury and product liability that could form the basis of counterfactual analysis to explore possible futures. For example, Nintendo Wii's release in 2006 saw the widespread adoption of motion-based controllers that allowed users to interact with games.

What followed was a series of lawsuits from litigants claiming that poor design and warnings resulted in damages ranging from broken screens *(Cavalli, 2008)* to torn ligaments *(Jalink et al. 2014)*.

Pokémon GO also saw a range of unintended consequences reported in the media, from users falling off cliffs to trespassing (*Bayles, 2018*), and causing traffic accidents (*Li, 2017*).

The producers responded with a series of updates, including strengthened terms of service and visual warnings for users to remain alert.

Legal liability is yet to be decided in some early lawsuits, and developers should heed the challenges raised and respond to them. As Nabil Bisharat at Reed Smith LLP pointed out in a review of emerging legal considerations around VR: "It will be very difficult for any augmented reality app developer to claim that it was 'unforeseeable.'" (*Bisharat, 2017*).

As new realities technology becomes embedded in social and corporate environments, insureds should review their liability aggregations to establish what might be covered or excluded under general and product liability policies.

Insureds should also talk about their needs with their brokers and carriers to ensure products keep pace with risk understanding and needs.

For example:

– If injury can be attributed to the headset, there may be product liability issues for manufacturers around design safety.

– If injury occurs on public or private property and is attributed to the device, the property owner may have occupier's liability concerns.

– Developers of solutions should also ensure they understand potential product liability - and that this is communicated and understood by those using their services - or face being called as defendants.

(*Kennedys, 2017*)

4.1.2 Mental implications

According to industry research, by 2020 there will be 1bn users of AR and VR, and by 2018, 171m of users of VR (*Purow, 2016*). This is a significant number of estimated users, making consideration around the potential mental impact and liability aggregations a key area to consider before integration accelerates.

Some researchers believe that around half the neurons that are turned on in a real-world environment shut down in the VR environment (*Boddington, 2017*). Researchers at the University of California, Los Angeles have been conducting experiments on the effect of VR on the brains of rats in order to establish a knowledge base *(Boddington, 2017)*.

Rats explore a virtual environment on treadmills while the activity in the hippocampus region of the brain responsible for spatial awareness, learning and memory is monitored. It is not yet known if the human brain reacts in the same way, but research is continuing in this area to provide insight into the impact of VR on human brains.

Some psychiatrists have released warnings that children should be limited in their use of VR because their brains are not fully developed and they are still 'reality testing', or learning what's real from what's not *(Hill, 2016)*. Some headset manufacturers have set age limits. Both Oculus Rift and Samsung's Gear VR have a 13+ age rating, while Sony's PlayStation VR is not to be used by children under the age of 12.

Several VR apps are using the technology to induce synaesthesia, which is when the stimulation of one sense triggers an automatic, involuntary experience in another sense (*Moss, 2018*). SoundSelf, which has been called "A VR acid trip without the drugs and flashbacks", *(Kohler, 2016)* has users talk, hum, or whistle to create colourful, morphing patterns, and eventually the images unfold on their own without the need for voice control.

The hypnotic experience is said to induce a trance or a meditative state and has been compared to a synesthetic experience where sight, sound and other sensations blur into one *(Pangburn, 2014)*. With neonatal hypothesis positing that all infants are born 'synesthetes' *(Bor et, al., 2014)* we could find that VR allows us to tap into a dormant part of our brains, enhancing creative capabilities.

Risks in this area are also being recognised at an international level. In the 11th International Classification of Diseases, released by the World Health Organization in June 2018, "gaming disorder" is included on the list of mental health conditions *(World Health Organization, 2018)* .

Researchers who study the effects of immersive and interactive video game experiences have now coined the term game transfer phenomenon (GTP), a reality-blurring psychotic-like feature that highly-active gamers can experience *(Ortiz de Gortari et. al., 2011)*.

Dangers of immersive gaming can include depression, isolation, reclusive behaviour, and even lead to suicide, as well as virtual world conflict turning into real-world violence. UK Addiction Treatment Centres estimates that more than 46m Britons of all ages may be addicted to internet use in some way *(UK Addiction Treatment Centres, 2018)*. Gaming addiction is being treated in a similar way to other behavioural addictions such as gambling, sex and general internet addiction. The emerging industry around treatment ranges from clinical to unconventional therapies *(Foran, 2015)*.

In a study in the UK of more than 1,600 gamers *(Griffiths, 2014)*, researchers found that many showed symptoms of GTP, including seeing and hearing aspects of the game such as voices, explosions and screams for hours and even days after they stopped playing *(Ortiz de Gortari, et. al., 2011; Ortiz de Gortari & Griffiths, 2014)*.

These aspects in regards to the new realities must be considered. Virtual reality in particular has the potential to change behaviour, similar to the way smartphones have influenced our brain patterns (*Brueck, 2018*).

Everyone experiences things differently, and in virtual reality, where people are out of their comfort zones and in worlds where there are no rules, it's difficult to predict the impact on individuals of these ever-richer, ever more real experiences, and how these experiences will manifest in real life (*Kelion, 2016*).

As the technology develops and new use-cases emerge, users will experience risks in new environments without a reference for comparison – new combinations of sensory experiences may result in reactions not previously seen in current simulator environments. For example, businesses are providing experiences where customers can skydive in virtual reality to simulate falling through space (*Gallaga, 2018*), or ride a waterslide with a VR headset (*Gartenberg, 2018*).

Some futurists predict users may start to strongly identify with their avatars and create virtual intimacy, which could become an unconscious influence in a person's physical reality resulting in 'virtual intimacy disorder' – a term coined by Amelia Kallman. Developers of content for the new realities may find that they are spending longer than recommended inside the metaverse, impairing their reorientation back into the real world.

Insight

For jobs or tasks that involve time in the metaverse employers are going to have to consider the from an employer's liability perspective. They will also need to think about physical risks as technologies develop.

It is also important to keep in mind that the metaverse has the potential to provide positive experiences to millions who experience mobility challenges, and employers could need to evaluate the technology to enable those under their employment to bring parity of access within their workforce.

The dislocation of going from reality to a virtual one and back again may have extreme side effects. For instance, spending so much time in a virtual world where walking into traffic has no physical consequences that a person becomes inclined to disassociate behaviour from risk in the real world. This could result in a surge in inexplicably dangerous behaviour that may be blamed on VR.

Amelia Kallman believes that as the metaverse marketplace expands, a black market will also emerge, though currently this is a potential risk that has received very little attention.

"Here, experiences that are illegal or not socially acceptable in the real world may be offered, and may significantly impact mental states," she says. "Because there would be a detachment from consequences, there is a potential for these actions to influence and manifest crimes committed in the real world."

4.1.3 Digital consent

The new possibilities of escapism play a huge part in the attraction of the new realities, and the range of applications and enterprise integration will raise many questions around how issues such as consent, infidelity, abuse and how misrepresentation in virtual worlds will be dealt with legally.

A case brought forward by a female gamer who claimed psychological trauma after being groped in virtual reality was thrown out because the criminal code currently does not recognise assault in the new realities *(Wong, 2016)*. Haptic body suits might mean that kicks, punches and sexual advances can be recorded as data proving assaults. Prevention of virtual harassment may eventually be embedded into content from the beginning through coding.

Insight

Allegations of sexual harassment in the real world have dominated headlines over the past year, and in April 2018, there were reports that one large US insurer has seen a 50% increase in claims for employment practices liability insurance *(Rasaad, 2018)*. Sentiment suggests there will be an increase in future claims as society becomes less tolerant of such behaviour and more cases are brought forwards to litigation.

The US remains the most significant territory for litigation arising from allegations of sexual harassment, and demand for insurance coverage is expected to increase. The rise of haptic technology will require consideration within common products for sexual harassment, which include:

- Employment practices liability insurance: coverage has broadened over the years and can now include discrimination and harassment made against an employer or employee, or even third parties such as customers and vendors. Most policies exclude coverage for bodily injury but can have carve-back for emotional distress.

- General liability and employers' liability: are intended to provide coverage for injury, and coverage can depend on the scope of bodily injury definition. Broader bodily injury definitions may include mental injury or mental anguish.

- Sexual abuse, molestation and misconduct liability products: policies specifically provide coverage for claims from third parties for sexual abuse and misconduct.

- Medical malpractice

- Professional liability

- Directors' and officers' liability

- Contingency

Companies will need to ensure their employment policies take potential risks into consideration, and that data and device security controls are appropriate to prevent misuse or hijacking by malicious actors.

4.2 Data risks

According to Amelia Kallman, actions in the new realities can translate directly into data due to their digital nature. While this can lead to great insights and fresh possibilities, it also means that a wide range of data, from financial and personal information, to biometric and emotional data, may be more susceptible to fraud, hacking and malicious acts.

While it is not possible to be 100% secure from a cyber-attack, there are several measures companies can take to reduce the risk of it happening, and to ensure they minimise the consequences and recover more quickly should a breach occur. New realities will exponentially expand the aggregation and touchpoints for data, and will require companies have strong existing controls before technology is embedded.

Because of their digital nature, actions in the new realities translate directly into data, surfaces the potential to mine behavioural data to learn about people in completely new ways. In 360° video, companies like Facebook, YouTube and Vimeo offer advertisers heat maps of the places that get the most views and dwell time *(Redohl, 2017)*, which can also be rendered in VR.

Companies should fully understand their responsibilities around General Data Protection Regulation (GDPR) compliance here. While new data sources and shared access have the potential to surface new opportunities, there are real concerns around data security, confidentiality and intellectual property that will need to be addressed (*Pattynova et al., 2018*).

Insurance and risk management is part of this solution. Every day, Lloyd's specialist cyber underwriters work with thousands of companies, from multinationals to SMEs, across the world to understand their risks better and to provide them with the expert advice and insurance cover they need.

4.2.1 Inaccuracy

As quality experiences in the metaverse improve, people are expected to make more high-value decisions based on their experience with the new realities. Businesses may become reliant on the accuracy of training and simulations in virtual worlds. In fields such as construction, aviation, military, marine and medical, any inaccuracies could prove costly or even deadly. Discrepancies could occur between virtual and physical placements, causing confusion at vital moments.

When inaccuracies in the new realities are to blame for unexpected obstacles, losses, or trouble in the physical world, the liability could rest in several areas. For instance, virtual prototyping of 3D models in the metaverse may be thoroughly tested for defects before going into production, though there is no guarantee that the virtual and real prototypes will match perfectly *(Velykholova, 2016)*.

There is a need for responsibility to be defined in both the physical and virtual worlds, and it may mean that new forms of contingency training will also become necessary, adding new costs.

At the moment, many producers of the new realities content and software are unaware that they could be professionally liable if discrepancies arise, and this may be an opportunity for brokers to advocate professional liability insurance to a new and growing market.

4.2.2 Data and cyber security

While the metaverse increases the number of places attacks can occur, the true value of potential data and cyber breaches currently still lies within underlying legacy systems. This may shift however as these platforms become more popular.

Presently, the high cost associated with AR, VR and MR solutions means that many bespoke systems are created through open source platforms to keep costs down.

Obtaining core software from open source platforms means there is a risk of inadvertent exposure to third party coding that could allow sensitive information to be shared or distributed by accident or malicious intent.

In the race to innovate, many large enterprises are partnering with start-ups who may not have been properly vetted from a security practices standpoint. The risk of a developer leaving a backdoor into coded systems open or unlocked is one of the biggest threats companies face.

For example, researchers from the University of New Haven in Connecticut recently staged a controlled cyber-attack where they infected a computer with malware attached to an email to see if software on the Oculus Rift and the HTC Vive would stay secure if other safeguards failed *(Ng, 2018).* The researchers acted as hackers and were able to change content during an active VR session, as well as change the digital barriers that keep people from walking into walls or falling down stairs through unencrypted access to digital wall boundaries, the camera, and the screen's display *(Ng, 2018).*

Insight

Open source software has come a long way over the years and active coding communities, such as GitHub, are one of the primary reasons for its uptake. Open source software and other collaborative projects benefit through development or advocacy or because of the community *(Open Source Initiative, 2017).*

As a result of these features, popular open source software projects are often described by industry experts as being "on the cutting-edge of technology" *(Noyes, 2010; Zivtech, 2015).* More than half of the software acquired over the next several years is predicted to be open source *(Rowley, 2017).*

New code may also be a potential point of vulnerability, and open source software is impacted by both the benefits and risks of using a collaborative development approach. Most third-party and open source components do not undergo the same level of security scrutiny as custom-developed software.

Many of the open source software projects uploaded to Github and elsewhere are presumed to be reviewed for functionality and security, but in fact no standards or definitions exist for this purpose.

Exposing these vulnerabilities may lead to security reviews and standards reforms. Integrating x-commerce through contactless payments into software will also increase the risk of fraud and hacks. Additional security frameworks will be required, and new regulated protocols put in place, which could add cost.

Governmental regulatory bodies across many jurisdictions can bring actions against organisations for failure to comply with laws and regulations regarding information security and privacy. This coverage will continue to be increasingly important as more countries adopt data-breach regulations.

Insight

Data breaches involving sensitive information of individuals and companies are increasingly driving the introduction of legal obligations to notify the affected individuals. In the US, 47 states have data breach notification laws *(NCSL, 2017)* and other countries including EU nations and Australia have passed similar regulations.

While there is significant variation in the specific contractual coverage provided under this policy section, examples include:

– Hiring of IT forensic consultants to identify the scope of the breach

– Legal representation to advise on obligations based on the geographic and regulatory specifics of the situation

– Letters to notify potentially affected individuals (some policies may require a regulatory requirement to notify, with others covering voluntary notification costs)

– Funds to retain a public relations consultant to help manage publicity around the event

– Credit monitoring, identity theft monitoring or identity theft insurance for potentially affected individuals (the length of monitoring covered can vary from policy to policy)

– Call centres to respond to queries from potentially affected individuals

4.2.3 Identity

When avatars are used as a form of identification, the persona and the personal data they represent become susceptible to being copied, stolen, deleted or manipulated. Identity fraud and misrepresentation may be called into question, especially around business practices.

While biometric identification may be one security solution, adding further security measures may be costly, and discrepancies within firewalls may make some communications incompatible. Laws around copyright, and the question of copyrighting identities and avatars, will have to be rewritten to include the metaverse. Law firms are starting to lead the conversation on these issues, but updating legacy laws, contracts and regulations to a new standard is a challenge many are only starting to grapple with *(McFarlane, 2017)*.

4.2.4 Intellectual property and value in a virtual world

Intellectual property (IP) may be one area of controversy when it comes to the metaverse. *Zenimax v. Oculus* was a recent lawsuit over ownership of virtual reality IP, for which Zenimax was found in favour and awarded $500m *(Moore, 2017)*.

Contracts drafted before the inclusion of the new realities could prove a key area of contention. For example, a production company that has granted video game rights to a gaming company may still be able to claim VR rights depending on how the original contract was drafted.

Going forward, contracts will need to consider immersive media rights and where boundaries of ownership will fall. Workplaces should also consider contracts with their employees to ensure the metaverse is included within considerations on where intellectual property rights are established. If environments become personal to the user, where does the boundary sit between corporate and social space. Errors and omissions insurance coverage will need to be considered for when customers might hold professional services responsible for the service provided or failed to provide, and if they did not receive the expected or promised results. In a still emerging technology this will be a risk area.

This also raises issues around digital assets and virtual currencies rolling over into the real world. In 2013 a case was brought forward against a game player who broke into 4,000 accounts on the role-playing game Runescape and stole virtual property that he then auctioned on sites and forums, raising nearly £3k *(Gallagher, 2013)*. In this case he was found guilty of hacking under cyber law. His lawyer said: *"It is clear he did not consider the long-term consequences because that world was not real." (Gallagher, 2013)*.

How content in the new realities is taxed, as well as what exactly is being purchased when something is 'bought' in a virtual world are both questions we are starting to ask. Hardware devices that are stolen may appear to be of relatively low value, but the content and data that is becoming increasingly embedded within devices may hold significant value, raising the device's insurable value.

Insight

The realisation period for measuring losses due to intellectual property (IP) theft or brand reputation can play out over years. Loss of first-party IP is not currently covered under cyber-liability policies mainly due to concerns around the speculative nature of valuations over time.

A 2014 report by the Center for Responsible Enterprise and Trade and PwC, based on extrapolations from national research and development spending and its associated benefits *(CREATe and PwC, 2014)*, estimated that anywhere from 1-3% of GDP is lost each year in more economically developed countries due to espionage.

Malicious actors engaged in this space can be grouped into the following:

– Nation states

– Malicious insiders

– Competitors

– Transnational organised crime

– Hacktivists
  (Passman, et. al., 2014)

It is recognised that cyber-enabled hacking and espionage play a significant role in this figure *(Passman, et. al. 2014)* and an extreme loss, mass vulnerability attack may contribute to a further increase in this GDP-loss estimate.

Conclusion

Take aways and next steps
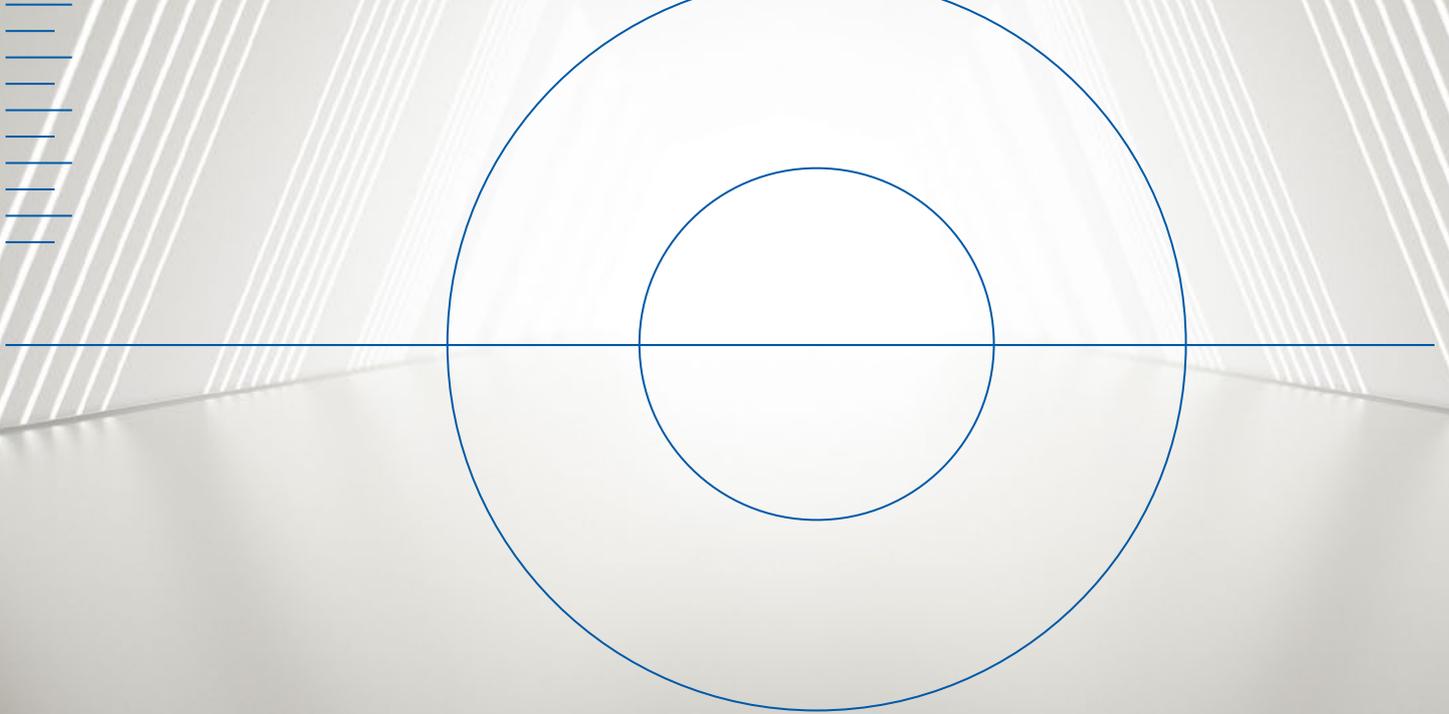
5. Conclusion

The new realities pose new risks, and will change existing products and policies in the insurance industry. Adjustments to pre-existing contracts and pricing, establishing liability, and staying vigilant to all the possible spin-off applications will be necessary to future coverage.

With the power to improve safety and training, as well as provide instant assessments and quotations, the new realities are likely to play a vital role in the future of the insurance industry. As the industry matures and the metaverse expands even more possibilities and opportunities may emerge that have yet to be imagined.

By using new sources of data, insurers may be able to alert clients of potential losses before they occur, assess damage in real time, speed up the claims process and prevent false claims, reduce administration through automation, and allow more personalised products and services to be developed.

Other examples for insurers include:

− Claims: AR and MR headsets may be used for physical inspections of property damage assessments, making it easy to take measurements and overlay information or previous images to identify damaged portions of a building. Attracting new talent into the profession is a key concern for claims professionals, and new realities technology provide a viable solution.

− Underwriters: new realities technology could bring significant reduction in cost for property & casualty insurers as underwriters could examine an asset without the need to physically be at the location. Errors & omissions insurance will also require consideration as the technologies develop, and experience and reality may not meet expectations.

− Brokers: using digital twin technologies, brokers could explore a client's risk in a space designed for their needs, consider and implement virtual risk management strategies, and move around their global assets without leaving the shared space −

whether this is a dedicated room with projection technology or a virtual suite.

− Create new products: innovative insurance policies such as Seguro GO that target specific demographics could help insurers reach a new generation of customers.

− Exposure managers to visualise models and scenarios: insurers can use AR, VR or MR to bring real scenarios to life, adding emotional engagement to a sales or marketing experience.

− Senior leadership: the CEO of the future might walk the virtual streets of their company assets. The technologies could be used by boards to communicate and understand risks, view global markets and explore investment portfolios.

− Risk managers: emergency response teams could train with the added realism of things such as extreme temperatures, noise and smells, in a replica of the real world physical space, which could benefit real response situations and help just-in-time interventions.

− Loss adjusters: training in the new realities may help agents, adjusters and risk assessors develop the right skills at a lower cost, reducing the dependency on the availability of experts, as well as lowering the cost of enterprise administration.

Being at the forefront of technology this game-changing is exciting, but there is still a lot to learn. While exploring how far we can push the boundaries of these technologies is something people will do, long-term research on its impact does not yet exist, and we are all a part of developing what will become the history of these platforms.

While the new realities offer plenty of new commercial opportunities, these technologies have the power to change us individually and as a society. The onus is on everyone to develop the technology and apply it responsibly.

Next steps

As the sophistication of new realities technology increases, many new benefits and opportunities that go beyond gaming and entertainment will emerge. Insureds and insurers should act to take advantage of them in the following ways:

1. Think beyond traditional products and services. Insurers should work with software and hardware manufacturers to support the responsible development of new realities technology and solutions.

2. Establish partnerships with companies that are developing new realities products. This will help insurers understand future distribution channels and mean they can work closely with their customers to develop relevant products and services.

3. Keep up with new developments. New realities technology will allow entirely new worlds to be created that will be vulnerable to cyber risks. The rapid development of digital technology is already having an impact on risk exposure, so insurers must ensure they fully understand the risks, and their potential aggregation, and price policies accordingly.

4. Work closely with risk managers. Risk managers must be aware of and act on these new risks. Insurers must do the same, and help their customers identify current and future challenges, and use that information to create appropriate products and services.

5. Consider how new realities technology can enhance the way insurers currently do business. They should work with technology providers to develop solutions to current process, systems and training challenges, while remaining alert to the risks the technology poses.

The new realities are opening up a new world of commercial and sensory possibility for developers, suppliers, users and insurers, at the same time as creating new physical, mental and reputational risks, some of which may be unknown today.

The insurance industry has an opportunity to work closely developers and all businesses using the technology to minimise these risks for all stakeholders and ensure the new realities sector develops in a considered and responsible way.

It can also use the technology itself to enhance all aspects of the ways it currently does business to reduce costs and provide a more bespoke, responsive service to policyholders.

To achieve these goals, insurers must immerse themselves in this new sector to stay on top of new developments, anticipate and react to new risks, and invest in innovation and new product development.

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