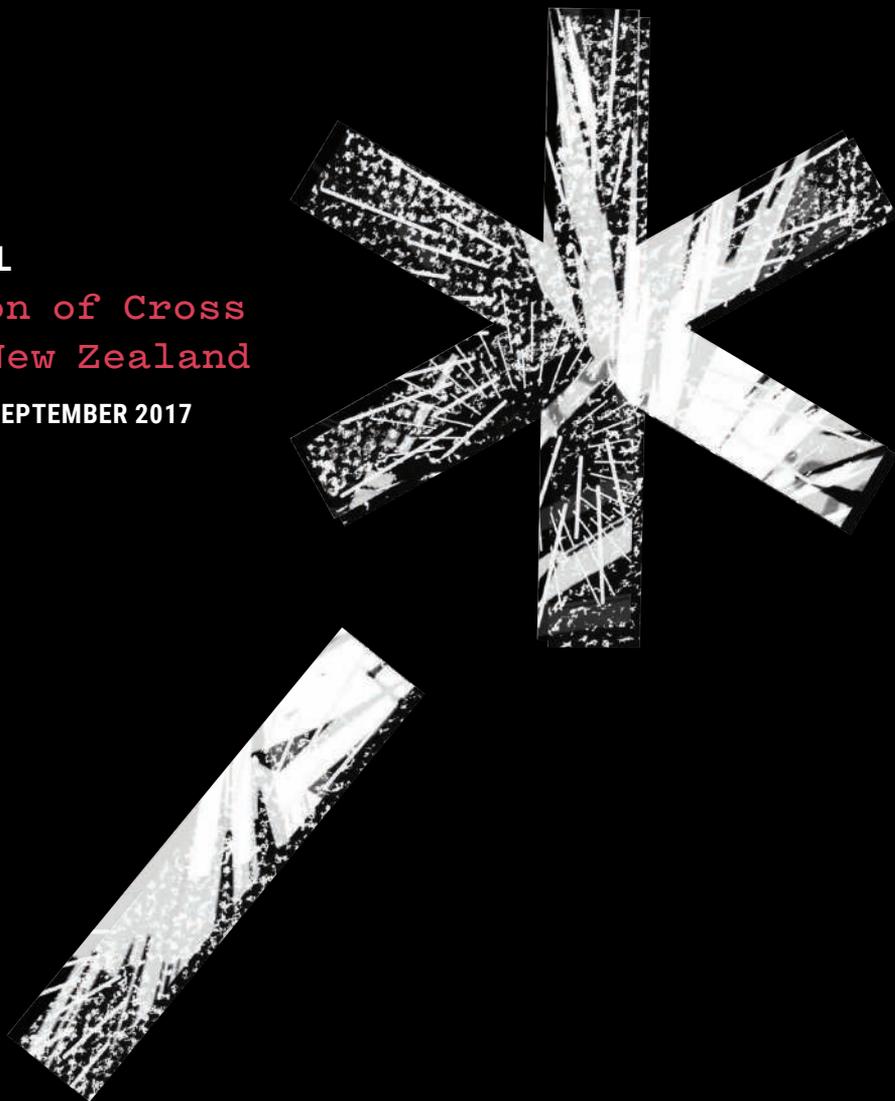


VIRTUAL GETS REAL

**The Explosion of Cross
Reality in New Zealand**

NZVRARA REPORT ONE SEPTEMBER 2017



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Thanks to all our project supporters

RESEARCH PARTNER

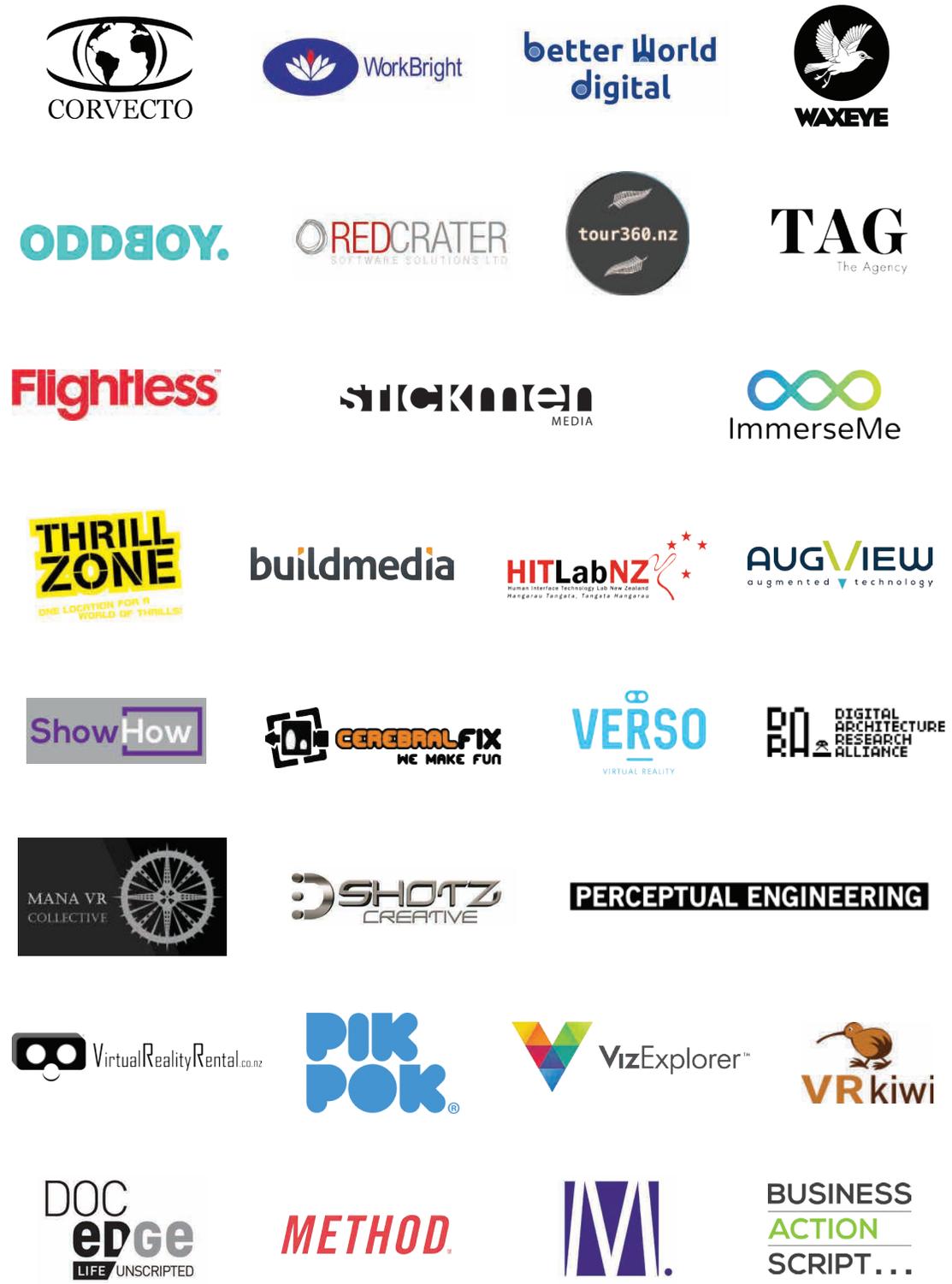


SECTOR PARTNERS



REPORT PARTICIPANTS





About NZVRARA

The New Zealand VR/AR Association was incorporated in September 2016 with the purpose of promoting the virtual, augmented and mixed reality sector and associated sectors, to facilitate research and development, encourage collaboration, education, innovation and economic development within the sector throughout New Zealand.

The NZVRARA is led by Chair, Michael Gregg, and a hands-on 16-strong Executive Committee based in Auckland, Wellington and Christchurch. The Association employs an Executive Director, Courtney Lomas, who also heads the NZVRARA Student Chapter.

Monthly meetups, workshops and other member events are held in all three main centres. The Association provides an up-to-date searchable public directory at www.nzvrara.nz of local members for interested users and sector clients to access.

The Student Chapter aims to have active clubs embedded in many of New Zealand's tertiary institutions during 2017. This will provide a vocational channel and closer integration between students and the research facilities, and commercial enterprises.

The NZVRARA is the official New Zealand Chapter of the VRARA (see page 35) and one of 40 Chapters around the world. Our members are part of the 3700 companies, brands and developers registered in their global Directory, providing the New Zealand cross-reality community with international connectivity to offshore skills, expertise, investment and business opportunities.

The Association will continue to survey its members and the wider VR/AR community to assist in forecasting industry size and potential, and to better understand the sector's education

and growth requirements.

This Report One and the coming Report Two are part of a wider plan to showcase our community, educate New Zealand, promote the work underway in our Sector and to advocate for greater cross-sector engagement.

The goals of the NZVRARA are fourfold:

- 1. Community:** To create opportunities for organisations and individuals to meet, showcase and collaborate on VR and AR innovations. The NZVRARA expects to have over 200 members by the end of 2017.
- 2. Education:** To build capability to ensure a strong talent pool exists in New Zealand and to assist members to grow their business, reduce risks and increase profits.
- 3. Promotion:** To promote the use of our creative, high tech, high potential cross-reality community to media, business users, government, and to a global audience.
- 4. Advocacy:** To advocate for the sectors needs to stakeholders, investors, industry, and government.

The NZVRARA has plans to establish an international Advisory Board this year that will facilitate deeper global linkages to new markets, technology and faster knowledge transfer.



CREDIT: OSCAR KEYS
NZVRARA MEMBERS CHAT WITH BRETT TELFER, AR/VR GARAGE.



JON HAMM IS TRANSFORMED INTO A 3D HOLOGRAM FOR SUNDANCE. IMAGE CREDIT: 81

... Introduction



MICHAEL GREGG
Chair, NZVRARA

PHOTO CREDIT: OSCAR KEYS

.....
: Foreword by
: NZVRARA Chair
:

The New Zealand VR/AR Association Incorporated was formed in September 2016 to champion, support and grow innovation within the virtual and augmented reality sector in New Zealand. Members span local and international technology companies, academic institutions and their students, the pulsating start-up community, support organisations and interested users. The Association is the official Chapter of the global VRARA.

MICHAEL GREGG
Chair, NZVRARA



.....
It really is an exciting time to be alive. With this new Fourth Transformation in technology, comes a myriad of opportunities for New Zealanders to embrace, exploit, innovate and export. As a nimble and connected nation, we are already well-advanced in creating growth and value from the creation and adoption of the ever-improving tools and technologies that virtual reality, augmented reality and now mixed reality provides us.

The New Zealand VR/AR Association Incorporated was formed to support and accelerate this advancement by creating a vibrant network of companies and individuals to share learnings, showcase innovations, collaborate for scale and to celebrate this new industry.

Founded in September 2016, our national Association was created to achieve four objectives: build a strong and vocal community; build capability and growth through education; promote the use of our sector and its innovations to contribute to a stronger economy; and advocate for the sector's needs.

This series of two reports provides a first chance to measure the size of our nascent sector and, at the same time, is an early step to help achieve all four Society objectives.

The study seeks to provide an early benchmark of the size and scale of the cross-reality sector, encompassing those who create and provide

product and service solutions across all types of virtual, mixed and augmented reality and to better understand those who can make use of it.

The second report, already planned for release later November this year, will provide deeper economic analysis, and look into other sub-sectors such as training, content creation, as well as to better understand pathways to offshore markets.

To any individuals or organisations involved in the VR/MR/AR industry who were not surveyed or have recently commenced operations, I urge you to contact the NZVRARA through its Executive Director via email to office@nzvrara.nz so you can be part of our second report.

As Chair of the NZVRARA, I can report that, following our successful first AGM in June 2017, a refreshed 16-strong Executive Committee has embraced an exciting action plan for the current year incorporating a wide range of events - workshops, meetups and demonstrations, as well as the establishment of our Student Chapter, building out an industry knowledge base, and providing greater global connectivity through an international Advisory Board and through our global Association and its worldwide member base at the VRARA.

Foreword by Callaghan Innovation

Callaghan Innovation is the government's business innovation agency. We're here to liberate innovators. We connect businesses to the networks, capability and funding they need to make ideas happen. We help our customers and New Zealand to step up to the challenge of change. We have more than 200 leading scientists dedicated to solving tough problems, help hundreds of companies improve their ability to innovate and boost R&D through more than \$140m a year in grants.

CHRIS HARTSHORN
Chief Technology Officer



CHRIS HARTSHORN

Anyone who still looks at augmented and virtual reality as an entertainment thing with a marketing spinoff had better look again. This technology has grown up and is about to start work somewhere near you.

The global AR and VR market is forecast by market analyst IDC to at least double each year over the next four years – exploding to nearly USD \$215 billion in 2021.

But while consumer spending has made the early running – manufacturing, retail, healthcare, education, construction, transport, government and professional services are coming up fast behind.

That's because this technology is nothing less than a new digital way of sensing – of seeing, hearing and eventually touching, tasting and smelling. It's the next transformation after

computers, the internet and mobile phones.

You will put on an ever-less-conspicuous device to enter a virtual world or augment your own and connect it with the tools of artificial intelligence, the internet of things and data analytics.

The technology will allow you to design, construct and test virtual prototypes quickly and cost-effectively in simulated environments or view, manipulate and analyse complex data sets in more intuitive ways.

You will be able to see the world your field worker sees and overlay it with instructions and maps, or have an expert dial in to guide them. You could allow your customers to connect virtually with your product and tailor it to their needs or whims.

The government supports R&D for AR and VR. Callaghan Innovation is leading teams of collaborators and creating the mathematics and engineering for out-of-the-box solutions. Read about two of our projects in this section.

AR and VR are not just for businesses who like to live on the bleeding edge of discovery. What we're great at in New Zealand is seizing on an invention and adapting it to solve a new problem.

If you have an idea, we're here to help and if we can't, we'll probably know who can. Talk to us.

Foreword by ATEED

Auckland Tourism, Events and Economic Development (ATEED) is the region's economic growth agency, working to advance Auckland's prosperity. We collaborate with private and public sector partners to develop Auckland's culture of innovation and entrepreneurship – recognising that innovation is a crucial driver of sustained income and business growth – attract business and investment, and grow and retain skilled talent.

DEAN BUTCHERS
GM Business Attraction & Investment



DEAN BUTCHERS

The AR/VR Garage is a globally unique collaboration involving industry, local government, tertiaries, and internationally connected AR and VR organisations, all focused on ensuring Auckland is at the forefront of the global AR/VR wave.

Attracting project R&D to New Zealand means our emerging talent can stay here, yet work on globally significant challenges alongside the world's top AR/VR experts. This is fundamental to Auckland and New Zealand growing sustainable, globally significant companies.

The key to New Zealand's future success lies in our ability to adopt new technologies, and to be at the origin of new digital capability by converging, integrating or replacing existing technologies.

Our regions need to work together to deliver multi-disciplinary technology solutions. Strategic partnering with global entities allows immediate distribution, marketing and commercialisation issues to be addressed.

Auckland represents more than half of New Zealand's industry and a global gateway that can showcase New Zealand's skills, capability and emerging talent. ATEED and the AR/VR Garage are collaborating with as many people from around the country as possible, helping companies to stay on the leading edge of the technology curve, and enabling them to strive to lead the world in digital capability over the next decade.

By the middle of 2016, ATEED identified the huge global growth of commercial interest in augmented reality (AR) and virtual reality (VR) technologies as a golden opportunity for Auckland and New Zealand. We embarked on a work programme to support, accelerate and sustain the growth of Auckland creative sector companies looking to take on the world.

We were proud to open the doors of the AR/VR Garage just months later, launching New Zealand's first international facility for AR/VR co-location, incubation, and international project R&D work.

The Auckland Council-funded AR/VR Garage immediately enabled start-up and medium-sized firms to access new tools, equipment, technology training and resources. The facility provides Kiwi companies with a global competitive advantage and allows them to attract and contribute to international R&D projects.

Foreword by WREDA

The Wellington Regional Economic Development Agency (WREDA) includes teams responsible for business incubation, acceleration and development, destination promotion, talent attraction, major events and civic venue management. Our vision is to help Wellington become the most prosperous, vibrant and liveable region in Australasia by 2025. Wellington has the people, the culture and the opportunity to thrive in an increasingly connected world.

DAVID JONES
Business Growth & Innovation General Manager



DAVID JONES

an inherently pioneering culture, this is ideal. Like our meat and dairy producers a century ago, the markets of the world are now accessible to a new generation of innovative New Zealanders. And in tech as in farming; Kiwis are doing it better. In Wellington, we have the digital equivalent of rolling green pastures – a young, highly skilled workforce, world-class liveability, and a creative culture that’s second-to-none. Hooked together as a collaborative community, Wellingtonians compete on the world stage, and they’re winning.

Wellington. We’re a community of just half a million people, living at the tip of an island in the South Pacific, thousands of miles from the world’s megacities.

And right now, we’re in an ideal position.

One hundred and thirty-five years ago, technology disrupted the world’s biggest industry, creating a priceless opportunity that New Zealand was quick to seize upon. Refrigerated shipping destroyed the tyranny of distance, connecting our clean and fertile farms to the markets of Europe. And we’ve never looked back.

We’re now in the midst of another technological revolution, representing an economic opportunity for New Zealand of similar potential. Global digital connectivity has created a marketplace where distance has simply ceased to exist. For a remote nation, home to a small but smart population with

At the leading edge of digital tech, in the AR/VR/MR space, the news gets even better for Wellington. As XR crosses the tipping point from early adopter tech to mass market, game-changing applications and experiences are crucial. That’s where Wellington’s creative visionaries are set to really thrive.

We’re already home to the likes of Weta Digital, Magic Leap, 8i, Mixt, PointZero with more arriving on the scene constantly.

At WREDA, we believe that making Wellington famous for tech is key to attracting the talent and capital to fuel our success. We love working with our XR pioneers to do this, because they understand disruption, they understand audacity, and, like us, they have the imagination to play with reality as they find it.

Foreword by ChristchurchNZ

ChristchurchNZ works to optimise the economic and social opportunities that tourism, major events, city promotion and economic development can bring to Christchurch and Canterbury. We champion the city and regional economies by providing leadership and integration to develop a strong city profile and attract visitors, migrants, students, new business and investment through integrated marketing, major events and conferences. ChristchurchNZ works to ensure the business environment supports successful and sustainable enterprise and encourages creativity and innovation.

HELEN SHORTHOUSE
Strategic Tech Leader



HELEN SHORTHOUSE

Christchurch has a vibrant tech sector which often flies under the radar, despite being New Zealand’s second biggest city and home to the second biggest tech sector in New Zealand (Digital Nation Report). The city’s tech community includes software, services, electronics, high-value manufacturing, health-tech and agri-tech businesses, ranging in size from global multi-national companies to small start-ups. Christchurch tech companies are recognised as great at producing world leading creative solutions for niche markets.

Christchurch has been coined a ‘Goldilock’s city’ – perfectly proportioned to be small enough to connect with others for work and play, but a large enough scale for an accessible international airport, an active and supportive eco-system and three tertiarys, as well as an abundance of

co-working spaces and meetup groups ... not to mention the wealth of lifestyle activities on the doorstep!

AR/VR in Christchurch includes well established entities like the world-leading educational institute of HITLab which has also seen the successful spin-out of companies such as Quiver’s colouring books and Motim Technologies now a global leader in creating brand experiences for companies such as Walt Disney and Ford Motors, using VR, AR and a host of other digital technologies.

There’s a growing band of players in the space, some emerging from existing companies such as Stickmen Studio’s MTech Games and the global giant Trimble Navigation. Others are emerging from new players in the space. As is typical with Christchurch-based companies, offshore markets are approached pretty much from day one.

What’s also exciting is the collaboration we’re seeing between AR/VR businesses and more established organisations operating in different markets – such as health and power industry training. Early on many people saw the technology pathway to consumer market through entertainment and gaming, but we’re also seeing companies such as Corvecto and Virtual Medical Coaching successfully taking this technology into new B2B markets.

Foreword by Jasmax

Jasmax is one of New Zealand's largest and longest established architecture and design firms. Known as an industry leader for driving progress and innovation in both sustainable building design and new ways of working (Workplace Strategy), we've now set our sights on emerging technologies. Two and a half years down the track on this journey, we're pushing the boundaries of Virtual and Augmented Reality to see how we can use these visual communication tools to re-define the design process for both our in-house design teams and the clients we work with.

TIM STEPHENS
Digital Innovation Lead



TIM STEPHENS

Minds eyes' and 'imagination' work differently in us all and yet 'pictures speak a thousand words'. So, why wouldn't architects and designers use Virtual Reality and Augmented Reality to bridge that gap?

I first hired out an Oculus Rift headset two and a half years ago. At this point, Virtual Reality was something I was tinkering with. Playing, exploring, just classic kiwi inquisitiveness. It seemed like a pipe-dream that Virtual Reality would become my reality, but today, I'm at the helm of some pretty exciting projects in a newly established role, as Jasmax's Digital Innovation Lead.

I'm an architect by trade, and have had the opportunity to work on major infrastructure projects in Australia and New Zealand; most recently Auckland's City Rail Link. But it was in

mid-2015 that my interest was sparked for Virtual Reality, and the potential that new, emerging technologies could have for the communication of design. It's the perfect medium for our clients selling off the plan or needing to get a varied stakeholder group on board.

VR and AR enables architects and designers to experience and interrogate a design short of actually building the project. No other mediums communicate volume, scale and proportion like they do. They leave little room for misinterpretation.

Now that Jasmax is regularly providing VR services to our clients, we're developing up our portfolio in Augmented Reality – the offering of x-ray vision is an enticing one!

Our AR/VR space is set-up in-house at our Auckland premises – be sure to ask for a spin next time you're in the neighbourhood.

Foreword by NZTech

NZTech is the voice of the organisations that are redefining the world we live in. A national not-for-profit that represents over 400 organisations across the NZ technology landscape who collectively employ more than 100,000 people including startups, local tech firms, multinationals, education providers, major corporations, network providers and high-tech manufacturers. NZTech's goal is to stimulate an environment where technology provides important productivity and economic benefits for New Zealand.

GRAEME MULLER
CEO



GRAEME MULLER

New Zealand's ambitious virtual and augmented reality firms are entering the global, multi-billion-dollar, VR/AR market and proving they have what it takes to compete on the world stage. Yet the most significant impact is expected to come from the embedding of these immersive technologies into other sectors. Using these emerging technologies to improve productivity, save lives, to educate and entertain, New Zealand firms will be the beneficiaries of a successful, globally competitive, local virtual and augmented reality sector.

To avoid the growing pains of rapid growth, the sector can learn lessons from other high growth sectors, such as the value of actively supporting the development of local talent, or the power of collaboration to enter international markets. The New Zealand VR/AR Association (NZVRARA) is providing the early cohesion that will help define the success of yet another exciting part of the New Zealand tech story.

This report, Virtual Gets Real, produced by NZVRARA, provides valuable information to help us better understand the cross reality sector and the opportunities this sector presents for New Zealand.

Technology is critical for the future prosperity of New Zealand. Currently, the tech sector employs 6% of the country's workforce, over 100,000 people. It is the fastest growing segment of the economy generating more than 8% of our GDP and 9% of our exports.

However, it is the actual use of technology that will truly drive prosperity for New Zealand. Better use of the Internet could drive \$32 billion in economic growth, better use of IoT in dairy farming alone is worth \$448 million and smarter use of data could be worth \$4.5 billion. Across every sector technology is creating new opportunities to engage, transact, learn, and share. It is with this back drop that a small but rapidly growing virtual and augmented reality (VR/AR) sector is expected to deliver positive economic impact for New Zealand.



SEBASTIAN DEAN
One Fat Sheep

PHOTO CREDIT: OSCAR KEYS

Definitions

VIRTUAL REALITY (VR)

VR is an artificial, computer generated simulation or recreation of a real life environment or situation. Viewers wear headsets that hold a screen in front of their eyes, powered by a mobile phone, gaming console or computer. It blocks out the world around them, immersing the viewer into a computer-generated stereoscopic 3D environment that they can interact with or explore. It can stimulate many of the viewer's senses, including sight, hearing, touch and even smell. When viewers look or walk around, their virtual environment moves like in real life. The image or environment can be live-streamed virtual reality, or created using 360° cameras for filming, or computer-generated VR content.

AUGMENTED REALITY (AR)

AR uses computer technology to overlay computer generated enhancements and 3D visual information on top of a person's view of the real world. Viewers can still see the real environment around them at the same time, so it is an open experience, unlike VR's closed experience immersed in a simulated environment. AR technology can be delivered via mobile devices, such as smartphones, head-mounted displays that still allow the viewer to see the real world, retinal displays or haptic sensors. A prime example is the augmented reality game Pokémon Go, released in July 2016 by Niantic, which swiftly became a global phenomenon. Players can locate, capture, battle and train virtual creatures, called Pokémon, which appear on their mobile devices' screens as if

they were in the players' real world locations. The game uses the mobile devices' GPS capabilities.

MIXED REALITY (MR)

Mixed Reality allows digital and physical worlds to combine, creating a new environment that is anchored to real time and allowing virtual and real world content to interact with each other.

Currently viewers don goggles that superimpose 3D computer-generated images on top of the real world by shining light into their eyes, fooling the brain into thinking virtual objects co-exist within reality.

Microsoft's HoloLens is widely considered a mixed reality headset. The technology giant describes it as the first fully self-contained holographic computer that enables viewers to interact with high definition holograms in the real world.

CROSS REALITY (XR)

XR is increasing being used to refer to the virtual to reality continuum and incorporates all technologies including augmented and mixed reality. As demonstrated in the survey findings within this report, many of the sector companies are actively working across all three digital reality technologies given the fundamental shifts occurring in the way people view, share, create and use data, and are not bound by delineations of experience between AR, MR and VR. Another term, OpenXR, is also being adopted by some companies.

About this Report

Commentary on the populist arrival of virtual reality and its companions, mixed reality and augmented reality, has covered a spectrum from “it’s just another monitor and mouse” through to proclamations of the Fourth Transformation (the first three being computers, Internet and mobile). It is likely to fall somewhere between.

This first report in a series of two, has been prepared to acknowledge the rapid rise of the cross-reality sector which comprises virtual reality (VR), augmented reality (AR) and mixed reality (MR) in New Zealand and to explore the opportunities for New Zealand to exploit these novel technologies. Report One: Virtual gets Real delves into the current eco-system, and explores the three main centres, Auckland, Wellington and Christchurch to uncover start-ups, support structures and exploration underway across the sector. In the start of a series of deeper cross-sector analyses, it investigates the role of virtual reality within the architecture industry and probes the research and development aspect of the cross-reality activity that has been underway in New Zealand for at least the last decade. This report also includes the results of a quantitative survey undertaken by known sector members with a 61% participation rate. The results provide insights into their current state and possible future requirements.

The vertical sector investigations for onshore success will continue within Report Two: Going Next Level covering the topics of tourism, education, content creation including games and entertainment, enterprise AR/VR and the potential for global testbeds to be located in New Zealand. Importantly, the second report will also include an economic analysis of the local cross-reality sector to independently assess market size and potential contribution to the New Zealand economy.

Rounding out Report Two will be a consideration of international channels and strategies to achieve offshore success.

The two reports have been commissioned by the New Zealand VR/AR Association (NZVRARA) together with the Ministry of Business, Innovation and Employment (MBIE). Support for this first report has also been provided from three economic development agencies: ATEED, WREDA and ChristchurchNZ, together with Callaghan Innovation and architectural practice, Jasmax. The proposal for this investigation was first presented to MBIE by consulting company, Blackeye VR Ltd, following the release in March 2017 of their self-published BlackpaperOne™ report that tabled global forecasts and a commentary on the sector’s potential. These reports are designed to extend that knowledge base and provide support for decision-making within the sector participants and by supporting organisations and Government. They also highlight opportunities for vertical sector adoption of these new technologies.

It was jointly agreed to offer the opportunity for industry leadership, and publication of the two reports into the sector, to the New Zealand VR/AR Association, as the leading industry group, with the Association co-funding the study through strong support from industry and sector partners.

The Report has stimulated the delivery of a first survey of 112 cross-reality companies and support organisations to investigate the extent of the deployment of digital reality technologies in New Zealand and their use in other industries. As the sector grows, the NZVRARA will continue to survey both its membership and the broader XR community to better understand the size of the local industry, the changing deployment of digital reality technologies and any risks or issues that may constrain its continued growth.

Executive Summary

Virtual reality has finally arrived. Along with augmented reality that superimposes a computer-generated content onto the real world (think of the TV news weatherman blended into the New Zealand weather map), this disruptive technology has now reached the critical mass of technical maturity, content pervasiveness and early adoption needed to drive the signposted boom in growth that will embed AR and VR within the everyday activity of consumers and businesses.

Despite actual worldwide headset sales and global industry revenues not reaching the previous year analyst forecasts, headset price discounting and access to a wider range of content, particularly through mobile-AR, is driving the innovation adoption cycle through to the ‘early majority’ phase.

The growth of the industry depends on content and, in the case of business, use cases and prototypes that can demonstrate value creation – whether it’s manufacturing productivity gains, product sales, or health and safety benefits.

Consumer content is being driven by games and marketing. Immersive content such as branded experiences, 360° tours, training aids for health and workplace safety are being produced and deployed across a burgeoning range of platforms.

In New Zealand, the NZVRARA industry body surveyed its members and the wider industry during July 2017, resulting in projections of over 2000 fulltime equivalent employees to be working in the cross reality sector (comprising virtual, augmented and mixed reality) with annual revenues conservatively exceeding \$324,000,000 within two years. Numerous VR/AR-specific agencies and development shops are forming to provide content creation services. A range of support entities and venues for startups have been established. Research & development into immersive technologies has been underway for much longer with some New Zealand businesses, research companies and university sectors.

There is increased excitement of a coming global phenomenon that will drive the local creative sector to expand significantly to provide services and products to the market being formed for VR, AR and MR solutions.

Auckland has a diverse and established community of digital agencies that are building VR and AR expertise, accompanied by a plethora of new startups to produce commissioned content. The ATEED-supported AR/VR Garage was launched in September 2016 to create a collaborative R&D facility to house research



and commercial project teams, startups, and industry events including facilitating international linkages. Auckland University of Technology (AUT) is playing a leading role in the city, including investing in AR/VR startup, Imersia. Their creative technologies programmes led to the creation of The Green Fairy VR Series, now being commercialised at Conical Interactive Studios.

In Wellington, content creation is being driven from the global success of the screen sector. Weta Workshop is partnered with mixed reality display inventor, Magic Leap, who have been heavily funded by Google & Alibaba. Wingnut Productions offshoot, Wingnut AR collaborated with Apple to showcase an immersive application of Apple's new ARKit technology at their recent WWDC 2017 convention. Holographic capture company, 8i has established a studio in Los Angeles and launched Holo, an app that allows 'holograms' to be placed within consumer-created content. The city recently celebrated the launch of a new privately-owned co-working and events venue, PROJECTR, to cater to the specialist demands of the growing sector.

In Christchurch, augmented reality arrived with the HIT Lab in 2002, which has since created and spun out intellectual property, and built a global reputation in its field of human interface technology. One related company, Motim Technologies, has gone on to be a global provider of brand experiences utilising AR/VR and related solutions. The EPIC Innovation campus is home to many hi-tech companies including Corvecto and

Stickmen Media who are providing cutting edge VR and AR solutions locally and offshore.

New Zealand is a country packed with imaginative people. And within this innovation environment, interdisciplinary teams are forming with skills and expertise across digital technologies, software engineering, video production and storytelling to create world class content creation and innovations. With the advent of new immersive technologies, these cross-sector teams are now collaborating on projects and startups utilising VR, AR including mobile-AR, and mixed reality.

Playing to our strengths suggests that government support to leverage our international reputation for creative storytelling will deliver significant early success. Our games community may also have an early advantage with the onshore location of games and entertainment skillsets and development activity for Magic Leap.

There are other verticals that New Zealand can take a global leadership role in as cross-reality solutions take hold. Our global expertise in 3D visualisation software created by NZ-founded Right Hemisphere (sold to SAP in 2011) could be leveraged with expertise from local company, Nextspace, who is proposing a significant digital transformation project to rationalise, visualise and collaborate on local government data through a deeper understanding of the value of open accessibility to data through novel connectivity and adding context to datasets. This could manifest itself in a global testbed where, for example, building consents may be viewed in



BUZZ ALDRIN AS A 3D HOLOGRAM IMMERSIVE EXPERIENCE WITH TIME INC. AND HOLOGRAPHIC CAPTURE STARTUP 8I. IMAGE CREDIT: 8I



PHOTO CREDIT: RUSH DIGITAL

virtual reality and utilise artificial intelligence to rapidly consider applications and report on potential issues, delivering significant productivity gains, and global export potential from this innovation.

Productivity improvement through reduction of rework is an important reason the architecture sector is fast adopting virtual reality solutions. At Jasmox, New Zealand's leading architectural practice, they have reduced render times down to a matter of minutes, enabling clients and staff to view real-time work in progress beyond the limited fixed-point perspectives available through traditional 3D models. The potential of immersive design available through virtual reality also has the potential to open up entirely new ways of working in this discipline.

Studio Pacific Architecture in Wellington is using VR as a decision support system to increase the efficacy of in-building signage. Viewing their work on the Nelson Airport extension within VR allowed them to efficiently deploy a virtual signage system to maximise visibility and minimise the quantity of signage required within this development.

It is clear that within the architecture vertical, and likely to be across all other sectors to be investigated in Report Two: Going Next Level, there are early adopters and there are laggards. It is possible that not having VR/AR skillsets within a particular practice may, limit involvement or even eliminate them from securing commercial work in future and it is acknowledged that it's going to take a few years for those working in architectural practices to pick up the new

technology emerging now. Thus, it is vital that graduates of New Zealand's tertiary programmes in architecture have a base level of competency in these digital technologies. Anecdotally from the sector, this may not yet be the case given the recency of commercial applications and possible lag in adapting course material and pedagogy. It appears that this is quickly changing, with technology now available on campus for architectural students.

It may be that professional training has benefits far exceeding those from simply increasing a practical understanding of the technology and from viewing existing renders. A common viewpoint is that immersive experiences are more engaging, add educational value by narrowing the gap between learned theory and practice, and visualisations can reduce the need for as many onsite visits, providing a decrease in health and safety risks.

Generally, the tertiary education community is taking a leading role in adoption of digital reality technologies. Massey University Wellington has a new VR Room within the School of Design. AUT's Motion Capture Lab and Sentience Lab and other facilities are world class. At Victoria University in Wellington, there are over 50 staff and students working on research projects within virtual and augmented reality. At HIT Lab in Christchurch over 40 people from around the world visit and study in their facilities annually.

The NZVRARA is working with tertiary educators across New Zealand to open VR clubs on campus, based on the successful 'VRTX' university club operating on Massey University's Wellington campus. Members of these clubs are provided with membership to the NZVRARA Student Chapter formed in 2017. This provides channels to extracurricular learning at industry workshops and events that would otherwise not be accessible to under- and post-graduates students, as well as internships and access to graduate employment opportunities within the cross reality sector.



360° CAMERA FOOTAGE ABOARD 2017 AMERICAS CUP WINNER EMIRATES TEAM NEW ZEALAND PHOTO CREDIT: ANIMATION RESEARCH

...The Global VR/AR Market

The Global VR/AR Market

The commercial virtual and augmented reality sector is firmly in start-up mode, it's promise of being a transformative technology has spawned a significant range of operating businesses. The global VRARA association's industry directory already lists over 3800 organisations operating across the digital reality sector. Over 40% are content and app creators. The remainder include hardware providers, research and community organisations, tool providers and discovery & distribution companies. Here in New Zealand, the local chapter of the association has conducted an inaugural survey of 112 organisations to collate data for this report.

US advisory firm, Digi-Capital produces quarterly reports on the global Augmented and Virtual Reality market. Their prediction is for worldwide AR/VR revenues to be worth over US\$108 billion by 2021. It should be noted that this is a downward revision of their 2016 estimate which was US\$120 billion by 2020.

A HISTORY OF VIRTUAL AND AUGMENTED REALITY

185 years ago, English physicist Sir Charles Wheatstone invented the stereoscope in 1832. This device views two 2D images of a scene or object shown from slightly different angles, about 6cm apart, mimicking binocular vision thereby tricking the viewer's eyes into seeing the image as three-dimensional.

Jumping forward almost a century and in 1929, American inventor Edward Link created the Link Trainer, the first commercial flight simulator for pilot training, which was used to help to train World War Two pilots.

There is a rich history of storytelling within a virtual reality world. American science fiction writer, Stanley G. Weinbaum's 1935 short story, Pygmalion's Spectacles, mentions people wearing 'magic glasses' that immerse them into a dream world where they can interact through all five senses.

The View-Master was invented in 1938 by German immigrant William Gruber. This stereoscopic visual simulator has cardboard disks that are slotting into the machine hold seven pairs of images, which create seven stereoscopic images. When peering into the View-Master, the viewer sees a pair of slides, one for each eye, which simulates binocular 3D vision.



HOLMES STEREOSCOPE.
PHOTO CREDIT: OSCAR KEYS

Stereoscopy creates an illusion of three-dimensional depth from two-dimensional images.

2000+

people employed directly in the local VR/AR sector within two years - NZVRARA Industry Survey July 2017.

The power of filmmaking underpins much of the evolution of VR. In 1957, American inventor and filmmaker Morton Heilig invented the Sensorama Machine. This groundbreaking simulator created the illusion of reality for one to four people using 3D film with smell, stereo sound, vibrations of the seat, and even wind in the hair.

Heilig patented the Telesphere Mask in 1960; the world's first head-mounted display to offer stereoscopic 3D video with wide vision and stereo sound. He was later crowned the 'Father of Virtual Reality'.

Technology advanced quickly during the 1960's with two engineers from American electronics company Philco Corporation creating Headsight, the first head-mounted display that has motion tracking capability in 1961.

In 1966, American inventor Thomas Furness started working with the first helmet-mounted displays for Air Force fighter pilots' training. His work led to the development of the Visually Coupled Airborne Systems Simulator in 1971 for fighter pilots' training, and in 1986, he developed the Super Cockpit programme, an immersive virtual world for pilots' training. He continued to pioneer virtual and augmented reality developments and has been nicknamed the Grandfather of Virtual Reality. Dr. Furness oversaw the post-graduate studies of New Zealander, Mark Billingham at the Human Interface Technology Laboratory (HitLab) at the University of Washington in Seattle.

CROSS REALITY AS A CONTRIBUTOR TO THE NZ ECONOMY

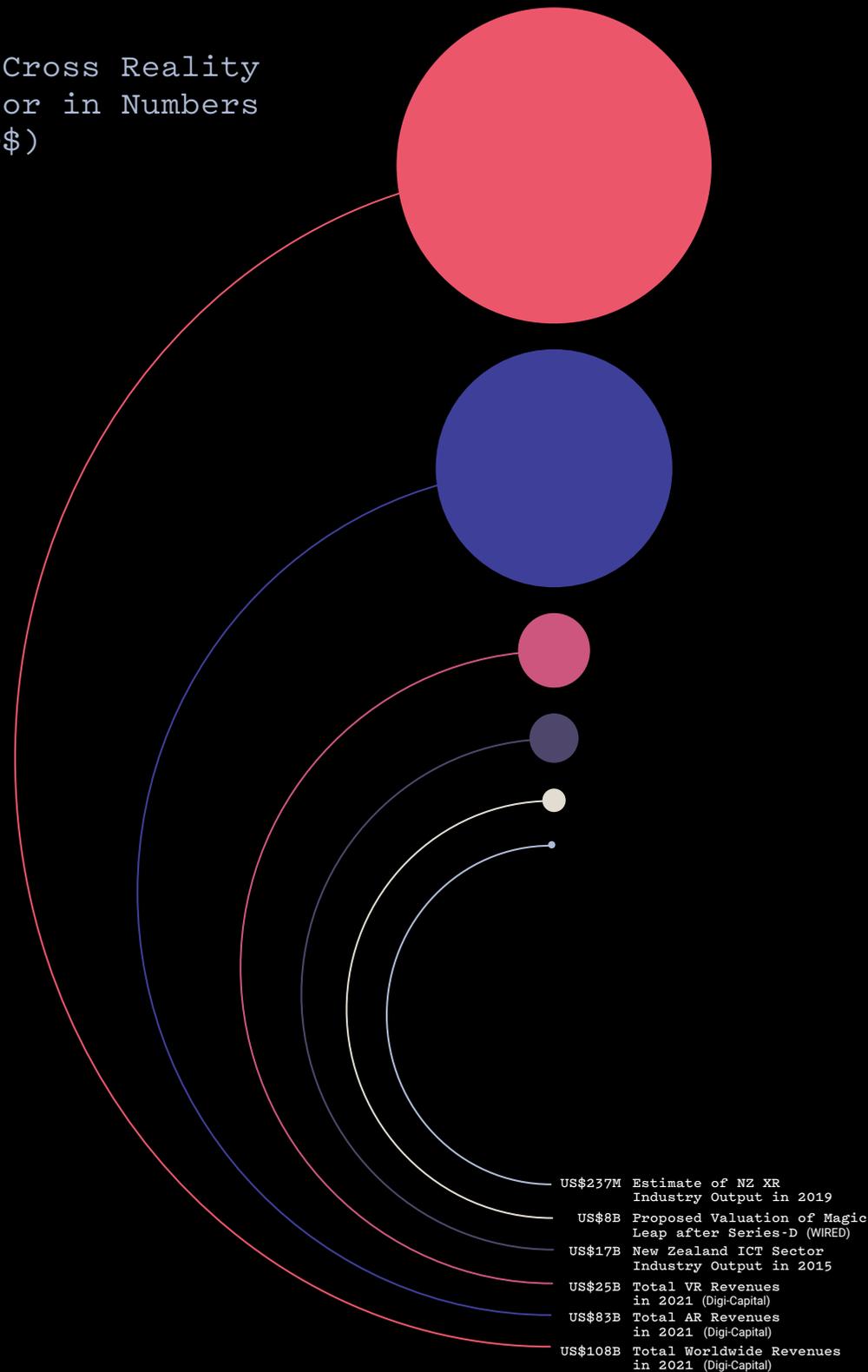
The transformative technologies of virtual, augmented and mixed reality provide novel solutions already being created across New Zealand's technology companies. Many local technology companies, such as ICT solutions provider Datacom, have teams actively working on client projects using immersive technologies.

The NZVRARA July 2017 Industry Survey results show that over 2,000 people will be working directly in the local cross-reality industry within two years. It is expected that the sector will quickly begin to play a significant part in the New Zealand

economy, not only through its GDP contribution by producing high value outputs and exporting its services, but also through tremendous productivity improvements as an enabling technology, reducing time to market for manufacturing, speeding up research and development,

Referencing the results of the 2016 'From Tech Sector to Digital Nation' Report, it is anticipated that the cross reality sector will act similarly to the wider tech sector and contribute \$3 of growth for every dollar spent and creating 5 new services jobs for every direct job created.

The Cross Reality Sector in Numbers (USD\$)



.....
 NZ\$324M
 estimated cross reality
 sector industry output
 in 2019

In 1968, American computer scientist Ivan Sutherland and his student, Bob Sproull, create the Sword of Damocles, the first VR/AR head-mounted display connected to a computer rather than a camera. The technology was also used for flight simulation for pilot training.

The term 'virtual reality' was first coined in 1987 by Jaron Lanier, also regarded as a founding father. Jaron founded VPL in 1985 as the first firm to sell personal VR equipment.

A decade later in 1995, Nintendo released Virtual Boy, the first portable 3D virtual reality gaming console with 3D graphics, but it was withdrawn from the market within a year because its graphics were too hard on viewers' eyes and caused dizziness, nausea and headaches.

In 2002, Dr. Mark Billinghurst moved from the University of Washington in Seattle to Christchurch, New Zealand to establish the Human Interface Technology Laboratory (Hit Lab NZ) at the University of Canterbury, together with Canterbury Development Corporation, and with intellectual property gifted from its sister lab in Seattle.

In 2010, an American inventor Palmer Luckey built his first head-mounted display prototype at age 17 in frustration with the inadequate HMDs available for gaming. He founded Oculus in 2012 and secured US\$2.4 million from a Kickstarter crowdfunding campaign two months later to develop the Oculus Rift headset. Facebook purchased Oculus in 2014 for US\$2 billion. Widely credited as the first immersive virtual reality headset for video games, Oculus Rift was launched in March 2016.

Founded in 2010, Florida-based ultra-secretive Magic Leap is one of the largest technology start-ups in mixed reality. The company attracted US\$1.4 billion from investors including Google and Alibaba and was valued at over US\$4.5 billion in 2016, but is yet to bring their headset to the market. In New Zealand, Magic Leap has partnered with Weta Workshop to produce content, and Weta co-founder and founding Magic Leap Board member, Richard Taylor was announced as Magic Leap's Arts Ambassador to China in 2016.

The first consumer versions of the popular HTC Vive virtual reality headset was released in April 2016 by Taiwanese consumer electronics company, HTC and video games developer, Valve Corporation. Prior to that date, developer kits were dispatched in August 2015, after the unveiling of the first prototype at the 2015 Game Developers Conference and officially at the Mobile World Congress in March 2015.

In January 2016, the global VRARA was launched by Nathan Pettyjohn, Founder and CEO of Aisle411 Inc. as a global trade association for the virtual reality and augmented reality marketplace. Nathan described the sector as “the wild-wild-west” – fragmented across the globe with hundreds of developers building dozens of unique solutions and he saw the association as a way to accelerate growth, knowledge and connections.

In September 2016, the New Zealand VR/AR Association was incorporated. New York-based Sam Witters who had secured the New Zealand rights, connected Jessica Manins and Michael Gregg to the VRARA and facilitated the establishment of the NZVRARA as the New Zealand Chapter of the VRARA.

A GLOBAL VIEW OF THE INDUSTRY

The virtual reality sector is still in its infancy globally and possibly even more so in New Zealand. Consumer adoption of headsets is lighter than predicted with less than 250,000 high-end Oculus Rift headsets sold last year out of a total 6.3 million headset sales. The games community is an important market, but an emerging view is that enterprise and industrial adoption of both virtual and augmented reality will surpass consumer revenues within the next five years.

It’s clear that many predictions are simply guesswork. For example, despite many pronouncements that 2016 was the year of VR, total worldwide revenue was an insignificant US\$1.8 billion, mainly due to lighter than expected consumer adoption of headsets. The current commentary on last year’s bullish forecasts shilling the industry called them “plainly unrealistic”. As an example, the January 2016 forecast by games market research firm, SuperData, had predicted US\$5.1bn of revenue, subsequently downgraded mid-year to US\$3.6bn, only to end up at 50% of that figure six months later.

In 2017, price slashing of VR headsets is driving much greater consumer uptake. An Oculus Rift bundled with two motion controllers has halved in price to US\$400 on sale and is now the cheapest high-end headset on the market. Now the predictions are starting again – Will 2017 be the Year that VR finally goes mainstream? One thing is sure and that it’s only a question of when, not if. This report will help ensure New Zealand cross-sector companies and supporting organisations are ready to capitalise when it does.

There is much to look forward to. The offshore venture capital firms are already investing heavily with one VC company, Presence Capital, investing in thirty-three VR and AR companies within the



PHOTO CREDIT: KRIS KOLO

We’re here to help member companies grow efficiently, facilitate knowledge sharing and connect globally.

KRIS KOLO
Global Executive Director, VRARA

3800

organisations listed in ‘The Directory’ of the global VRARA.

last two years. Interestingly twenty-seven of those investments are enterprise-focused. These applications present a clearer return on investment for business as they have the power to transform workplaces. For VR, this means the form factor of headsets is less of an issue than for consumers. In the AR space, overlays for navigation, tourism, commerce and engineering apps, shopped-related apps are all showing potential to explode in innovation, investment and adoption.

The general consensus is that whilst “VR will be big, AR will be bigger and take longer” according to the 2017 Digi-Capital AR/VR Report. Their 2016 revenue prediction for the entire VR/AR market was US\$4.4 billion and they now estimate actual total VR/AR revenue to be 11% under that target at US\$3.7 billion. Again, acknowledging the rapidly changing state of this emergent sector, they attribute the expansion of AR in 2016 to reshaping the future of the market, and driving significant new global revenues, particularly through mobile AR’s replacement cycles for hardware.

VR industry analyst, Robert Scoble strongly supports this view and believe Apple will lead the AR revolution, given their strong user base, the pending release of AR-ready iPhone 8 with its built-in enhanced AR features and the rapid adoption of ARKit. Many of the features of ARKit are already available in Google’s Tango product but it does require handsets to have the Qualcomm Snapdragon 835 processor.

THE GLOBAL ASSOCIATION

The NZVRARA is affiliated to the VR/AR Association (VRARA) as their official New Zealand Chapter. Launched in 2015, the VRARA is an international organisation with over 45 staff, dedicated to encouraging collaboration between innovative companies and people in the VR & AR ecosystem to accelerate growth, foster research and education, help develop industry standards, connect member organisations and promote the services of member companies.

With 40 Chapters around the world, and over 3800 companies, brands and developers registered, the VRARA provides the New Zealand cross-reality community with global

connectivity to offshore skills, international expertise and world-leading businesses.

Industry Committees within the VRARA are setting best practices, industry guidelines and standards to accelerate adoption of VR/AR and to bring better experiences to market. Visit www.thevrara.com to get more information.

The VRARA Directory offers New Zealand members access to a global community, divided between apps & content creators (42% of the registered organisations), access to the latest hardware (23%), community & research organisations (22%), tool providers (10%) and discovery and distribution companies (3%).

The mixed reality market is still in a nascent stage with the most phenomenal aspect of the technology being the level of investment into research and development. Companies such as Magic Leap, Microsoft and Apple are fiercely competing on the release of next- or first-generation processors, sensors and headset displays.

Forecasts for the mixed reality market remain highly variable with reporting ranging from total market size in 2024 of US\$3.4 - US\$6.9 billion. The actual result will be heavily dependent upon quality of customer experience and subsequent consumer and industrial adoption.

WORLDWIDE MARKET SIZE

It's clear that forecasting market size has been very difficult and will remain so as the sector experiences the growing pains of market entry. But now the market for VR and AR products and services has actually launched, actual data, alongside more defined strategies from the major technology providers, is allowing for more accurate forecast estimates to be calculated.

One of the more recent, and more bullish, is the August 2017 forecast from International Data Corporation (IDC) estimating worldwide revenues from augmented reality and virtual reality to increase by 100% or more over each of the next four years. This is according to their Worldwide Semiannual Augmented and Virtual Reality Spending Guide. Total spending on AR/VR products and services is expected to grow from US\$11.4 billion to almost \$215 billion by 2021, achieving a compound annual growth rate (CAGR) of over 113%, according to the report.

What is perhaps surprising about their findings is the breadth of use cases. IDC predicts that the consumer market will be the largest source of AR/VR revenues in 2017 and remain so in the Asia/Pacific region over the next five years. However, in the US and Western Europe, the consumer market is expected to be surpassed by process manufacturing, government, discrete manufacturing, retail, construction, transportation and professional services.

They propose significant opportunities to re-cast how users interact in business processes and everyday tasks with the biggest industry use cases being retail showcasing, on-site assembly and safety, and process manufacturing training.

IDC believes that at the outer end of their 2021 forecasting, the largest industry use cases will be industrial maintenance, public infrastructure maintenance and retail showcasing. They say that, "in contrast, the consumer segment will be dominated by AR and VR games throughout the forecast." Other use cases to grow quickly during their forecast period are lab and field plus therapy and physical rehabilitation.

100%

year on year increase in global AR/VR revenues is predicted for each of the next four years - IDC August 2017 Forecast

NEW ZEALAND'S GLOBAL CONTRIBUTION

The ground-breaking research of AR pioneer and Kiwi, Mark Billinghurst, in the University of Washington in 2001 led to the establishment of the HIT Lab NZ at the University of Canterbury in 2002. This is now widely regarded among the top global human interface laboratories with postgraduate students flocking to the lab from around the world to undertake real, mixed and virtual reality research.

Since their launch in 2014, New Zealand company 8i has become a giant in the holographic capture world. After raising NZ\$57 million in two funding rounds, they've recently launched their Holo app allowing users to record video content complete with the addition of photo-realistic 3D holograms. Their Los Angeles studio can quickly shoot holographic video clips for both high-end VR and phone-based AR and 8i has built powerful relationships with best-of-brand content partners to exploit their competitive advantage.

Global technology juggernauts, Google and Alibaba, amongst others, saw enough in Florida-based Magic Leap's mixed reality vision and head-mounted virtual retinal display technology to invest over NZ\$1.3 billion into the company. New Zealand-based Weta co-founder, Sir Richard Taylor was a foundation director of Magic Leap and serves as the company's Arts Ambassador to China. Weta Workshop houses around 40 staff working on creative experiences for the Magic Leap platform.

Sir Peter Jackson and Fran Walsh have also announced plans to undertake augmented reality production, through their Wingnut Films Productions, which has in turn established Wingnut AR. At the June 2017 Apple Worldwide Developers Conference

(WWDC), Wingnut AR demonstrated a tabletop AR experience produced using advanced access to Apple's ARKit built over Unreal Engine 4.

Other New Zealand companies such as PikPok (VR enabled games), Imersia (AR/VR storytelling engine), Motim Technologies, Convecto, Staples Productions and M Theory (AR/VR content creators) are among the early sector exporters forging ahead into international partnerships and offshore assignments.

It is a widely held view amongst sector participants that the cross-reality sector needs to focus on going global quickly, but with enough scale to be able to compete and deliver, in order to achieve success, given the small size and value of current market opportunities in New Zealand.



PRIME MINISTER BILL ENGLISH PHOTO CREDIT: CORVECTO

AN EYE ON THE FUTURE

There are increasingly loud claims to support analysts' forecasts. Facebook CEO, Mark Zuckerberg is calling augmented and virtual reality the next major computing platform. His 10-year roadmap predicts that these technologies are capable of replacing smartphones and personal computers. Facebook is currently working on smart glasses and its VR subsidiary, Oculus, filed a patent application for a 'waveguide display with two-dimensional scanner' in August 2017.

But the immediate reality may be keeping consumer and enterprise adoption of currently available technology alive. Bloomberg reported in August 2017 that Android phone maker, HTC, where their Vive arm is a leader in the hi-tech headset market, is considering spinning off the Vive VR business and is in talks with parties including Google. The Vive's recent price drop (emulating Oculus' earlier discounting on the Rift) was designed to stimulate product sales and user base, so the sale rumours may be more due to HTC's 75% drop in market value over the past five years.

Despite the focus on the premium end of the headset market, IDC's June announcement of global headset shipments for the first quarter of 2017 shows Oculus with only 4.4% market share and HTC with 8.4% share. The leading headsets are from Samsung with 21.5% with those figures expected to grow with the launch of their latest range of smartphones. Sony is second with 18.8% of headset sales for their Playstation VR product that ties into their Sony ecosystem of games console and content.

Apple's recently launched ARKit augmented reality platform has been billed as a same shot in the arm for the adoption of AR, and compared to Pokemon Go that delivered in 2016 when half a billion people around the world downloaded that app. Whilst the product's adoption has some way to go to reach this level of engagement, the product has delivered to developers a tool that will rapidly grow the AR user base. Somewhat like Google's Tango product, Apple's 'world-tracking' with ARKit allows for scanning of real world points, perspectives and scales to allow virtual objects to be placed in live environments. Imagine placing virtual furniture in your actual home before buying online, for instance. Mainstream adoption will come from compatibility across all Apple iOS devices and is potentially a gateway to an iPhone-based headset that has been predicted for Apple to release.



PHOTO CREDIT: GHANUM TAYLOR

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More interaction between our industry players and greater offshore connectivity is critical.

GHANUM TAYLOR
Global VP, Rush Digital

CONSTRAINTS ON XR TECH ADOPTION

There are a number of constraints to the adoption of emerging cross-sector technologies that may impact the growth of the installed base of sector hardware.

Computational power: AR/VR needs a lot of computing power to create the high-quality graphics, reduce the lag between a user's movement and the display's response, and to increase the visual frame rate to 90 frames per second (FPS), a rate that won't induce motion sickness. The development of dedicated processing units that can increase computing power and speed, while reducing power consumption, will allow AR/VR hardware to do more.

Battery life: This is particularly important in the workplace. Many guidance and collaboration applications will remain impractical until the batteries in the MR or VR headsets can last an entire work shift—at least eight hours. Most devices on the market currently last less than half that time. As battery life increases, so will the practical appeal of these applications.

Eye tracking: Many devices today already use gestures and voice commands, but advances in new eye tracking techniques will soon reduce power consumption and increase the interface's responsiveness. Techniques include foveated rendering (this takes advantage of the fact that the resolution of the eye is highest in the fovea – the central vision area), which decreases system demands by tracking a user's eye and rendering only what he looks at versus the entire field of view.

Field of view: The human field of view can extend to approximately 180°, the middle 114° of which is considered to be binocular in which humans use both eyes and can perceive depth and distance. Although many

devices have fields of view just higher than 100°, increasing the field toward 180° will expand the observable environment and enable more immersive experiences.

New entrants and sensors: There's been a lot of market conjecture about some of the currently absent names such as Apple and Samsung fully entering the mobile AR market within the next year. Their entry would stimulate a larger developer base to create new content as it has with the release of Apple's ARKit, driving demand for new sensors that could better track a user's location, or gauge proximity to other objects, and to perceive depth.

Pricing: Most quality AR/VR hardware is still expensive, with costs ranging from several hundred to several thousand dollars per user setup. It's clear that the recent sales for Oculus Rift equipment has lifted consumer and business demand. These decreasing price points may stimulate greater enterprise adoption also. It is anticipated that enterprise engagement in proof of concept activity and BAU deployment will increase.

Comfort: Some devices weigh up to half a kilo and can be bulky and uncomfortable. The current form factors are unlikely to be suitable for workplace use over an extended day. But as slimmer and lighter quality headsets come onto the market, greater satisfaction and meaningful adoption will occur.

It is unlikely that the New Zealand industry can have any meaningful impact of these technology adoption levers, but it does provide some context as to why consumers and businesses are slower to uptake than some have previously anticipated.



...The NZ Opportunity

VIRTUAL HAKA FILMED WITH 360° CAMERA IMAGE CREDIT: AUGUSTO

The New Zealand Opportunity

New Zealand has had innovators working in augmented and virtual reality for over two decades. In the early 2000's, there was significant effort put into establishing a CAVE virtual reality environment by Scott Houston from Silicon Graphics (SGI) in partnership with MediaLab South Pacific. The launch of the HIT Lab NZ in Christchurch in 2002 gave exposure to the MagicBook work of Mark Billingham and the University of Washington's ARToolkit.

A decade later, the US release of Oculus Rift developer kits in March 2013 (DK1) and July 2014 (DK2) and the subsequent trickle of these kits into New Zealand along with the release of HTC Vive developer kits in August/September 2015 allowed local technologists, engineers and enthusiasts to begin to build out content and experiment with new head mounted displays (HMD). Samsung released their HMD in November 2015

In mid-2016, the concept of establishing a New Zealand Virtual and Mixed Reality Centre called ProjectR was pitched by Michael Gregg (ex-founding CEO, MediaLab SP) to a small group including Ian McIntosh from Victoria University and Mario Wynands from PikPok, who had released Into the Dead for Samsung Gear VR (initially Galaxy Note 4 compatible only) seven months earlier. In August 2016, Jessica Manins was contracted to prepare a strategic plan for ProjectR and take it through to launch.

It was evident to industry insiders that, outside of collaboration within the AR/VR Garage, there was a wide range of VR and AR activity underway across New Zealand, but little in the way of collaboration at any significant scale. Prospective members of the New Zealand VR/AR Association met in mid-September and incorporated on 26 September 2015 and appointed Michael Gregg as its first Chair and Jessica Manins as Executive Director. The global VRARA had been established in New York only nine months earlier on January 5, 2016.

Also in September 2016, the launch of the AR/VR Garage in Uptown Auckland was noted by then Mayor Len Brown as "having gone from concept to reality in just three months". Its international linkages with The VR Society (as Oceania HQ) alongside existing international relationships through Auckland's Tripartite Economic Alliance with Los Angeles and Guangzhou were then, and remain a powerful tool for the sector to utilise.



PHOTO CREDIT: IAN TAYLOR

.....
Since 1990 we've been focused on developing augmented reality and creating world class innovation from Dunedin.

IAN TAYLOR
 Animation Research Limited

.....
 88%

of the sector live in Auckland, Wellington and Christchurch - NZVRARA Industry Study July '17

NZVRARA INDUSTRY SURVEY

In July 2017, the NZVRARA undertook its first Industry Survey to collect initial data on the local industry as the first step in moving to independently collected and aggregated industry analysis, such as already being enacted by the New Zealand Games Developers Association. As the local VR/AR Association less than a year old, it is still building out a comprehensive local membership to enable a more comprehensive survey to be undertaken.

69 responses were received from 112 companies identified as working within the cross reality sector, providing a healthy 61% response rate. 88% of the respondents were based in Auckland, Wellington and Christchurch.

40% are working primarily in virtual reality, 17% mostly work in 360° video, with 14% electing either mixed or augmented reality. The remaining 15% provide support services, consulting or a more specialised offering.

The survey showed that commercial work is being undertaken across a wide range of vertical sectors including entertainment, marketing, education, storytelling, training, tourism, and architecture.

THE ROLE OF AR/VR IN OTHER SECTORS

The July 2017 NZVRARA Industry Survey asked respondents to select any sectors they had previously provided services to. The results show the widespread application of VR, AR and MR solutions already being developed and deployed within New Zealand

A wide range of 'Other' sectors were submitted by 1-2 respondents including environment & conservation, airline, movie studios, IT, online crime, forensics, police, military, banking, corporate learning, museums and exhibitions, construction, community engagement, interior design, visitor experience/art/fine arts, fitness, transport and retail.

Education, entertainment and marketing remain the top three when respondents are asked to name the main sector they provide

services to and are also the top three sectors that respondents expect to provide services for in the next two years.

Entertainment	62%
Marketing	59%
Education	53%
Storytelling	45%
Training	45%
Games Development	42%
Tourism	42%
Architecture	40%
Research	22%
Healthcare	20%
Manufacturing	19%
Engineering	16%
Real Estate	4%



BRIAN LUCID
Massey University

PHOTO CREDIT: OSCAR KEYS

PRODUCTIVITY AND TECHNOLOGY TRANSFER

The opportunity for New Zealand is not only derived from the exploitation of cross sector technologies within vertical sectors such as those listed above, but in the increase in productivity from the deployment of these new transformational technologies and tools.

Animation Research Ltd received a Project Grant from Callaghan Innovation to develop the on-board virtual reality camera used by Emirates Team New Zealand and Oracle Team USA. Grant Dalton was quoted as saying “what we do and what we develop has a flow on effect to the New Zealand marine industry as well as to so many other New Zealand businesses where there is a crossover in the technology we develop.”

A VORTEX OF UX

In July 2015, Brian Lucid arrived in Wellington, from the Massachusetts College of Art and Design, to begin a role as Professor of Interaction Design at Massey University. Now the Head, School of Design in the College of Creative Arts at Massey’s Wellington campus, Brian has launched a new course in User Interaction in Virtual and Mixed Reality, applying skeuomorphic context and design principles. Skeuomorphism is where an object in software mimics its real world counterpart, such as the ‘trash can’ on your computer desktop.

But for some of the five students taking Brian’s elective next term, this course may represent a fundamental change in their lives. They have already formed VRTX (pronounced vortex), the first virtual reality University Club in New Zealand, and established a Student Chapter within the New Zealand VR/AR Association, of which Brian is an Executive Committee member.

Brian quotes Amber Case who at TEDWomen 2010 famously declared, “we are all cyborgs now” (referencing our reliance on external brains, such as mobile phones and computers, to communicate,

remember and even live out our secondary lives) to reflect that mixed reality technology is still immature, and as a new medium, now is the right time to focus our attention onto getting the user interactions right.

For Massey University, securing professors such as Brian brings with it a breadth of international linkages, immensely valuable when the local innovation with new digital reality technologies is reliant on offshore parties. Brian’s work with Proximity Labs put him in close contact with blue chip clients such as Adobe, Phillips and MIT Media Lab. Referencing the breadth of skilled staff at Massey, Brian agrees, “it’s always been about the people here. Massey has design programmes among the best in the world, and our alumni are everywhere.”

The opportunity for New Zealand to exploit the new technologies such as VR and MR continues to lie with its people, their connections, their smart thinking and their vision. Brian firmly believes that a mandate of the University is to prepare students for professional practise, to be teaching 4-5 years out so students can stay fearlessly ahead and remembering that many of them won’t be retiring until “2068”.

The benefits for New Zealand through productivity gains lie across almost all the vertical sectors including training, health & safety, education and hi-tech manufacturing. The sector needs to take a leadership role in deployment of graduates who are knowledgeable in the use and deployment of virtual and augmented reality solutions. This has been identified as an issue in the architectural sector. Also New Zealand must build a skilled workforce, capable of deploying AR and VR solutions within their own workplace. Given the embryonic position of the sector, organic growth in knowledge and skillsets should be expected, but if New Zealand wants to make 'unreasonably' large gains, stimulating this through advanced workplace training in VR, expert training and equipment availability in schools, extra-curricular consumer courses, and for Government to further stimulate demand for VR and AR training.



PHOTO CREDIT: TAYLOR CARRASCO

RISKS AND ROLES

The sector is already addressing internal challenges to its success, generally with a maturity that has emerged as attendance at technology events, meetups and industry shows has turned into phone calls, meaningful conversations and discussions about shared trials and tribulations, resulting in a comradery that is increasingly evident.

Like any new industry, its start-up businesses face the unsavoury challenge of competing with each other for small budgets, with the need to create portfolio-level outputs. At the same time, the sector faces the issue of lack of scale plus the depth and breadth of capability required to win larger international assignments.

The NZVRARA is facilitating new conversations between parties that might not otherwise be talking. Their focus accelerating connectivity in Auckland during the latter part of 2017 should prove to bring parties in this important region closer. The AR/VR Garage has been playing this role for the past year as well as a critically important job in hosting international Tripartite-centric trips and at the same time, hosting foreign groups at the Garage.

Recommendation: *Greater opportunities for offshore commercial collaboration are required. Support to identify these, facilitate team interactions and joint proposals as well as neutral project management could be centred around the regional physical facilities such as AR/VR Garage in Auckland, Projectr in Wellington and Epic Innovation in Christchurch. These could be supported by the local regional economic development agencies, NZ Trade & Enterprise, Callaghan Innovation as well as the participating companies as is normal.*

In addition, the Association will continue to hold monthly events,

.....
“XR is emerging as a new trillion dollar industry which will change the way advertisers engage customers, consumers shop and play, retailers showcase, and stories are told.”

TAYLOR CARRASCO
 Creative Development, MIXT

.....
 NZ \$99.9M

Revenue earned in the year to 31 March 2017 by the NZ Game Development industry.

regular workshops and use its online communications channels to build deeper and wider sector engagement.

It was a common theme of the interviews conducted for the report that graduates aren't equipped with any VR skills – unsurprising perhaps, given the newness of the technology. But for some industries such as architecture, it's a critical requirement for some studios. Tim Stephens from Jasmax (See Part Six – Architecture) has a clear expectation that more undergraduate training in virtual reality and associated technologies is important. The Association has already achieved the establishment of 'Uniclubs' at Massey University Wellington and Victoria University Wellington to enable simple training courses, workshops and attendance for students at Association events.

Recommendation: *The Association continue to initiate on-campus clubs at all other Universities and major polytechnics. These club's links back to the NZVRARA Student Chapter, where student membership is currently subsidised to zero, due to corporate sponsorship for the initial 50 members but most have been taken up by Massey and Victoria Universities). Some support would be useful in deploying this nationwide, given that the scale required is beyond the resources of the Association.*

James Everett, past-head of the Game Developers Association (GDA) is cognisant of the challenge in front of the game developers he represents, to break into the VR space, commenting on the low install base, that fact that very few publishers are funding VR games, the need to build specifically for VR (“a lot of hard yards,” warns James). The opportunities for game developers to work on other VR projects is obvious, with the shared requirements to understand the underlying technologies such as Unreal Engine and Unity.

Recommendation: *Greater linkages between the NZGDA and the NZVRARA are required to deliver positive shared outcomes such as greater income flows, skill transfer and cross-sector employment.*

The sector has little data available. One recommendation from James at the GDA was for the VR/AR Association to commission a neutral third party to collect financial data, head count and 'hire count' information in order to build base line data beyond what's appropriate for the Association to ask for in its own regular survey work.

Recommendation: *NZVRARA appoints a reliable, trusted 'independent of sector' consultant to survey the industry to collect, aggregate and disseminate appropriately segmented data back to industry participants.*



STAPLES PRODUCTIONS RECORDS IN THE AV/VR GARAGE GREEN SCREEN, IMAGE CREDIT: STAPLES

Spotlight on Auckland

Spotlight on Auckland

As New Zealand's largest city and commercial hub, Auckland is home to many of the head offices and industries that the cross reality sector needs to access for early stage production work that will aid in building out required local skillsets, equipment needs and bring in offshore talent to provide world class cross sector solutions within New Zealand.

The city was an early mover, building a dedicated facility, the AR/VR Garage (see page 53) in Uptown Auckland, that houses a green screen studio, co-working spaces, rental equipment and is home to many of the early adopters and experimenters of VR and AR technologies.

PRODUCTION AT SCALE

The city houses a wide range of creative technology and digital production companies, who are fast-expanding their virtual and augmented reality expertise due to customer demand. These include creative technology company, Rush Digital (see page 55), and digital agency, Method Studios, who have recently launched a new division, M Theory (see page 51). AR development shop, One Fat Sheep is located within BizDojo in GridAKL and has an offshoot business in Melbourne, Plattar, who have produced a cloud-based augmented reality platform to create, manage and distribute AR content, with funding from News Corp Australia.

Brand marketing experiences using VR are disruptive and engaging, hence their early adoption by advertising agencies and their clients. Auckland is home to the bulk of the New Zealand advertising industry so expect an avalanche of VR experiences to be produced in Auckland. There is already a fast-growing rental and support service network providing cameras, operators, sound engineers and post-production facilities.

One early entrant into this market is Staples VR, based in the AR/VR Garage (see page 53). Staples comprises a comprehensive production studio and VR equipment rental & sales division. The company has established hubs in Australia and the United Kingdom and offers a complete VR production service including 360° image capture, live streaming, Lidar scanning, specialist post production, VFX within VR, and augmented reality applications. The highly successful 'Escape My House' interactive experience launched in March 2017 by the New Zealand Fire Service and



PHOTO CREDIT: ROY DAVIES

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“At Imersia, we’re building a cross-platform, geospatial-aware AR solution for enterprises that don’t have games developers. It’s time for a simplified platform in the cloud, and on the device side, to ease the process of launching and maintaining AR apps.”

DR. ROY C. DAVIES
 CTO / Cofounder / Director
 Imersia Reality

their agency FCB, was produced by Staples, alongside production partner, Kaleidoscope. Using typically kiwi ingenuity, this demonstration to tackle behaviour change pushed the boundaries of what was considered possible with 360° camera technology.

As new specialist immersive experience agencies open their doors, the well-established operators who were interviewed for this report are passionate about ensuring the industry stays focused on quality delivery and appropriate pricing to ensure a world-class standard of experience is provided. They believe this is an important element in building the scale and trust necessary to cooperatively work on large offshore contracts – a widely shared aspiration across the sector’s commercial providers.

Also based at the Garage is one of the mixed reality industry’s local pioneers is Dr Roy Davies who helped establish Nextspace to build a commercial interactive realtime 3D graphic industry, before heading to Auckland University of Technology to undertake interactive 3D graphics research and teaching. Now, as co-founder

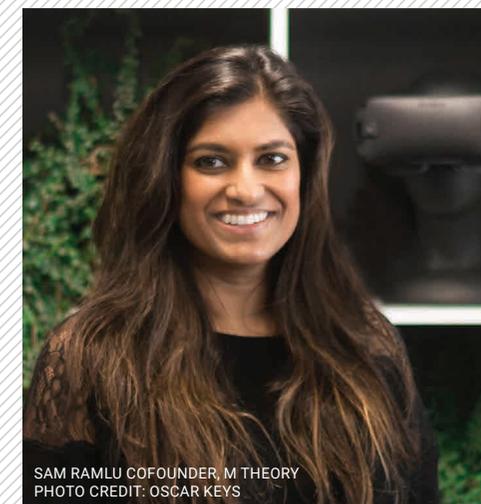
A RALLY CRY FOR COOPERATION

M Theory is a spinout of successful Auckland-based digital agency, Method, and was established to create AR and VR content. Moving into creating virtual reality content was a natural progression demanded by clients and advertising agencies who rely on Method for their web and digital advertising production.

With almost two decades of digital experience behind her, M Theory and Method cofounder and managing director, Sam Ramlu offers some sage advice to new production studios. “In the early digital advertising days, New Zealand companies were well ahead of the game. When we went offshore to ad:tech and similar events, it was clear we were punching above our weight as an industry. But going back only a couple of years on, we had been surpassed,” says Sam.

Whether this was due to smaller local budgets or divisiveness between sector participants not working collaboratively,

Sam is adamant that the local VR/AR community needs to make sure it doesn’t happen this time around. Sam believes we first need to come together to showcase our work internally more, then quickly build compatibility and capability to allow New Zealand companies to cooperate in winning offshore work.



SAM RAMLU COFOUNDER, M THEORY
 PHOTO CREDIT: OSCAR KEYS



BRETT TELFER
Head of AR/VR Garage

PHOTO CREDIT: OSCAR KEYS

and CTO at Imersia, Dr Davies is commercialising a 'REALITY Virtual Parallel Universe' platform, where users can explore, interact and share experiences within an intuitive 3D space.

New Zealand-owned IT service provider, Datacom, is one of Asia-Pacific's leading information technology companies. Datacom has between 30-40 people working from their Auckland base on digital innovation including animation design, UX/CX, mobile technologies and VR/AR solutions. Early access to Microsoft HoloLens developer kits allowed Datacom collaborative teams to be established at the AR/VR Garage working on prototypes for

DRIVING GLOBAL GROWTH OUT OF THE GARAGE

Established by Auckland City Council-controlled Auckland Tourism, Events and Economic Development (ATEED), the AR/VR Garage was launched in September 2016 as New Zealand's first dedicated facility to service the wider cross reality community. The facility is supported by Datacom, Microsoft and HP.

The AR/VR Garage comprises a collaborative R&D facility, an event hub, a technology showcase venue, a co-working place for startups to innovate, and houses the NZVRARA in Auckland, as part of a recently signed Strategic Partnership between them and the NZVRARA to work together to accelerate the growth of the cross reality sector.

Industry tours are held every week to allow the public, industry and visitors to New Zealand to experience VR and see the latest research and development activity taking place, and the resident teams hold weekly networking events with local businesses, investors and advisors.

Games development incubator, Arcade Auckland, is housed adjacent to the AR/VR Garage providing a natural interaction between Auckland's independent games community and XR innovators. For entrepreneur, Joe Chang, this crossover

happened with the creation of the company he co-founded to gamify gym-based training. Joe managed the Arcade and joined the AR/VR Garage in March 2017 to commercialise their exciting augmented reality and multiplayer solution. Being inside the Garage has provided Joe and his co-founder Chentur Thambiah with serious international introductions, access to advice from Callaghan Innovation and enabled them to head offshore to showcase their prototype at Viva Technology in Paris.

This is only one of the many projects underway in the AR/VR Garage. Staples VR collaborated with Auckland DHB to deliver a VR experience to reduce child patient anxiety levels and Datacom has worked within the Garage deploying collaborative teams on augmented reality projects using Microsoft's HoloLens technology.

The Garage is becoming a global testbed for proof-of-concept and prototyping innovations, aided by its Tripartite Economic Alliance with Los Angeles and Guangzhou and through its international partnerships, such as with the VR Society whose star-studded members include Walk Disney, Pixar, Dreamworks Animation among many others.

some existing Datacom enterprise customers. Three prototypes were created in a few months and presented to the customers, their board members and end-users and received “amazing feedback”, according to Datacom Digital Innovation Agent, Chris Blair. Chris attributed the positive response to the fundamentally different immersive 3D experience of a prototype solution, calling it “transformational accelerated change” and noting the speed of innovation when “problems get solved through experiences.”

Feedback from Auckland service providers suggests that whilst there is awareness of the digital reality technologies across the head offices of the major New Zealand companies domiciled in the city, more education needs to be provided to demonstrate the value of enterprise AR/VR solutions. Despite this, feedback from interviews conducted during the report suggests that early VR/AR solutions are being commissioned across various units at major corporates including Air New Zealand, Foodstuffs, ASB Bank, Vodafone, Fonterra and Lion New Zealand.

The enterprise and industrial market for cross reality solutions is exponentially growing and is forecast to exceed consumer revenues in some markets (IDC August 2017). This sector includes applications for training and simulation, education, virtual prototyping/3D modelling and medical therapy. Consumer behaviour specialists, Lumaten partnered with Rush Digital to develop SHOPPER360 offering a custom-built virtual retail environment to test scenarios for packaging, point of sale, pricing strategies, product mix, marketing campaigns, store layout, category layout and other shopper-related challenges. Viewed through a VR headset, this virtual supermarket allows users to interact as they would in a real supermarket, whilst measuring interactions and analysing for insights.

TELL US A STORY

The region is also home to many other storytellers, demonstrated by their success in the recently announced Interactive Development Fund from the New Zealand Film Commission. Auckland-based recipients include a collaboration by two interactive studios, Method and Oddboy, who are creating an immersive VR adventure called Wanderer; Dot Dot Ltd, creators of interactive documentaries and educational games, is making The Worst Journey in the World; Fisheye Films from Matakana is creating The Last Ocean Virtual Expedition – an immersive Antarctic adventure; and Conical Interactive Studios is producing more content for The Green Fairy – a VR story that follows a green fairy who secretly live inside of traffic lights.

There is one truly New Zealand experience that demonstrates this



PHOTO CREDIT: CHRIS BLAIR

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Mixed reality offers a transformational experience for the customers of our corporate clients.

CHRIS BLAIR
 Digital Innovation Agent, Datacom

country’s early adoption of immersive technology. For the 2015 Rugby World Cup, creative/production agency and sports content specialists, Augusto produced a 360° virtual reality experience that gained global attention throughout that tournament, the AIG Haka 360°. With over 3 million YouTube views, app downloads in over 104 countries, the virtual Haka (traditional war dance or challenge from the Māori people of New Zealand) received 9 marketing award nominations worldwide.

Over 50% of the respondents to the July 2017 industry survey conducted by the NZVRARA are content creators. Repondents identified a potential skills shortage in the sector within the next two years – not unique to the cross reality sector and previously acknowledged within the 2016 Digital Nations report produced by NZTech. Auckland has a wide range of tertiary education options covering creative technologies disciplines, outlined within the Research & Development chapter, that will be required to assist in addressing this coming skills shortage.

PARTNERING TO INNOVATE

Rush Digital define themselves as a specialist, cutting edge digital engineering studio fusing technology and creativity with the tagline: ‘redefining your reality’. That’s exactly what they did for New Zealand supermarket, New World, who have been running store-wide egg hunts each Easter since 2011.

This year, the hunt was redefined using augmented reality with Rush Digital and New World’s agency 99, launching the Epic Easter Hunt activation experience using AR activation marketers located in New World’s

138 stores nationwide. The gameplay involved completing a frenetic game after triggering an instore marketer, culminating in a real egg redemption by the store. The game reach #3 in both Apple’s iTunes (NZ) App Store and Google Play (NZ).

Partnering on large scale projects comes naturally for this company. With a presence in the US, they’re already looking to take their AR and VR expertise offshore, particularly where they can partner with other New Zealand companies who need a hi-tech hand.



NEW WORLD’S AUGMENTED REALITY ‘EPIC EGG HUNT’ ACTIVATION EXPERIENCE. PHOTO CREDIT: RUSH DIGITAL



Spotlight on Wellington

DORIEN VERMAAS, SECTOR DEVELOPMENT CREATIVE INDUSTRIES, WREDA AT PROJECTR IN WELLINGTON'S NEC BUILDING. PHOTO CREDIT: OSCAR KEYS

Spotlight on Wellington

The economy of New Zealand's creative capital will receive a significant lift, thanks to the deployment of talent into content creation to satisfy our nation's and international consumers and enterprises who are fast adopting cross reality technologies. Credit for the work coming to Wellington is largely due to the solid base of content creators the city has attracted and retained over the past two decades.

The NZVRARA received survey responses back from 20 Wellington companies who are active within the cross reality community and it maintains contact with a larger group through the Association's membership, including many Wellington tertiary students and individuals involved in the sector.

Wellington is also home to PROJECTR – the co-working, R&D lab, events and workshop space dedicated to the acceleration of the local cross reality industry. Launched in July 2017, this space also houses the Executive Director of the NZVRARA, Courteney Lomas, and acts as an office-away-from-office for sector companies in Auckland and Christchurch.

THE CREATIVE CAPITAL

The magical pulling power of Miramar has brought in partnerships from Magic Leap with Weta Workshop and from Apple with Wingnut AR. Sir Peter Jackson and Sir Richard Taylor's broad range of businesses will continue to attract offshore talent with the necessary skills in software development and content creation to produce quality mixed and augmented reality product, as well as the many support skills needed to run globally competitive production studios.

Having a strong local film production sector will be an advantage as virtual reality and its associated 360° video production builds momentum. The services offered by Screen Wellington will continue to be invaluable in location scouting, permits, directing international crews to local experts – just as for 2D film capture.

There are a wide range of specialist production companies in the city, including Wrestler; a creative content agency that makes video content for brands, as well as their own original content in the 360° video, interactive VR and AR. Wrestler was successful in securing support through the Interactive Development Fund of the



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*Co-working at
 Wellington's PROJECTR
 Virtual and Mixed
 Reality Centre.*

BRINGING REALITY TO THE CBD

Whilst Wellington's compact central business district ensures cross-fertilisation of ideas across innovators through its vibrant café culture, the breadth of innovation in the city is enhanced by the range of physical spaces that allow entrepreneurs and specific industry sectors to meet and co-locate as they grow.

Centred at crossroads of Wellington's entertainment strip, Courtenay Place, and the arterial route of Taranaki Street, PROJECTR formally opened on 27th July as the hub of the local MR community.

Billed as New Zealand's Virtual and Mixed Reality Centre, the centre was first conceived in April 2016 by Michael Gregg, who together with Ian Cassels from The Wellington Company, contracted the services of Jessica Manins who secured growth grant funding from the Wellington City Council and prepared the venue's strategic plan bringing PROJECTR into existence. Jessica completed a rigorous feasibility phase to ensure the success of the centre.

Soft-launched in early 2017 as an immersive tech play space with co-working capacity for 34 VR/AR practitioners, PROJECTR, in partnership with Victoria University, has

added an Open Lab environment for collaborative R&D projects to be undertaken between tertiary researchers and commercial entities. This also allows for testing or piloting solutions. The third string to its bow, is as a central venue to host industry events, workshops and hackathons. The venue has formed a strategic partnership with NZVRARA to host all their Wellington meetups, workshops, Executive Committee and member meetings. This partnership includes conditional member access to technology available at PROJECTR.

PROJECTR houses a wide variety of VR and MR technologies, including Oculus Rift, Microsoft HoloLens, Swibo Tilt boards, screens and associated demonstration spaces.

Current co-working companies at PROJECTR include ShowHow, Mixt, StaplesVR, Swibo, Imersia, Synty Studios, Maggle, Polytronic and the Executive Director of the NZVRARA.

Partners include Ernst & Young, WREDA, Ricoh, Amazon Web Services, Crestline, HTC Vive, Victoria University, Wellington City Council and Sony PlayStation VR.





BEN KNILL
ShowHow

PHOTO CREDIT: OSCAR KEYS

THE TRAINING OPPORTUNITY

Joe works for Probation Services at the Department of Corrections. Right now he has pulled up outside a house. His job is to check whether it's a suitable home for an ex-offender. He calls in to confirm his location, gets out and checks for dogs, knocks on the door and carefully shuts it himself to make sure it's not locked. He scans the house for multiple mobile phones, knife racks out of place or any other tell-tale signs of potential offending.

Joe is actually wearing a headset and running through scenario training for workplace training, with the platform and content developed by Ben Knill from Wellington-based company, ShowHow. Ben operates from PROJECTR as one of their foundation tenants.

ShowHow is creating other scenarios for the Department of Corrections to aid training of prison staff in other workplace applications. Other clients include Housing New Zealand for asbestos inspection training and plant room induction with Porirua City Council.

For the medical profession, they have clinical trials underway at the Waitemata District Health Board for junior doctor simulations via a series of modular courses that provide junior doctors with virtual first-person experience. Courses can be downloaded to a mobile phone or viewed via a web link or within a Learning Management System. Participants can complete the course either on a desktop or via a headset and with their results recorded for participation or performance compliance.

As a typical kiwi startup, ShowHow has supplemented their revenue with VR marketing commissions and is seeking further investment in order to ensure the company remains viable in order to cross

the chasm from the current early adopters to the early majority phase. The role of government as an early customer has been critical in the success to date of ShowHow, and this is reflected in the stories of many other cross sector start ups.

Again, as a typical start up, ShowHow has identified a need to bring in additional management experience in the education and training space to complement their technology team. They believe that this will allow the founders to focus on the technical aspects of the business and continual improvement of their solution. Being collocated in PROJECTR's co-working space is providing ShowHow with links to other sector companies who can assist, either with technical knowhow, or simply as a support network, as well as greater connectivity to WREDA and other local networks.

Corporate and workplace training represents a major early-entry market for the cross-reality sector. And the 'Dalton flow on effect' mentioned on page 45 is clearly evident in the training vertical. Development of training products is a significant way for this flow on effect to deliver not only improved training solutions, but tremendous productivity gains and improvements in health and safety to New Zealand.

As a workplace tool to address potential health & safety hazards, virtual reality and augmented reality solutions present a highly engaging method of educating workers. Gamification and scenario-based training are a perfect fit with early headsets as current form factor limitations are less likely to impact this market than for consumer applications.

New Zealand Film Commission to produce two prototype concepts for Wake and also, Mataatua; a collaboration with Te Whara Wānanga o Awanuiāraangi. The company's founders are active in the sector, sitting on the NZVRARA Executive Committee, the global VRARA's Stories & Audiences Committee, and Wrestler is involved in the VR/AR education via a partnership with Miramar Creative and Victoria University of Wellington.

Production studios are fast becoming established in the city, including Maggle Creative (with their MAGGLE AR app), Mixt who is housed within PROJECTR, Tag the Agency (with a green screen facility onsite), and a number of freelance 360° VR directors are available for assignments.

But Wellington is not just digital agencies and production studios. Rachel Hatch, at VR kiwi, has developed a physical platform – a complete hardware and software solution providing the freedom to walk or run naturally and unrestrained with a headset on. Ready for commercialisation, this product allows immersive walks of the Great Wall of China, or the chance to run a marathon from your own home.

One of Wellington's fastest growing startups in the cross-reality space is holographic capture company, 8i. Founded by Linc Gasking, Eugene d'Eon and Joshua Feast in 2014, they have fast assembled a talented team with credentials spanning the globe, housed within their R&D lab in central Wellington. 8i has developed proprietary technology to transform video from an array of camera into a photo-realistic human hologram that can be viewed from any angle on any device for virtual, augmented or mixed reality (see story on page 63). 8i have recently established a studio in Los Angeles to support their holographic capture vision.

Wellington has a celebrated startup culture that firmly encourages and supports entrepreneurship. With CreativeHQ, BizDojo and now PROJECTR, the city has a wide range of incubation and co-working spaces, with their respective support networks of advisors and informative events. WREDA and the Wellington City Council have played vital roles in supporting this movement. WREDA and WCC established CreativeHQ in 2002 and were pivotal in the launch of PROJECTR fifteen years later.

Wellington is home to two Universities with deep virtual reality expertise. Massey University's Wellington campus was the first to form a VR university club, VRTX (see page 95), and through their School of Design (see page 45) have now established a VR Room. At Victoria University, there are many staff and students undertaking cross reality research – from the Virtual World Lab at the Victoria University School of Design, to the School of Engineering and



PHOTO CREDIT: 8i

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“We're enabling volumetric human content and communication for the immersive computing era.”

TONI MOYES
 COO, 8i

Computer Science, particularly within their Computer Graphic Programme (more on page 85). Victoria's School of Architecture has an active interest in virtual reality (see page 74). In addition, the University's newly opened Miramar Creative Centre is collocated among the Weta Group buildings to bring the world of education and film together.

WELLINGTON. MIXING YOUR WORLD WITH HOLOGRAMS.

Buzz Aldrin. Anderson Silva. Lola the Tiger. Jon Hamm. Spider-Man. Right in the palm of your hand, thanks to technology company, 8i. As of June 2017, this Wellington-founded startup launched Holo, an augmented reality mobile app that now makes holograms globally accessible to Android and iPhone users.

With Holo, consumers can mix their world with live action 3D holograms of real people and animals, and get creative with photos and videos of celebrities, athletes, musicians, and other characters to share on social networks. AR functionality will soon become a commonplace smartphone feature - and 8i is an early mover in this space, building support for Apple's ARKit into their iOS app.

But 8i's vision extends beyond their creation of Holo. Since the company's start in 2014,

8i has secured over US\$41M of investment which has, in part, granted expansion of their headquarters and production studio to Los Angeles with a second R&D hub in Seattle. Their growing team of experts have developed proprietary software that delivers high fidelity reconstruction of human holograms as volumetric video assets, allowing real-time playback for virtual, mixed, or augmented realities.

8i demonstrated the groundbreaking capabilities of volumetric capture in their first official VR release, *Buzz Aldrin: Cycling Pathways to Mars*, as viewers walk around Aldrin's hologram to experience true volume and depth. 8i's mission is to enable the evolution of storytelling in the age of 3D computing, working with various brands and personalities to create vivid content and true "presence" through human holograms.



holo
 MARVEL STUDIOS
SPIDER-MAN
Homecoming
 IN THEATERS JULY 7
 8i, IN PARTNERSHIP WITH SONY PICTURES, BRING HOLO USERS A NEW WAY TO SNAP VIDEOS AND PHOTOS WITH SPIDER-MAN. IMAGE CREDIT: 8i



THE EPIC INNOVATION HUB IN CHRISTCHURCH PROVIDES A HOME FOR LOCAL VR/AR STARTUPS. PHOTO CREDIT: OSCAR KEYS

Spotlight on Christchurch

Spotlight on Christchurch

New Zealand's second largest city, Christchurch, combines world-leading research and development with creative, innovative, global-facing companies. The city has a powerful and connected support network comprised of incubators and programmes to support start-ups and businesses looking to scale; physical venues that encourage collaboration and a supportive economic development agency with deep connections with central government. It's the 'perfect storm' for world-beating VR/AR sector participants to emerge and thrive.

NEW ZEALAND FIRSTS

Christchurch is brimming with early adopters, so it's not surprising that New Zealand's first virtual reality gaming arcade, the VR Room, was established here in 2016. Sporting premium headsets, this venue allows consumers to experience new generation technology and the latest available content without purchasing equipment.

Also a New Zealand first, but a decade and a half earlier, was the establishment in 2002 of a local offshoot of the famous HIT Lab at the University of Washington, Seattle. Focused on augmented reality research through the work of Mark Billinghamurst (see below),



PHOTO CREDIT: MARK BILLINGHURST

"As founding Director of the HIT Lab NZ I am incredibly proud of what was created and the on-going success of the institution. Since it's founding in 2002 the HIT Lab NZ grew to become the largest academic AR/VR research in the Southern Hemisphere, and created such innovations as the world's first mobile phone collaborative AR interface, mobile AR advertising campaign, AR authoring tools for non-programmer, and the first AR colouring books, among others. Today the HIT Lab NZ continues this tradition under new leadership, extending into new research directions in Virtual Reality, and I'm excited to be continuing to collaborate with the lab."

MARK BILLINGHURST
Founder, HIT Lab NZ

ENCOURAGING DISRUPTIVE BEHAVIOUR SINCE 2002

Established by Dr Tom Furness and founding director, Mark Billinghamurst, as an annex of the first HIT Lab at the University of Washington in Seattle, the Human Interface Laboratory (HIT Lab NZ) is located on the University of Canterbury's Christchurch campus. Providing stimulus for the attraction of the lab was the work of the Canterbury Development Corporation, part of the Christchurch City Council.

Over the past fifteen years, the lab has garnered a strong reputation in its field of human-interaction and is high demand amongst academics. The augmented reality work of Mark Billinghamurst, and more recently

a stronger focus toward virtual reality has resulted an intake of 4 post-doctoral students, 15 PhD students, 5 Masters students to undertake research activity alongside the resident continuing staff and myriad of visitors who travel to study at HIT Lab NZ from around the globe.

The lab has been driving significant commercialisation with 8 companies spun out and technology licensed to existing companies. Success stories include the commercial spin out of intellectual property now commercialised as Quiver!, an AR app that brings colouring book pages to life.

the centre has more recently broadened its research into virtual reality through the addition of Rob Lindeman as Research Leader at HIT Lab NZ. Securing this centre was primarily due to the diligence and foresight of the Canterbury Development Corporation, with central government support from the then Ministry of Economic Development (through Industry New Zealand) and the Ministry of Research Science and Technology (through research funding from agency, FoRST).

Previously established as HIT Lab's commercial company and reformed into Motim Technologies during the late 2000's, this digital technology company is using mobile marketing, augmented and virtual reality, along with genuine ingenuity to deliver cutting edge marketing solutions to major global brands.

With investment from Powerhouse Ventures (41.8% shareholder as at Dec 2016 alongside a wide shareholder base), Motim Technologies has developed a range of mobile interaction technologies and sports an impressive global client list. Back in 2009/10, Motim developed a mobile app using AR to help launch the Ford Ka in the United Kingdom and Europe, viewing the car in 3D. Other clients have included Coca Cola, Nike and Toyota. More recently Motim Technologies has worked with electronic music producer, Boys Noize, global technology company HP, and closer to home, work for Skycity in Auckland.

Developed in Christchurch, Virtual Medical Coaching (VMC) bills itself as the world's first true VR application for learning radiographic positions and principles. The company provides a radiation free simulator environment where users can perform radiographic examinations within e-coaching modules that adapt to learners' needs.

The VR training software was introduced into the Ara Institute of Canterbury in early 2017 providing their students with a world-first opportunity to learn to take X-rays and perfect their techniques. In traditional training students can't test multiple angles on a limb for instance and expose a patient to three or more X-rays in a row, but with this technology they can find out what happens if they move the limb and what the outcome will be.

VMC is an excellent example of New Zealand's skill in rapidly adopting new core hardware or software technologies then innovating through the creation of locally conceived and commercialised 'second order derivative' technologies.

THE HOME OF TECH STARTUPS

The city endured two major earthquakes and a myriad of aftershocks in 2010 and 2011, and has subsequently undertaken

a huge rebuild programme to replace damaged infrastructure and buildings. This has, in turn, spawned a new wave of hi-tech innovators, many of whom call the EPIC (Enterprise Precinct & Innovation Campus) hub their home, alongside mature Christchurch companies who required new office space due to earthquake damage. Opened in late 2012, EPIC Innovation (see page 69) was celebrated as an early commercial milestone in the rebuild. It remains a significant flagship venue, hosting many technology events and building collaboration necessary for technology startups.

Current EPIC tenants working in the cross reality sector include Henry Lane and his Corvecto team (see page 70-71) who provide a wide range of VR training solutions; games & entertainment company CerebralFix who developed and spun out the virtual medical coaching business mentioned earlier, and Stickmen Media who create games and VR and AR apps.

Starting from the expertise of games company, Stickmen Media, MTech Games was created to investigate using virtual reality for rehabilitation (see case study on page 83). Through the successful launch of their wheelchair training/simulation environment, MTech has established relationships with partners in Australia and the US and are establishing themselves as health innovators in VR, completing projects for stroke rehabilitation for Callaghan Innovation, spina bifida for Auckland University and on depression for the National Institute of Health Innovation.

Also housed in Christchurch's Innovation Precinct are a range of other tenants including digital and ICT incubator, GreenHouse, which houses up to 50 tenants within an intensive startup/commercialisation programme with expert assistance on hand.

EXPANDING EXPERTISE

Similar to the other main centres covered in this report, Christchurch has quickly built up capability and continually expanding expertise in early VR production services. Local video production company, Resonate, is one example, building capability in immersive 360° video and virtual reality experiences. Resonate stresses the accessibility of 360° content through YouTube 360 and branded headsets. Demonstrating the maturing of the VR sector, they have partnered with another filmmaker to create, Virtually Real, a dedicated 360° production company.

Focus360 is another local company producing 360° content, for virtual tours, health and safety content and for educational or marketing use.



PHOTO CREDIT: ROB LINDEMAN

The HIT Lab NZ has a great reputation around the world, attracting many world class researchers to New Zealand.

ROB LINDEMAN ScD
Research leader/Professor,
HIT Lab NZ

ENGINEERING INNOVATION

But content creation goes beyond marketing and storytelling. At the Christchurch base of global engineering company, Aurecon, they're seeking to build out their in-house virtual and mixed reality capability and are (at time of writing) advertising for a game developer/visualisation specialist. In their words: "our problem is that we have the hardware to provide a virtual experience, and we have the engineering models on which to base that experience, but need more firepower to create virtual worlds around them that are believable." This is a pertinent demonstration of the breadth of the industry, and the critical crossovers between the cross reality and the games development sector – and their collective role in supporting the rollout of virtual and augmented reality within other vertical sectors, such as engineering.

And over at Trimble's Christchurch operations, they're integrating cross reality into their solution suite, creating a single platform for

EPIC TALENT

After experiencing one of the largest seismic events in world history in 2010 and 2011, New Zealand second largest CBD undertook a major rebuilding programme. Within the Enterprise Precinct and Innovation Campus sits EPIC Innovation.

Opened in October 2012 as the first commercial venture back into the rebuild zone following the Restart Mall, EPIC houses over 20

ICT/hi-tech companies with over 250 FTEs and has played host to hundreds of functions and public events.

Over 80% of the tenants at EPIC have a strong focus on exports. Tenants include VR innovation and production companies, such as Corvecto (VR training solutions), CerebralFix (virtual medical coaching), and Stickmen Media (VR/AR app development).



PHOTO CREDIT: EPIC INNOVATION



HENRY LANE
Corvecto

PHOTO CREDIT: OSCAR KEYS

use with VR, AR or MR. Their platform incorporates current leading-edge technology such as Microsoft HoloLens and DAQRI Smart Helmets for industrial use in architecture, engineering, construction and heavy industry, allowing users to interact with digital content within the physical work environment.

This immersive content is particularly useful for industries such as mining (think visualisation of materials or geological data), facilities management (including realtime data, through-the-wall visualisation or adding context to data), geospatial mapping – viewing digital archives, 3D scans and models, and in the field for stake-out navigation (hands-free walking in rough terrain), remote data collection or tracking a UAV (unmanned aerial systems) as well as for reviewing architectural design and remote collaboration.

A PLATFORM TO BUILD ON

Christchurch-based Corvecto has a broad-based portfolio of virtual and augmented reality solutions that are delivered in partnership with leading global brands, corporations and organisations around the world.

The company's founder and Managing Director, Henry Lane, spent 5 years delivering digital engagement solutions for Hollywood entertainment organisations such as The Walt Disney Company, DreamWorks and Sony Pictures, as well as being a part of the team who established the EPIC Innovation campus in the Christchurch CBD.

Following this Henry established VR Development Studio Corvecto, and partnered with fellow EPIC tenants CerebralFix and Skillitics to develop a tertiary X-Ray VR training suite for client Virtual Medical Coaching.

The suite limits the need for medical students to safely access physical equipment which is notoriously expensive and hazardous to operate. As a result, one of the early adopters of VMC's suite saw an 80% reduction in operational costs, combined with a 50% increase in student self-directed learning.

Corvecto's VR AR Training platform is now in use by the South Island's largest civil construction company, Fulton Hogan. This allows the employees of Fulton Hogan to virtually experience the negative consequences of not following official procedures without experiencing physical affliction, leading to refinement of employee skills and overall workplace safety improvement.

As a typical New Zealand startup, Corvecto has taken on a wide range of assignments from virtualising industrial machinery for WYMA Engineering through to development of a VR design tool for international indoor trampolining giant, FlipOut.



PHOTO CREDIT: CORVECTO & FULTON HOGAN



3D ARCHITECTURAL VISUALISATION IMAGERY. IMAGE CREDIT: BUILDMEDIA

Architecture

Architecture

Virtual and augmented reality represents a paradigm shift for the architectural industry. The benefits are increasingly obvious – immersive visualisation of 3D models means internal teams and clients can more accurately understand and appreciate the design work undertaken, well ahead of the build phase. The sale cycle is potentially quicker, or at least simpler.

But the opportunity is much bigger than that. Rework due to misunderstandings or simple mistakes within plans costs the industry many hundreds of thousands annually. Efficiency savings from greater collaboration, informed discussions with consultants and clients, and less misinterpretation from the use of VR headsets and onsite AR visualisation promises to be highly profitable for the architectural community.

The New Zealand Institute of Architects has around 3000 members, with approximately 50% working as registered architects in New Zealand and the rest working overseas or retired, or architectural graduates, students and teachers. Representing more than 90% of all registered architects in New Zealand, it's a fair measure on the size of that industry. That's a big market for headset and software sales, solutions and unbuilt marketing visualisations for sales purposes.

TRANSFORMATIVE DESIGN

The benefits to the sector of adopting VR/AR are even more profound. There is a progressive movement into using immersive technologies to transform the way architects design the built environment.

Daniel Innes, a current Masters of Architecture student at the Victoria University of Wellington, School of Architecture and Design is researching and developing software for virtual reality that enables an intuitive interaction between designers and digital models. Daniel states that, "the advantage of VR is that it is immersive, it's intuitive architectural design and modelling with shifting perspectives constantly." Daniel also works at Wellington-based, Archaus Architects, a leading practice advocating for VR/AR in architecture and BIM contexts, so is able to put his theory into practice there.

This immersive design concept is not far off, advises Jasmax Digital Innovation Lead, Tim Stephens. "I think very soon we will



PHOTO CREDIT: DANIEL INNES

Immersive VR provides for intuitive architectural design and modelling.

DANIEL INNES
Post graduate Student,
Victoria University

cross that bridge and start designing within the VR environment - it won't be a year or two away, it will be just around the corner."

INDUSTRY CHALLENGES

But just getting this far has been a journey. Pre-processing render times for 3D visualisation used to take days and hours, whereas over the last six months, at Jasmax at least, they've come down to minutes, allowing for almost realtime viewing of design alterations and rapid regrouping for collaboration or problem solving.

One of the challenges facing the architectural community is employing graduates with practical VR skillsets. As Tim notes, "we

PLANES AND EFFICIENCY GAINS

When Wellington-based Studio Pacific Architecture tackled the extension of the Nelson Airport terminal, they used an immersive VR system to develop their plans, then they packed it up and took it show their clients. The Airport board, CEO and staff were all able to easily visualise the extension. Feedback was that the visual nature of the content allowed for better understanding with less explanation. It was more comprehensive and visually compelling.

Back at the studio, they were also able to use their VR renders as a decision support

system to increase the efficacy of the signage within the terminal. Immersive viewing of interior passenger traffic flows within the multipoint model allowed them to efficiently deploy a virtual signage system that maximises visibility and minimises the volume of signage required within this development.

The Studio Pacific team is excited about its potential for consultation, demonstration of new products and building technologies, and for more immersive design processes.



PATRICK THOMPSON, EVZEN NOVAK AND SAMANTHA ZONDAG FROM STUDIO PACIFIC ARCHITECTURE. PHOTO CREDIT: OSCAR KEYS



TIM STEVENS
Jasmax

PHOTO CREDIT: OSCAR KEYS

can find graduates that know how to use 3D printers, but finding those that know virtual reality is much harder.” If this is correct, it represents a sensible opportunity for the education sector to deploy more VR technology through the tertiary system, and for the architectural community to avail itself of the courses and events being run in places like PROJECTR in Wellington and through the NZVRARA.

VIRTUAL REALITY AT JASMAX

There’s an Oculus Rift headset and a large screen sitting on an empty table at the Jasmax architecture studios. During the interview with Digital Innovation Lead, Tim Stevens, there is constant traffic arriving at the headset and screen, murmuring, motioning, and then departing, for another group to quickly arrive.

Tim explains that since he started investigating these transformative technologies over two and a half years ago, they’ve become a ‘game-changer’ at Jasmax. “It’s not often in our careers we get to encounter a paradigm shift, but the way these technologies are transforming how we communicate our designs is a powerful and engaging opportunity for the architecture and design industry,” reckons Tim.

An architect by trade, Tim’s latest role at Jasmax includes oversight of the planning and deployment of immersive visualisation tools into the workflows and processes of their teams of architect and designers. He has implemented a proprietary Nextspace system that allows for almost realtime rendering of the firm’s Revit Architecture outputs as 3D models to a games engine for viewing in VR.

With over 300 staff across offices in Auckland, Wellington, Christchurch and Tauranga, Jasmax is New Zealand’s largest multidisciplinary architecture practice. They are utilising virtual reality to remain competitive, to meet growing market

demands, make visualisations more quickly as well as to increase efficiency and reduce rework.

“We’re finding that VR and AR is creating a common language between our designers, and with our client groups. Designs can be updated in real time, which allows for greater internal design discussion and team understanding.”

The reduction in rework is non-trivial, and delivering significant productivity and efficiency gains to the practice. Clients are highly engaged, through being better able to fully visualise their projects, and can quickly understand the implications of any potential revisions.

Tim believes that short of actually building the project, virtual reality allows design teams to experience and interrogate a project in the most true-to-life way possible. In his words, “no other medium communicates volume, scale and proportion like VR does. Unlike so many other mediums that we as designers use to communicate our projects, VR leaves little room for misinterpretation.”

At Jasmax, they still do their work in the typical core software packages, then use virtual reality as a communications tool. But Tim is clear that very soon, they’ll be starting to design within the VR environment and deliver the results in multi-user experiences with their clients.

At the July formation of the Victoria University Wellington campus VR 'uni-club,' a quarter of the attendees were from the architectural school, demonstrating a demand for information and a hunger to learn more. Daniel Innes is confident that although the hardware is there (VR room with HTC Vives and a Hive spherical screen), "it's going to take a few years for people to pick it up," says Daniel.

It may be that not having internal immersive visualisation technology within the studio may limit involvement in projects or even eliminate some practices from getting on the shortlist for commissions in future. Evzen Novak from Studio Pacific Architecture agrees. "without staying current, we could miss out on major overseas work."

THE BIGGER PUZZLE TO VIEW

For a sector that has some participants still coming to terms with the implication of BIM (Building Information Modelling) processes – where intelligent objects stay updated throughout the designs by consolidating the building, the information and the concept modelling into a single accessible platform, VR represents an opportunity to not only visualise the prototype concepts, but all the other geospatial and local government data that may have an impact of the project.

This has got Mark Thomas from Nextspace enthused. His new Bruce project proposes Auckland as a testbed for an overarching 3D reference model of Auckland's infrastructure and local body services. Mark previously cofounded New Zealand 3D viewing software company, Right Hemisphere, which sold to SAP in 2011. Within this project, mixed reality (or VR/AR) would allow levels of datasets to be turned on/off and viewed remotely or whilst working in the field. Any changes to data can be submitted for acceptance and shared across all users so that views remain current. The job of Bruce is to be open, make connections between existing datasets possible, and be the "glue" between BIM outputs, local body infrastructure datasets and many other datasets.

This has profound implications for the adopting of a new concept, City Information Modelling (CIM), that could, for instance, result in building consent applications only being accepted as 3D models and being interrogated by artificial intelligence (AI) for more rapid assessment that is currently possible. It's therefore no surprise that the early adopters of the CIM concept are companies like Autodesk, who drove the adoption of BIM for infrastructure. The direction of city modelling means immersive visualisation tools are critical in collaboration, remote viewing and will ensure a greater understanding of the data being displayed than through a 2D screen.

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City Information Modelling will be a big opportunity for immersive visualisation.

It is clear that whilst the architecture design industry is already fast-adopting immersive visualisation technologies for collaboration and efficiency gains, the journey of immersive design and viewing of 3D objects, concepts and unbuilt structures is in for intense change over the next decade.

MARKETING UNBUILT ARCHITECTURE

Buildmedia's Auckland and Australian operations encompass a variety of interactive methods for visualisation of 3D modelling and building plans, including full virtual reality, interactive touch tables and interactive display suites. The repeat business within their extensive and blue chip portfolio suggests that these methods of visualisation, together with their high quality of pre-rendered 3D images and fly-throughs clearly work to help sell property and large scale developments.

The company also produces a sizable volume of stakeholder communications material for public consultation and audience education. Their immersive content simplifies the communication of complex messages, plans and stories in a highly engaging way.

To produce virtual reality content (not pre-rendered) to the quality required for their demanding clients, they have invested in a render farm that consists of 40 dedicated high-powered servers, enough to process in almost 'real-time', frames where the achievable quality is now acceptable for architectural visualisation. This means that to view high quality realtime VR content, there is no need to pre-process rendered frames and when, they advise, three minutes of linear animation requires 6000-9000 hours of computer processing time, going to VR simply make sense for some jobs.

"Although the technology doesn't suit every project, realtime visualisation offers massive benefits that are going to disrupt the industry," states Gareth Ross, Creative Director at Buildmedia.





...Research & Development

THE HIT LAB NZ AT THE UNIVERSITY OF CANTERBURY PHOTO CREDIT: OSCAR KEYS

Research & Development

New Zealand has a proud history of research and development activity across blue sky and applied research, within government, the university and polytechnic sector and within private enterprise. Hi-tech industry such as virtual and augmented reality is supported by Callaghan Innovation, New Zealand business innovation agency, who boosts New Zealand R&D through more than NZ\$140 million a year in grants and have more than 200 scientists dedicated to solving tough problems.

UNIVERSITY ADVANCEMENT

Within the universities, there is active research underway into specific problems facing the advancement of virtual, mixed and augmented reality adoption and opportunities for novel applications incorporated cross reality technologies. Education using these technologies is an important early phase of building capability ahead of undertaking post-graduate research and allows for training that will be critical in filling the skill shortage facing the cross reality sector in the coming years.

Promisingly, Auckland has a wide range of training programmes and significant research underway utilising AR and VR technologies, some of which are destined to produce commercial spinouts that will stimulate growth in the cross reality sector.

Recognising the need to address capability with digital reality technologies, the Media Design School in Auckland offers a qualification that includes a stream in AR/VR.

Massey University's Wellington campus was the first to form a VR university club, VRTX (see page 95), and through their School of Design have now established a VR Room, after first exposing students to the technology by deliberately leaving secured kit in the design labs. Given the undergraduate interest in VR, Head of School of Design, Brian Lucid (see page 44), has launched a new elective within the Bachelor of Design for 2017, exploring User Interaction within Virtual and Mixed Reality.

The programmes at Auckland University of Technology (AUT) and world-class laboratory facilities within their Colab collaboratory (a centre without walls – William Wulf, 1989) for Design and Creative Technologies are already generating world class graduates, such as Alejandro Davilia from Conical Interactive Studios, who is



“At AUT, we are giving students access to the latest technology in the field of VR/MR/AR, so that they can work together with academic and industry experts on interdisciplinary projects that stretch the technical limits and explore new ways of education, entertainment, storytelling and visualisation.”

DR. STEFAN MARKS
Senior Lecturer at Colab and
Director of Sentience Lab at AUT

THE VR WHEELCHAIR TRAINER BY MTECH GAMES

People with tetraplegia will soon be using virtual reality to master their powerful new wheelchairs without colliding with any real hazards.

The VR Wheelchair Trainer is the invention of a Christchurch collaboration set up by Callaghan Innovation with clinical researchers at the Burwood Academy of Independent Living (BAIL) and game developer Stickmen Media.

As MTEch Games gets set to commercialise the system, the team is also closing in on a solution to the virtual motion sickness problem plaguing virtual reality users everywhere.

HOW THEY DID IT

- Stickmen Media scores one of the early Oculus Rift developer kits and shows it to Callaghan Innovation engineer Marcus King who has been working with BAIL and others for over a decade.
- King takes it to BAIL and they brainstorm a game-based virtual practice zone where people with tetraplegia can learn to control their new wheelchairs without risk.
- Callaghan Innovation organises co-funding, designs the study with BAIL, and commissions Stickmen Media to virtualise a real hospital rehabilitation unit.
- Within six months of getting the kit, the team has ethics approval and has run a pilot study.
- Stickmen Media offers to commercialise the prototype and Callaghan Innovation transfers the intellectual property to new entity MTEch Games Limited.
- King introduces MTEch Games to a contact at the world's biggest wheelchair research facility, the University of Pittsburgh's Human Engineering Research Laboratories (HERL), funded by the U.S. Department of Veterans Affairs. HERL asks MTEch Games to plan the first clinical trial.
- BAIL and King develop a protocol to reduce virtual motion sickness by up to half in just five days, and begin testing to get it to a clinically workable level.



MARCUS KING INSIDE MTECH'S VR WHEELCHAIR TRAINER ENVIRONMENT. CREDIT: CALLAGHAN



TAEHYUN RHEE
Victoria University

PHOTO CREDIT: OSCAR KEYS

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Victoria University's, Dr. Taehyun Rhee has been appointed as Chair of the SIGGRAPH Asia 2018 VR Showcase to be held in Tokyo.

creating immersive storytelling as a direct result of his education and training.

At Auckland University, there are a large number of research groups utilising these technologies within many disciplines including vision science, engineering, learning methods for nursing training, augmented reality sports environments, virtual surgery simulation, VR 'exergames', and alternatives to stereoscopic 3D visualisation for consumer virtual reality.

Victoria University's newly opened Miramar Creative Centre is collocated among the Weta Group buildings on Wellington's famed Park Road in the heart of the local film production quarter and brings the world of education and the film industry together. With green screen, computer labs production software/hardware and motion capture technology, this facility, and the people who emerge from its Masters programmes (Masters of Design Technology and Master of Fine Arts (Creative Practice)), are just another reason why New Zealand will lead the way in creation of world-beating content using virtual and mixed reality technologies.

Victoria University of Wellington has been building up strong research capability for many years. There are over 50 staff and students undertaking research across a range of groups within their Virtual World Lab at the Victoria University School of Design and the School of Engineering and Computer Science, particularly within the simply named but very innovative, Computer Graphics programme.

Dr. Taehyun Rhee (pictured left) is Director of the Computer Graphics Lab at Victoria University. He spent 16 years as a researcher with Samsung and was a leader of the Computer Graphics and Medical Physics research teams at the Future IT Centre of Samsung Research (SAIT), before joining Victoria University in 2012. He established its Computer Graphics Programme and presented his recent work on MR360: Mixed Reality Rendering for 360° Panoramic Videos at SIGGRAPH 2017, presenting the work behind his Dreamflux startup for mixed reality. SIGGRAPH is one of the world's premier events for computer graphics and interactive technologies. Dr. Rhee has been appointed as Chair of the SIGGRAPH Asia 2018 VR Showcase to be held in Tokyo next year, a further demonstration of the leadership roles New Zealanders are taking on the world stage.

Victoria's School of Architecture has an active interest in virtual reality, with technology available for students and Masters research underway exploring immersive design (see page 74).

Within the interviews conducted for this publication, there were a range of views offered with respect to the accessibility of

immersive technology equipment within institutions, the skillsets of the latest graduates being hired by companies using this equipment, and within the institutions, whether the introduction of related courses and teaching content is sufficient to support the rapid adoption of virtual, mixed and augmented reality solutions within New Zealand businesses – both inside the sector and within the verticals outlined in this first of two reports. Education is slated for deeper exploration within the second report and substantiated insights and recommendations can be expected when that is published.

COMMERCIALISATION

The close-to-commercial nature of much of the private sector ICT R&D and the rapid commercialisation of development activity within many VR/AR startups means much of the R&D is completed during an initial product development phase and subsequently during cycles of product improvement.

It's an observation that intellectual property within VR startups is often only captured as tacit knowledge and secured through confidentiality undertakings, with the focus on getting to market ahead of potential competitors. However, there are some local patents being lodged, such as for VR Kiwi's hardware platform, and local companies do need IP support services in order to ensure that the solutions being created are either not infringing others IP, or any novel elements can be protected.

Channels for rapid commercialisation are a vital element of building a virtuous R&D value chain, in order to drive commercial success from spinouts and startups, thus driving more demand for R&D and investment into research activity.

The past decade has seen a surge in the volume of capacity of co-working locations, incubators and start-up hubs. Within the cross reality sector, EPIC Innovation (Christchurch), and the newly opened PROJECTR (Wellington) and the AR/VR Garage (Auckland) has been profiled within the regional spotlight chapters earlier in this publication.

Along with their support for the Garage, Auckland Tourism and Economic Development (ATEED) has also created GRIDAKL, a home for entrepreneurs, startups and their support networks within the visionary innovation precinct in Auckland's Wynyard Quarter. GRIDAKL is home to several innovative startup VR and AR companies and, with their range of support services, is a useful venue before taking a first step offshore.

WOULD YOU LIKE SOUND WITH THAT?

At Callaghan Innovation, Dr Mark Poletti breaks sound barriers for virtual world-builders and global providers.

He picked up his PhD while inventing the technology behind the Meyer Constellation System used in concert halls worldwide. Now he's tuned in to the best ways to create soundscapes for virtual spaces.

"There are two ways to create sound in space – surround sound and binaural sound. Some platforms like Google's YouTube use both," says Mark.

Surround sound is recorded in a region of space using an array of microphones and reproduced with loudspeakers.

"We're finding new ways to stretch the audible bandwidth a microphone array can record, while still capturing a big enough sweet spot. Our latest experimental array can accurately record a bandwidth of up to 10 kHz – nearly double that of most others.

"We've also patented a solution to cancel out the interference from the unique reflections of each room that a recording

is played back in."

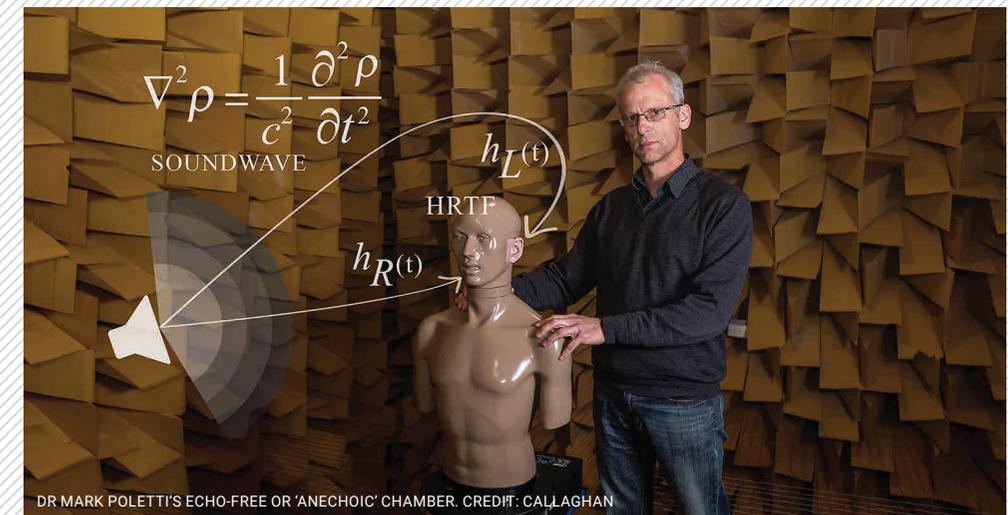
Mark is now at work on the math to overcome a big challenge to shooting in 3D – the complex distortions to the sound field created by camera and microphone equipment with complex shapes.

Binaural sound or "two-ear" sound is recorded by microphones in the ear canals of a simulated listener in a space and reproduced over headphones.

Mark is developing better mathematics and engineering to help internet platforms convert surround sound to binaural so it can be played back over headphones.

"But the problem with headphones is that after about an hour they get uncomfortable. The solution is virtual headphones and we've developed a better way of clamping them painlessly around your ears.

"We use a line array of eight loudspeakers and direct the sound with a new cross-talk cancellation system that makes accurate head tracking easier."





ALEJANDRO DAVILA FRONTS THE GREEN FAIRY VR SERIES. PHOTO CREDIT: CONICAL INTERACTIVE STUDIOS

...Conclusions

Conclusions

It is important to note early in these conclusions, that this report is one of two, with the role of this first volume being primarily to introduce the sector, provide a view into the work of some of its participants, the wide range of areas of focus within the wider AR/MR/VR sector, and the key locations where new virtual, mixed and augmented reality technologies are being exploited within New Zealand.

During the completion of this report, some customer verticals were identified that require deeper exploration. One of those, Architecture, is covered within this volume. The others, including Enterprise AR/VR, Tourism (of particular risk/interest to New Zealand), Games & Entertainment, and Training & Education will be addressed in Report Two: Going Next Level.

Given the fast maturing nature of this new sector, many of the sector business people interviewed had two driving goals – first, to move from fledgling startup to become a sustainable successful New Zealand-domiciled business, and secondly, to be able to export services or products offshore. There were some pockets of expertise where New Zealand may be ahead of others around the world, and where global testbeds or centres of excellence could emerge, for instance, holographic capture arising from the R&D at 8i, games and entertainment centred on the local Magic Leap team, AR content driven by Wingnut AR, and the Bruce project by Nextspace. This investigation work will also be undertaken as part of Report Two.

VIRTUAL GETS REAL

Virtual and augmented reality has definitely arrived with adoption driven by reduced headset pricing, an almost continual new technology rollout, the arrival on Apple and other major smartphone providers into the AR sector, and the prototyping and subsequent deployment of enterprise solutions into workplaces and training organisations.

Whilst significant success from consumer content creation for VR headsets may rely on a significantly larger installed user base than is currently in homes, Apple's recently launched ARKit augmented reality platform has been billed as a same shot in the arm for the adoption of AR, and compared to Pokemon Go that delivered in 2016 when half a billion people around the world downloaded that app.

.....
 1100
 FTEs currently employed
 in the NZ XR Sector

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The global AR market is projected to generate revenues of US\$83B in 2021 (Digi-Capital).

Whilst the product's adoption has some way to go to reach this level of engagement, the product has delivered to developers a tool that will rapidly grow consumer AR engagement. Mainstream adoption of Apple's augmented reality will come from compatibility across all Apple iOS devices and is potentially a gateway to an iPhone-based headset that has been predicted for Apple to release.

Somewhat like Google's Tango product, Apple's 'world-tracking' with ARKit allows for scanning of real world points, perspectives and scales to allow virtual objects to be placed in live environments. Imagine placing virtual furniture in your actual home before buying online, for instance. This innovation across such a large range of devices, and a ready-built commercial model represents a significant opportunity for New Zealand digital and creative technology companies to release novel commercial products and services.

SECTOR CAPABILITY

For this report the NZVRARA, still in its first year of operation, solicited as many local industry participants as it could uncover in order to gauge the size of the domestic industry, its areas of expertise, vertical markets where content is being deployed, and an estimate of forecast sector size in two years.

It uncovered a fast-growing industry, currently with 1100 fulltime equivalent employees, estimated to grow to over 2200 within two years, without considering those who did not respond and newcomers over that period. Using a simple model based on local revenue per ICT employee, it was estimated that the sector could produce annual revenue of over NZ\$320 million within two years, from those surveyed.

Globally, the sector has been struggling to meet the (perhaps too ambitious) forecasts of respected cross reality sector analysts, but their latest 2017-2021 five-year forecasting still suggests a rapidly growing industry in the 'early majority' phase of the innovation adoption cycle. Consumer content is generally coming from offshore in the form of games by suppliers such as Sony, with some domestic content creation and the enterprise market, whilst forecast to surpass consumer revenues in many markets, is still nascent here.

The economic impact of the introduction of AR and VR solutions into large enterprises through delivery of significant productivity gains has been well reported, but was not heavily referenced during this report, due to the lack of manufacturing companies and their technology suppliers interviewed. This will be investigated within the Enterprise AR/VR chapter in Report Two. That said, architecture

was one sector that those interviewed stated significant gains from immersive visualisation, both in productivity, but also from efficiencies in design and build.

These immersive technologies represent a completely new way to engage with audiences so there is particular excitement within the storytellers of the VR/AR sector, partly due to the release of concept funding for interactive creative content from the New Zealand Film Commission's Interactive Development Fund. This is supporting the emergence of some new 'pure play' AR/VR businesses in this vertical, in addition to more established businesses that have added VR or AR to their service offering. It is expected that this fund will stimulate collaboration between sectors and through the development of these interactive stories, potential new markets and audiences will be identified, developed and engaged.

There is also a fast-expanding group of pure-play generalist AR/VR businesses forming in the main centres to service a growing demand for immersive marketing content, workplace training apps for health & safety, and other vertical sector requests for prototype or concept level content.

Pockets of deep knowledge and expertise are deepening within other more specialist subsectors, such as games development for Magic Leap, for holographic capture and to create vivid content and presence through human holograms, and in management and visualisation of complex datasets such as GIS/LINS/BIM within local government. The formation of Wingnut AR and their recent demonstration of the ARKit technology at Apple's WWDC (worldwide developer conference) is a serious indication that the AR entertainment subsector is ready to go mainstream. Virtual medical and associated training is a growth segment worldwide, but New Zealand does have some early scale. It is recommended that consortia are formed where the specialist companies see value, in order to build scale for export. The process and opportunities for this activity will be explored further in Report Two.

There is sufficient scale already within these pockets of specialist know-how to warrant production of some industry-led promotional content in 2018. This would be used to celebrate the industry's success and proficiency, and to market the sector offshore, digitally and for trade shows and deployment at other events.

Collaboration between startups, students, the research community and corporates seeking project support is being facilitated by the New Zealand VR/AR Association and regional centres such as the AR/VR Garage, PROJECTR and EPIC innovation. These centres also provide the co-working, sharing and event environments needed to



PHOTO CREDIT: JAMES EVERETT

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We see many exciting opportunities for collaboration between games developers and the many industries exploring AR and VR.

JAMES EVERETT
 Past-Chair, NZ Games Developers Association

	RISKS & OPPORTUNITIES	STRATEGIC RECOMMENDATIONS
1.	Offshore commercial collaboration will free up bigger budgets and allow NZ Inc. to exploit this fast-growing international market.	Central and local government support would speed up identifying these opportunities, and further support (industry-led) is needed to facilitate team interactions and to prepare joint proposals is required, as well as provision of neutral project management services. Report Two will identify models for offshore engagement.
2.	Offshore opportunities may require NZ companies to adopt a consortia approach to provide scale	Greater intra-sector engagement is required to build rapport, shared trust, deeper understanding of specialist expertise and resources available to commit to offshore consortia. Report Two will identify recommended channels to offshore markets and support programmes.
3.	A skills shortage within the next two years is forecast by industry participants	The NZVRARA must continue its strategy of building awareness within tertiary institutions and expedite the formation of on-campus clubs at all universities and major polytechnics. The NZVRARA Student Chapter must ramp up connectivity between the chapter and its commercial members. Some support would be useful in deploying this nationwide, given that the scale required is beyond the current resources of the Association.
4.	The local games sector and the XR sector would benefit from closer alignment and skill sharing.	Greater linkages between the NZGDA and the NZVRARA are required to deliver positive shared outcomes. Data sharing through annual surveys would be useful. The two Associations must consider a joint action group to maximise opportunities, training and industry development for both sectors.
5.	Annual measurement of sector headcount and financial growth, forecast sector growth, and identification of constraints to success so they can be quickly addressed.	NZVRARA to appoint a reliable, trusted 'independent of sector' consultant (same used for NZGDA Survey) to collect, aggregate and disseminate aggregated annual data back to the sector and for external reporting. The NZVRARA should exclude games companies from its survey to avoid double-counting or poor response from games companies working in the XR space, subject to agreement from the NZGDA to have some XR questions included within their annual survey.
6.	There remains a risk that one-off concept funding of novel immersive storytelling content won't be enough to build sustainability.	Continued screen sector funding for interactive content and storytelling within immersive technologies will allow the sector to build expertise, supplement the income of emerging immersive filmmakers and their crews, and allow for the retention of specialist talent that can be deployed into contracts within other market segments if required.
7.	Risk of customer dissonance due to expectations not managed or met by overselling or shortage in capability or business experience.	The wider industry should consider how to address this issue more fully, whether through accreditation, industry rankings, directory with independent measurement. Assistance with training and delivery of project management services and support will ensure customer satisfaction and faster industry adoption of immersive technologies.

bring a primarily startup community together for shared benefits.

There is currently an ad-hoc arrangement of promoting all industry participants so they can access opportunities to work on prototype concepts for major brands, that they might not otherwise have the opportunity of coming into contact with. This requires further consideration by the sector leaders as this may represent a risk for the sector if there is an inappropriate capability match, or project support/budget is not aligned with the project requirements. Whilst this can be expected in any new technology market, it may lead to customer dissonance and build resistance in technology adoption which could slow industry growth. Companies within XR sector may wish to consider how to address this issue more fully, whether through an accreditation system, industry rankings, a directory with independently allocated measurement or other options open to the sector.

It is recommended that the industry considers experienced project management support and training for startup projects where useful and requested, and for project discovery processes to be taught and implemented to maximise client experiences into these centres and through the association. It may be appropriate for central and local government agencies to consider part-funding this support service, to ensure early success at both ends of the transaction, and more rapid growth of the market. Separately, investment in marketing of capability from leading businesses operating in this sector is important, in order to present their offerings at a time when identification of experience and expertise may be difficult for an outside customer to ascertain.

The universities are already building out a wide range of facilities, services and supplying the necessary equipment to students to build hands-on skills in using these technologies, but greater connectivity is required between industry and undergraduates, particularly in the architecture schools, to ensure that the rapidly changing requirements of the private sector are being addressed within the curriculum, or externally if necessary, prior to course completion.

In particular, The HIT Lab NZ, formed in 2002, is recognised offshore as one of the world's leading human interface technology laboratories and enjoys a regular influx of international researchers and visitors.

Despite still being in its first year of existence, the NZVRARA is widely involved across the sector, from operating introductory and informative events, to the establishment of the national Student Chapter for better connectivity and subsequent rollout of on-campus university clubs, through to the commissioning of this



PHOTO CREDIT: RUSH DIGITAL

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Virtual and augmented reality apps will reshape retail commerce and marketing.

report, and the planned annual independent industry survey. It is important that the cross reality industry fully supports this not-for-profit body and its volunteer base to ensure it remains viable as the workload and pressure on the organisation and its leadership increases.

The role of the NZVRARA is now transitioning from establishing a sustainable industry in New Zealand, to building the capability and expertise necessary for the sector to earn the majority of its future revenues from exports.

NZVRARA'S STUDENT CHAPTER

A skills shortage was noted by survey respondents as the second biggest challenge facing the cross reality sector in the next two years. The NZVRARA is tackling this at an under- and post-graduate level with the establishment of a Student Chapter.

By facilitating formation of 'VR clubs' at each major university and polytechnic campus across New Zealand, the Student Chapter is able to stimulate interest in VR/AR, and increase demand for related education and research activity.

On campus VR club members can automatically become members of the NZVRARA, with their membership fee met through corporate sponsorship secured by the Association. It is anticipated that closer tertiary student engagement with NZVRARA's corporate and startup members will lead to holiday internships, part time work and careers in the sector. Opportunities are also being considered for greater access to industry equipment.



JONATHAN BISHOP, COURTENEY LOMAS AND OSCAR KEYS ARE LEADING STUDENT ADOPTION OF VR: PHOTO CREDIT OSCAR KEYS

Coming in Report Two



THE VR GAMES SPACE IS SERIOUS BUSINESS. FIGHTING ZOMBIES IN PIKPOK'S 'INTO THE DEAD' GAME FOR SAMSUNG GEAR VR. IMAGE CREDIT: PIKPOK

Coming in Report Two: Going Next Level

The second report will seek to provide some rigorous economic analysis about the sector, and explore a number of other vertical markets where cross-reality technologies are already making inroads. It's about creating a viable onshore industry and creating offshore success by building channels to export markets.

ECONOMIC ANALYSIS

Independent economic analysis will be undertaken to forecast future impact of the cross reality sector on the New Zealand economy, both direct contribution and contribution of the clear productivity gains made through the adoption of cross reality tools and technologies by other sectors.

This research will also consider the cost to the sector of issues such as skills shortage - the local shortage of skilled resources and graduates arriving into a hi-tech workplace without cross reality sector skills, the valuable role of government as a large customer of the cross reality sector, and the value of educating businesses on adoption of cross reality tools and technologies.

ENTERTAINMENT

Report Two will explore the content creation sub-sector, producing entertainment including games and story-telling.

New Zealand has an active games community who will progressively pivot onto VR as the consumer install base expands. But there are other games-centric opportunities. Gamification of sport using augmented reality, such as being undertaken by Chentur Thambiah and Joe Chang at ARX, may provide a fresh product line for major gymnasiums and personal trainers worldwide. Joe's background in gaming with his start up Eyemobi, leadership of the NZGDA and time managing the Arcade Auckland next to the AR/VR Garage has put him in a strong position to produce a disruptive product.

Storytelling via virtual and mixed reality has been stimulated through funding support from the New Zealand Film Commission's Interactive Development Fund. In June 2017, they announced that six virtual reality concepts had been successful in securing funding: The Last Ocean Virtual Expedition by Fisheye Films, Wanderer by Method and Oddboy, The Worst Journey in the World

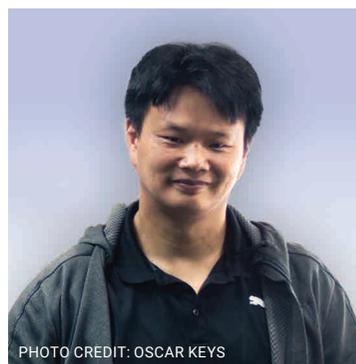


PHOTO CREDIT: OSCAR KEYS

We've used augmented reality to gamify exercise - the challenge is now to commercialise it.

JOE CHANG
Co-founder, ARX

60%

CAGR for enterprise VR hardware & content from 2016-2021 - ResearchandMarkets, March 2017

by Dot Dot Ltd, as well as one mixed reality concept: Omega by Robert Appierdo from Snow and Wrestler was successful in securing support for prototype concepts for Wake and Mataatua; a collaboration with Te Whara Wānanga o Awanuiārangi.

This funding allows the team to develop an interactive concept that may form the basis of a playable prototype that can be used to aid the securing of project financing to complete the project.

TRAINING & EDUCATION

Corporate and workplace training represents a major early-entry market for the cross-reality sector. As a workplace tool to address potential health & safety hazards, virtual reality and augmented reality solutions present a highly engaging method of educating workers. Gamification and scenario-based training are a perfect fit with headsets. Given the requirement for training to be undertaken, early form factor concerns are less likely to impact this market than for consumer applications.

Large companies such as Lion New Zealand and Fonterra are already investigating training options using VR and AR. Medical training is also a strong growth sector, as is use of XR solutions for rehabilitation and pain management.

Government departments and agencies are also taking a leadership role in creating training content. The New Zealand Police has a team looking into the use of mixed reality for more efficient cadet training. The Department of Corrections has commissioned a local company to provide a platform, content and VR headsets for workplace training.

TOURISM

There is already some early-stage content in the marketplace, such as the 360° footage on headsets at Southern Discoveries in Milford Sound, and as camera gear and production processes becoming more suitable for consumers, footage will become commonplace on many of the emerging content platforms.

Māori tourism represents a unique opportunity for New Zealand companies to craft content and tell stories about Māori mythology and traditions.

ENTERPRISE VR

The role of virtual reality in the enterprise VR space is expected to surpass consumer revenues, according to IDC (see page 36). In New Zealand, hi-tech manufacturing is already using VR. Medical implementation allows advanced simulation and instructional content, and patient education.



KAT LINTOTT & BEN FORMAN
Wrestler

PHOTO CREDIT: OSCAR KEYS

66

startups have received investment and mentorship from Taiwan market leader, HTC Vive's accelerator programme, VIVE X. (Source: RoadtoVR.com, 27 March 2017)

Mixed and augmented reality solutions allow streamlining of workflow by providing access to hands-free information while completing manual tasks, such as repairs, or maintaining equipment. The intention is for increased productivity particularly through reduced risk of error, injury or fatigue.

GLOBAL TESTBEDS

The early stage of deployment of cross reality solutions provides opportunities for New Zealand to carve out centres of excellence where we have a natural leadership position.

One of those is in the development of digital asset registers to capture visual and non-visual data, particularly for use in the compilation of digital assets related to the wider building industry (BIM) or more generally for local government (GIS). Mark Thomas (previously Right Hemisphere which sold to SAP) from Nextspace is undertaking a significant world-leading project to deliver this register – and ensure it can be output into VR and AR. This does not mean creation of more digital repositories, rather the opposite with greater open connectivity and meaningful context. This represents a huge opportunity for local and central government to take a global leadership role where our technology-lead represents a big business solution that would be exported around the world.

Further, the skillsets of Weta Workshops and Wingnut AR are already generating solutions for Magic Leap and via Apple's ARKIT. Building out bigger businesses working in this space, through the leadership of these global entertainment brands and the vision of Sir Richard Taylor and Sir Peter Jackson could give New Zealand critical mass in this very valuable quality content space.

OFFSHORE CHANNELS

Since the launch of the AR/VR Garage, ATEED has been delivering international channels for New Zealand companies through Auckland's Tripartite Economic Alliance with Los Angeles and Guangzhou, and through formal linkages with The VR Society among others. The NZVRARA has access to over 3800 organisations globally through The Directory of the VRARA. In Wellington, WREDA has a close relationship with Singapore's Economic Development Board and Singapore Airlines.

There are other links across the sector between New Zealanders operating abroad and those working in the cross reality sector here. It is important for the sector to capture, formalise and exploit these connections to allow the industry participants to secure offshore assignments and develop globally competitive scale within businesses and cooperatives.

Appendices



Appendices

CROSS REALITY COMPANIES

8I

Software and systems to create human holograms for AR, VR and MR.

ANIMATION RESEARCH LTD

ARL provides 2D & 3D visualisation across a wide range of industries.

APARTMINT

Off-plan apartment sales.

ARX

Using AR glasses to enhance personal training in gyms.

AUGUSTO

Content Marketing and Entertainment.

AURECON

Aurecon brings ideas to life to design a better future. Imagining what is possible, we turn problems into solutions.

AUGVIEW LTD

Augview is the first mobile GIS product incorporating AR capability allowing users to display underground or proposed infrastructure. We have a global market.

BETTER WORLD DIGITAL

Training & consultancy around VR/AR/MR; equipment hire & support.

BLACKEYE VR

Strategic VR/AR sector consultancy and internationally-focused producers

BLACK BOX PRODUCTIONS LTD

Research looking at VR as a social endeavour and will culminate in a VR artwork that seeks to establish a temporary commons in an art gallery environment.

BLACK TORTOISE LTD

We are committed to AR/VR technology in a variety of areas of application such as book publishing, education, museums, and real estate.

BUILDMEDIA

3D studio creating images, animations and VR/Interactive experiences for the real estate, infrastructure and transport industries.

CONICAL

We are a team of developers, publishers, and distributors of 3D animated content using Virtual Reality, Augmented Reality, Apps and Mobile Games. We are a one stop shop where we help brands tell their stories using the latest technology.

CORVECTO LTD

VR & AR Solutions for Training & Operations.

CURIAT

We're true Growth Hackers. We understand the real value that innovation adds to commerce and the community. Born for change and bred for success, the Curiat is our vehicle that is driving industry use of Ai+AR.

DOCUMENTARY NZ TRUST

Skills training and advocacy.

DATAKOM

Datacom Group Limited is an Information Technology services company, offering IT management and consulting, cloud services, data centre services, custom software development, business process management and payroll services.

DOTDOT

Digital Solutions for Human Problems.

FLIGHTLESS

Creative technology, design and communication. Flightless is a design and development studio. We specialise in projects for public, private and commercial clients, producing digital content, interactive software and immersive installations.

GEEKSTUFF LTD

Creator of the tour360.nz website/YouTube channel/Facebook page. 35+ years in ICT industry.

GUERRILLA HOUSE DIGITAL

We provide post production services for VR/AR and 360° video; VFX, animation, 3D modelling and visualisation.

HAKAMANA LTD

Our VR Collective creates wonderful VR experiences that express stories of culture, lands, people, histories, and legends, through great process methodologies that bring your vision to life.

HARMONIC LTD

Harmonic provides award winning music and sound design services to the New Zealand and international film, Virtual Reality and arts industries. See and hear Peter Hobbs' work at www.harmonicstudio.com

IMERSIA

We monetize experience using Augmented and Virtual Reality to tell stories. We influence behaviour in favour of a brand or product with our AI and Analytics Cloud Engine.

IMMERSEME LTD

We use virtual reality to learn languages.

INGAME

Gamification, behavioural psychology, training and sims.

JASMAX

Jasmax is one of New Zealand's largest multi-disciplinary design practices.

M THEORY

M Theory is an AR & VR innovations agency creating beautifully immersive and engaging experiences.

MAGGLE CREATIVE

We create digital experiences hosted in our AR platform, or custom AR/VR apps.

MARDER

Tourism Product Development and Strategy.

MATTER MACHINE

MatterMachine is a Mixed Reality content platform powered by a parametric geometry engine.

MIRAMAR CREATIVE LTD

Miramar Creative provides short courses to connect the creative community to the working industry and to support the future growth of the creative sector.

MIXT LTD

MIXT is a multi-disciplinary content creation & development studio based in Wellington.

ODDBOY

Oddboy is an eclectic crew of designers, 3D artists, developers and technologists. We work with brands and agencies to produce award winning games and digital experiences.

ONE FAT SHEEP

One Fat Sheep specialise in mixed and augmented reality and 360 interactive experiences that positively affect end users lives within the manufacturing, tourism and marketing industries.

PEPPER CREATIVE

Video, 2D/3D animation, VR/AR for industry.

PERCEPTUAL ENGINEERING

We provide creative and technical services to the entertainment, film, museum and art industries, using a range of technologies to bring ideas to life.

PIKPOK

Since 2009, PikPok has been making quality mobile games for the whole world to enjoy. We focus on engaging and delighting players with high quality art, intuitive gameplay and rewarding in-game experiences.

RED CRATER SOFTWARE SOLUTIONS LTD

Revit Holoview. Hololens application for viewing Revit BIM models and overlay on real buildings.

RUSH DIGITAL

Re-engineering the lines between reality and digital and bringing the future to your fingertips.

SAMSUNG

Mobile and VR hardware manufacture and sale.

SHOTZ PRODUCTIONS LTD

Training & consultancy around VR/AR/MR; equipment hire & support.

SHOWHOW

Virtual Reality Training Tools.

STAPLES VR

Content Creation Studio with rental and tech support.

STICKMEN STUDIOS

Stickmen Media is a video game and app development company in Christchurch. We develop virtual reality and augmented applications for serious purposes and entertainment.

SYSDOC

Digital solutions development and consulting in communications, change, knowledge management, learning, gamification and business process

TAG THE AGENCY

TAG The Agency specialises in digital storytelling.

TRIMBLE

Mixed Reality Services for Architecture, Engineering & Construction. Indoor and outdoor capabilities. Rugged, reliable, precise applications.

VEREL

Changing the way people experience 360-degree video.

VERSOVR LTD

VersoVR create fully interactive room-scale virtual reality experiences for entertainment and industry. Most of our projects allow multiple participants to compete or work together simultaneously.

VIRTUAL REALITY KIWI

Hardware Platforms for Walking and Running in Virtual Reality.

VIRTUALREALITYRENTAL.CO.NZ

Renting VR gear around New Zealand since 2013.

VIZEXPLORER

VizExplorer powers space and profit optimization, marketing intelligence, sales enablement, and real-time service automation solutions for gaming, manufacturing and sports and entertainment venues.

VRX LTD

Comprising talent across industries, VRx has a perfect mix of technological innovators, creative & strategic thinkers coming together

to form a best of breed Virtual Reality studio.

WAXEYE LTD

Our approach combines craftsmanship and creative problem solving in a way that keeps storytelling at the heart of everything we do.

WORKBRIGHT

Providing digital learning development in elearning, virtual reality simulations, interactive 360 video and augmented reality performance support. Keen to share our passion for effective, affordable learning and improved business performance.

WRESTLER

Wrestler is a creative agency making video, VR & AR content. Wrestler also creates their own IP through VR, AR, games storytelling.

SUPPORT ORGANISATIONS**COLLEGE OF CREATIVE ARTS, MASSEY UNIVERSITY**

Billed as the most comprehensive design school in New Zealand.

MEDIA DESIGN SCHOOL

Media Design School provides a Graduate Diploma in VR/AR, and also incorporates these into our other Design degrees.

THE UNIVERSITY OF AUCKLAND

Interactive learning experiences based on large datasets.

UNIVERSITY OF OTAGO

The HCI Lab at the University of Otago is one of NZ premier research lab for nearly all aspect of Mixed Reality covering hardware, software, and evaluation.

VICTORIA UNIVERSITY OF WELLINGTON

Victoria University of Wellington has over 50 staff and postgraduate students working on dedicated cross-reality research projects in five different faculties.

VRARA

The VRARA is an international organisation with over 45 staff, dedicated to encouraging collaboration between innovative companies and people in the VR & AR ecosystem.

WREDA

We help drive the economy forward - economic development agency. (R&D) business funding, connections and international capital & talent attraction.

SUPPORT VENUES

ACG YOOBEE SCHOOL OF DESIGN

Yoobee programmes embrace new and emerging technologies and the latest media platforms, with pathways from certificates and diplomas through to degrees with some of our partner schools.

AR/VR GARAGE

AR/VR/MR content, colocation/incubation, subsidised tools & resources, R&D project pipeline, domestic and international connectivity and alliances, investor connections, consultancy, business mentoring, industry cluster services.

GEO AR GAMES LTD

We turn urban parks into digital playgrounds for kids.

HIT LAB NZ

The HIT Lab NZ is a dynamic, international, multidisciplinary environment, bringing together people with varying viewpoints to design new ways of supporting people in their everyday lives, be it at work, play, or school.

MAHUKI

Mahuki is Te Papa's Innovation Hub. We support the accelerated formation of technology businesses focused on enterprise and experience innovation in the culture and heritage sector. This includes AR, VR, gamification, AI, IoT, 3D proto-typing and so on. Basically, any technology that will help us create new and exciting visitor experiences and run our businesses more sustainably.

PROJECTR VR LTD

Owns PROJECTR, New Zealand's Virtual & Mixed Reality Centre. PROJECTR brings together great minds in an incredibly creative space and provide the resources to be successful in the virtual, augmented and mixed reality sector.

THRILLZONE

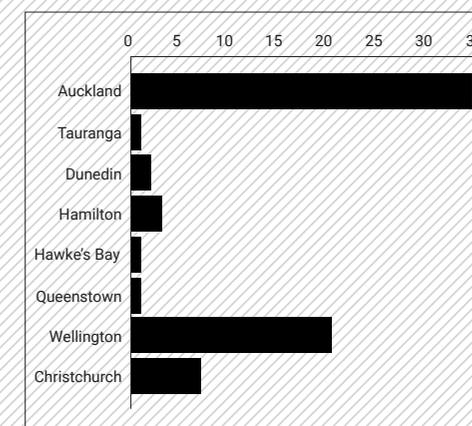
Thrillzone - one location for a world of Thrills! VR and AR Fun.

PLEASE NOTE

Organisations who would like to be included in Report Two: GOING NEXT LEVEL can send logo, business name and a brief descriptor to office@nzvrara.nz for inclusion. We reserve the right to edit content for accuracy or brevity.

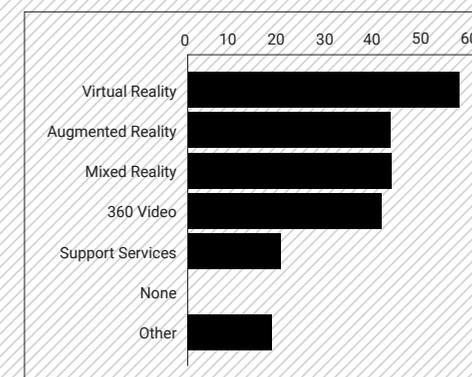
SURVEY DATA

Q1. NUMBER OF CROSS-REALITY COMPANIES PER CITY IN NZ



CITY	NUMBER OF COMPANIES
Auckland	34
Tauranga	1
Dunedin	2
Hamilton	3
Hawke's Bay	1
Queenstown	1
Wellington	20
Christchurch	7

Q2. WHICH OF THE FOLLOWING TYPES OF CROSS-REALITY TECHNOLOGIES DO YOU WORK IN?



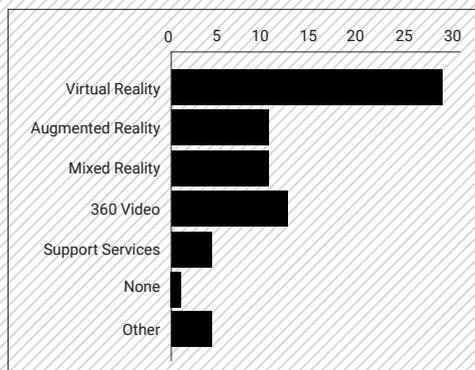
TYPE OF CROSS-REALITY	NUMBER OF COMPANIES
Virtual Reality	56
Augmented Reality	42
Mixed Reality	42
360 Video	40
Support Services	19
None	0
Other	17

OTHER ANSWERS	NUMBER OF COMPANIES
Artificial Intelligence	1
Rental and Consultation	1
Holograms and Illusions	2
Mocap	1
VRCAD Operations	1
Hardware Rental	2
Software Development	1
Apps	1
Gaming	1
Actuality	1
Creative Design / Development	1
Training and Advocacy	1
Social VR	1
Local government	1
PhD Research	1
International Business Attraction and Investment	1

We received a 61% response rate, with 69 responses from 112 organisations surveyed. The geographic spread of organisations was in line with expectations. As this was our first ever survey, we anticipate respondent quantity to increase significantly for future surveys.

Most participants are active in the three cross reality technologies with the majority also involved with 360° video. Companies may not yet be specialising – indicative of the early state of the industry.

Q3. WHICH OF THE FOLLOWING IS THE MAIN TYPE OF CROSS-REALITY TECHNOLOGY YOU ARE MOSTLY WORKING IN?

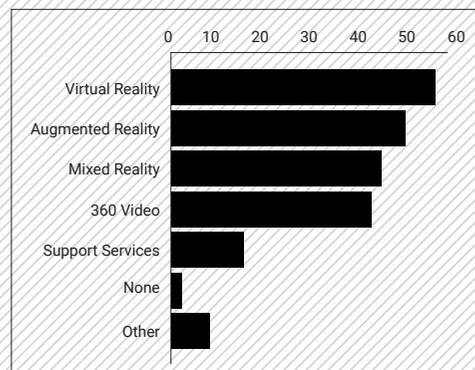


TYPE OF CROSS-REALITY	NUMBER OF COMPANIES
Virtual Reality	28
Augmented Reality	10
Mixed Reality	10
360 Video	12
Support Services	4
None	1
Other	4

OTHER ANSWERS	NUMBER OF COMPANIES
Equally across all technologies	1
Experiential	1
Holograms	1
Consulting	1

When asked to select only one technology, engagement with virtual reality was almost a third higher than the other two technologies and 360° video. Interestingly, when only able to select one service, the number of companies providing support services plummeted from 19 to 4. This may indicate that cross-reality technology companies are providing other support services, perhaps to supplement their revenue during the early start-up phase. This was reflected in our interviews.

Q4. WHICH OF THE FOLLOWING TYPES OF CROSS-REALITY TECHNOLOGY ARE YOU LIKELY TO BE WORKING WITH IN TWO YEARS FROM NOW?

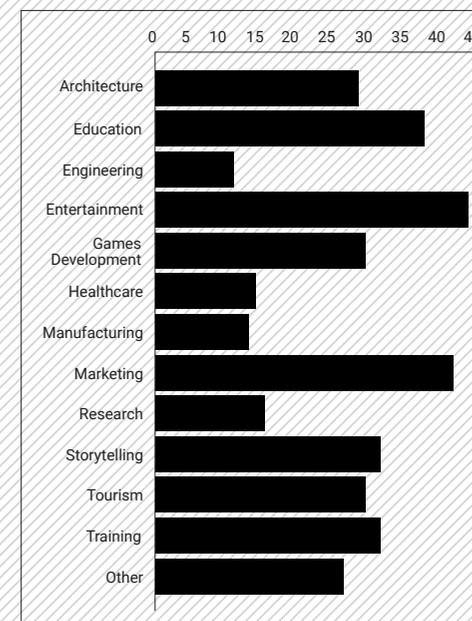


TYPE OF CROSS-REALITY	NUMBER OF COMPANIES
Virtual Reality	54
Augmented Reality	48
Mixed Reality	43
360 Video	41
Support Services	15
None	2
Other	8

OTHER ANSWERS:	NUMBER OF COMPANIES
Artificial Intelligence	1
Holograms and illusions	2
The next amazing piece of technology	1
Mocap	1
Software Development	1
Apps	1
Social VR	1
Converged services	1

Again, when able to select multiple technologies, most respondents elected to select two or more technologies as well as 360° video. It is anticipated that technology specialisation will increase as the volume, size and value of projects grows. Other services spanned the sector's skillsets.

Q5. WE WOULD LIKE TO UNDERSTAND WHERE CROSS-REALITY TECHNOLOGIES ARE BEING USED. WHICH OF THE FOLLOWING SECTORS HAVE YOU PREVIOUSLY PROVIDED SERVICES TO?



SECTORS	NUMBER OF COMPANIES
Architecture	28
Education	37
Engineering	11
Entertainment	43
Games Development	29
Healthcare	14
Manufacturing	13
Marketing	41
Research	15
Storytelling	31
Tourism	29
Training	31
Other	26

OTHER SPECIFICATIONS:	NUMBER OF COMPANIES
Environment & Conservation	1
Airline	2

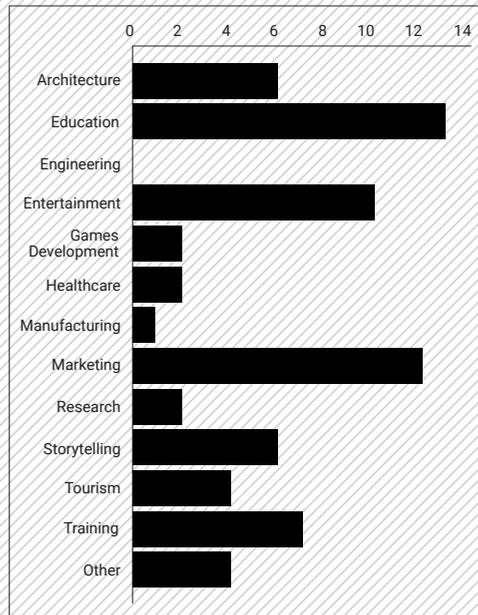
Movie Studios	1
IT	1
Online Crime	1
Forensics	1
Police	2
Military	1
Banking	1
Corporate Learning	1
Real State	3
Museums & exhibitions	2
Expo Events	1
Charity	2
Utilities	2
Mobile applications	1
Construction	1
Community engagement	1
Interior Design	1
Visitor Experience/Art/ Fine arts	2
Fitness	1
Transport	1
Retail	1

As expected, entertainment (43) was the most popular vertical sector respondents are working in. Marketing (41) and Education (37) were also popular with over half of all respondents having completed work in all three verticals. Architecture (28), Storytelling (31) and Training (31) also had high engagement.

Responses to the Other (26) option demonstrates the breadth of sectors that VR/AR/MR, 360° video and related services are being deployed into.

Question 6 on the following page also demonstrates this spread, in response to being able to choose only one main sector.

Q6. WHICH OF THE FOLLOWING IS THE MAIN SECTOR YOU HAVE PROVIDED SERVICES TO?

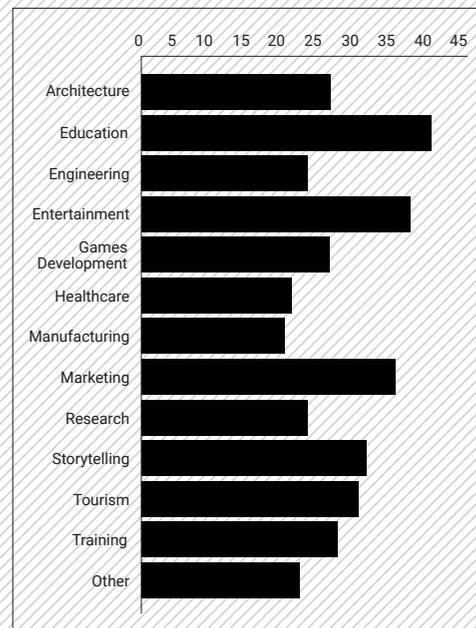


SECTORS	NUMBER OF COMPANIES
Architecture	6
Education	13
Engineering	0
Entertainment	10
Games Development	2
Healthcare	2
Manufacturing	1
Marketing	12
Research	2
Storytelling	6
Tourism	4
Training	7
Other	4

OTHER SPECIFICATIONS:	NUMBER OF COMPANIES
Working across all sectors	1
Utilities	1
Construction	1
Fine Arts	1

With respect to Q6, Game Development was surprisingly low, reflecting the small number of dedicated game developers who responded. The top three sectors were education, entertainment and marketing.

Q7. WE WOULD LIKE TO UNDERSTAND WHERE CROSS-REALITY TECHNOLOGIES ARE LIKELY TO BE UTILISED IN THE FUTURE. WHICH OF THE FOLLOWING SECTORS ARE YOU LIKELY TO PROVIDE SERVICES TO WITHIN THE NEXT TWO YEARS?



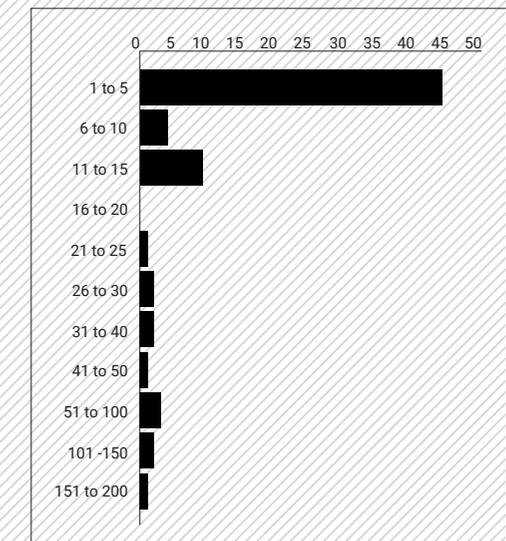
INDUSTRIES	NUMBER OF COMPANIES
Architecture	26
Education	40
Engineering	23
Entertainment	37
Games Development	26
Healthcare	21
Manufacturing	20
Marketing	35
Research	23

Storytelling	31
Tourism	30
Training	27
Other	22

OTHER SPECIFICATIONS:	NUMBER OF COMPANIES
Environment & Conservation	1
Airline	1
Movie Studios	1
IT	1
Online Crime	1
Forensics	1
Police	1
Military	1
Construction	1
Company Events	1
Conferences	1
Utilities	2
Mobile applications	1
Construction, Building Services	1
Community Engagement	1
Interior Design	1
Visitor experience/Art	1
Museums & exhibitions	1
Fine Arts	1
Fitness	1
Transport	1

Q7 shows the wide range of vertical sectors that the XR industry is involved in. Many of these such as architecture, healthcare, manufacturing, and Police may have a high training component. This demonstrates the productivity increase and greater engagement from deployments of these technologies.

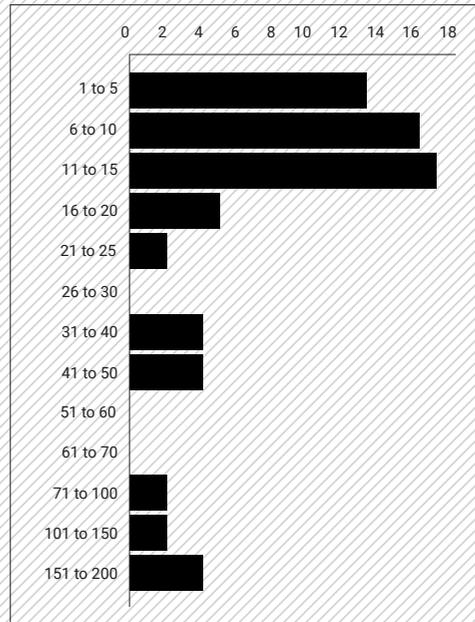
Q8. WE WOULD LIKE TO ESTIMATE THE SIZE OF THE LOCAL CROSS-REALITY INDUSTRY. PLEASE SELECT THE NUMBER OF FULL-TIME EQUIVALENT STAFF YOU ARE CURRENTLY EMPLOYING OR WORKING ALONGSIDE.



NUMBER OF EMPLOYEES	NUMBER OF COMPANIES
1 to 5	44
6 to 10	4
11 to 15	9
16 to 20	0
21 to 25	1
26 to 30	2
30 to 40	2
41 to 50	1
51 to 100	3
101 to 150	2
151 to 200	1

63% of respondents have 1-5 fulltime equivalent staff, reflecting the start-up nature of this early adopter group. As highlighted on the following page, 70% of this group expect to have more than 5 staff in two years, with significant hiring contemplated by respondents.

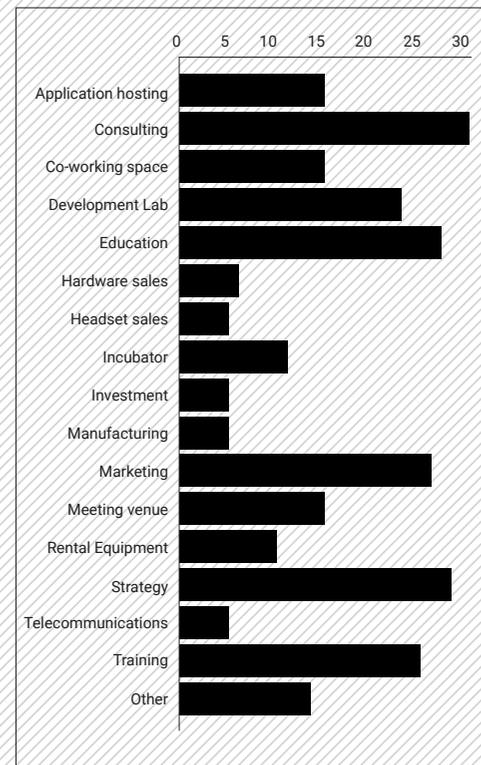
Q9. WE WOULD LIKE TO ESTIMATE THE SIZE OF THE LOCAL CROSS-REALITY INDUSTRY IN THE YEARS TO COME. PLEASE ESTIMATE THE NUMBER OF FULL-TIME EQUIVALENT STAFF YOU MIGHT BE EMPLOYING OR WORKING ALONGSIDE IN TWO YEARS FROM NOW.



NUMBER OF EMPLOYEES	NUMBER OF COMPANIES
1 to 5	13
6 to 10	16
11 to 15	17
16 to 20	5
21 to 25	2
26 to 30	0
31 to 40	4
41 to 50	4
51 to 60	0
61 to 70	0
71 to 100	2
101 to 150	2
151 to 200	4

The total number of FTEs predicted to be employed by the 61% who responded is in the midpoint range of 1940 FTEs. If we extrapolate to include the missing 39%, FTEs would be in the midpoint range of 2697 FTEs in two years.

Q10. WHICH OF THE FOLLOWING SERVICES, IF ANY, DO YOU OFFER TO THE CROSS-REALITY SECTOR WITHIN YOUR ORGANISATION?



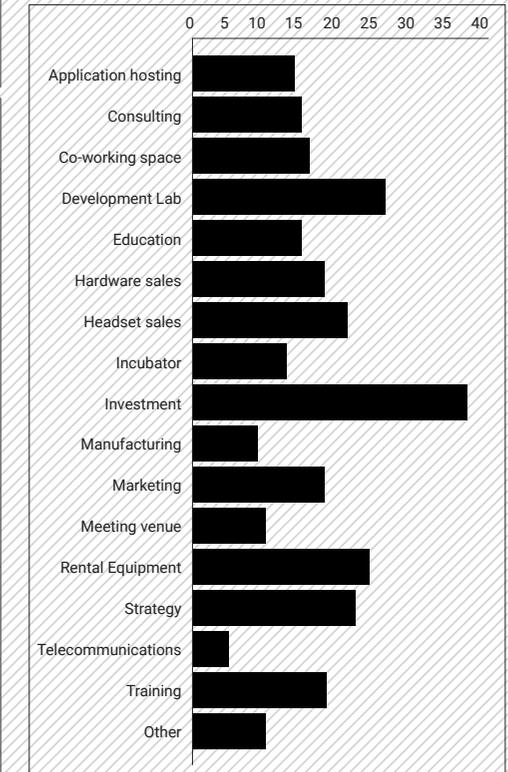
SERVICES	NUMBER OF COMPANIES
Application hosting	15
Consulting	30
Co-working space	15
Development Lab	23
Education	27
Hardware sales	6
Headset sales	5
Incubator	11

Investment	5
Manufacturing	5
Marketing	26
Meeting venue	15
Rental Equipment	10
Strategy	28
Telecommunications	5
Training	25
Other	14

OTHER ANSWERS:	NUMBER OF COMPANIES
None	1
Research	1
Entertainment	1
VRCAD	1
Development Outsourcing	1
We are a multi discipline company and this is technology is integrated into everything we do. It's simple another platform so everyone is involved.	1
customer support services	1
None (unless I misunderstood the question)	1
Sound and music production	1
Community Engagement	1
Software Development	1
Relationship building towards collaboration	1
International business development	1
Network events	1

The extent of support services offered by industry organisations is substantial, particularly marketing, education, training, consulting and strategy services.

Q11. WE WOULD LIKE TO BETTER UNDERSTAND WHAT SUPPORT SERVICES YOU MIGHT NEED IN THE NEXT TWO YEARS. FROM THE FOLLOWING LIST, PLEASE SELECT THOSE SERVICES YOU MAY NEED TO ACCESS WITHIN THE NEXT TWO YEARS.

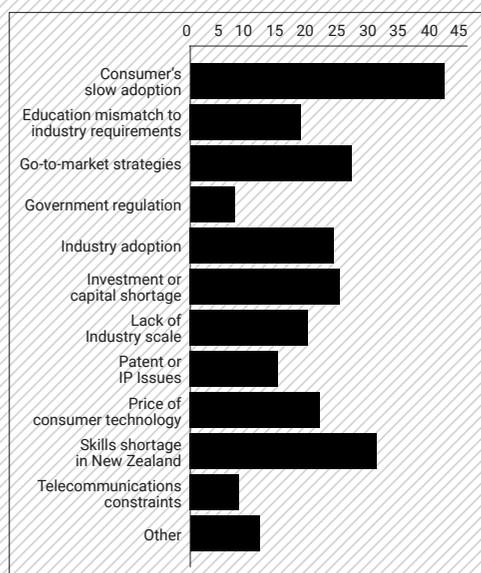


SERVICES	NUMBER OF COMPANIES
Application hosting	14
Consulting	15
Co-working space	16
Development Lab	26
Education	15
Hardware sales	18
Headset sales	21
Incubator	13
Investment	37
Manufacturing	9

Marketing	18
Meeting venue	10
Rental Equipment	24
Strategy	22
Telecommunications	5
Training	18
Other	10

OTHER ANSWERS:	NUMBER OF COMPANIES
Global Marketing	1
Entertainment	1
Content Development	1
24 hr support services	1
Recruitment of international talent	1
International Networking	1
Community Engagement	1
Strategic Alliances	1
International business development	1

Q12. FROM THE LIST BELOW, WHAT DO YOU BELIEVE TO BE THE BIGGEST CHALLENGE FACING THE CROSS-REALITY SECTOR IN THE NEXT TWO YEARS?



CHALLENGES IN THE SECTOR	NUMBER OF COMPANIES
Consumer's slow adoption	41
Education mismatch to industry requirements	18
Go-to-market strategies	26
Government regulation	7
Industry adoption	23
Investment or capital shortage	24
Lack of Industry scale	19
Patent or IP Issues	14
Price of consumer technology	21
Skills shortage in New Zealand	30
Telecommunications constraints	8
Other	11

OTHER ANSWERS:	NUMBER OF COMPANIES
Filtering though low end content	1
Shortcomings in Government support to this new disruptive business type compared to support given to existing businesses versus what other countries offer.	1
Distribution	1
Appeal Content for consumers	1
Business consumer's slow adoption	1
The risk is similar to that which faced 3D TV. I think there will be a lot of money lost in this sector trying to find the best use of this technology.	1
Cost of development is the biggest barrier to client adoption currently	1
Arrival of supporting technologies - primarily hardware related	1
Improvement in hardware	1
Funding	1
Lack of content	1

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- Auckland University of Technology **www.aut.ac.nz**
- Buildmedia **www.buildmedia.com**
- Datacom **www.datacom.co.nz**
- Epic Innovation **www.epicinnovation.co.nz**
- HITLabNZ **www.hitlabnz.org**
- Imersia **www.imersia.com**
- NZVRARA **www.nzvrara.nz**
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- Staples Rentals **www.staplesrentals.co.nz**
- Staples VR **www.staplesvr.com**
- Stickman Media **www.stickmanmedia.com**
- Studio Pacific Architecture **www.studiopacific.co.nz**
- VRARA **www.thevrara.com**

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This report is one of a two part series on the New Zealand VR/AR Ecosystem. Please read in conjunction with Report Two.

GOING NEXT LEVEL

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NZVRARA REPORT TWO COMING SOON

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