



AR/VR/XR MARKET REPORT

SEPTEMBER 2020

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Eight360



Beyond Studio

INTRODUCTION

Motivation

This report is a summary of a report provided to the Innovative Partnerships Programme at the New Zealand Government's Ministry of Business Innovation and Employment (MBIE). It aims to:

- Better understand the current state of the NZ AR/VR/XR sector
- Identify NZ's unique strengths in the AR/VR/XR sector, relative to the global industry
- Identify potential international R&D partners to help the domestic sector grow.

The goal is to provide a comprehensive report on the state of New Zealand's immersive technology (AR/VR/XR) sector for the industry, policy makers, academics, students and anyone with an interest in how emerging technologies can contribute to New Zealand's future economic development.

[1] <https://artillery.co/artillery-intelligence/ar-global-revenue-forecast-2018-2023/>

[2] <https://artillery.co/artillery-intelligence/vr-global-revenue-forecast-2018-2023/>

[3] <https://www.mbie.govt.nz/assets/b1dfe81d48/virtual-gets-real-nzvrar-report-one.pdf>



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HĪKINA WHAKATUTUKI

Introduction

Over the last decade the global Virtual Reality (VR), Augmented Reality (AR) and eXtended Reality (XR) industry has grown dramatically and will continue to do so (from \$15 Billion USD globally in 2020 to over \$40 Billion by 2025^[1,2]). Millions of people are using VR head mounted displays like the Oculus Quest in their homes and workplaces, and hundreds of millions are having mobile AR experiences on their phones with applications such as Pokemon Go.

There is a significant opportunity for NZ AR/VR/XR companies and researchers due to this growing market. This summary report provides an overview of the NZ VR/AR/XR industry and NZ research capabilities in these areas. This is done in the context of the global industry and also explores the perception that international leaders in the field have of the NZ industry and researchers.

This report extends the work conducted by the NZ VR/AR Association (NZ VRARA) in 2017, and the publication "Virtual Gets Real: The Explosion of Cross Reality in NZ"^[3].

Methodology

This report is largely based on data collected from three online surveys:

- 1/ An Industry survey of NZ companies in the AR/VR/XR space
- 2/ A Research survey of NZ academic researchers in the AR/VR/XR space
- 3/ A Expert survey of international leaders in the AR/VR/XR space and their perception of NZ AR/VR/XR industry.

The surveys involved a mixed of rating questions and free form answers. The Industry survey had many questions that were drawn from the 2017 NZ VRARA report, so that the responses could be compared to the feedback from 2017.

Note the data was collected between May 19th and July 27th 2020 and so the responses may have been affected by the COVID restrictions in place in NZ at the time.

Datasets

Data was collected from 83 companies, 67 academics and 27 international experts. We identified over 100 NZ companies in AR/VR/XR space, so we estimate an 80% response rate, including from all of the largest NZ AR/VR/XR companies. All of the most prolific NZ academic researchers responded. All of the respondents are listed in the document Appendix.

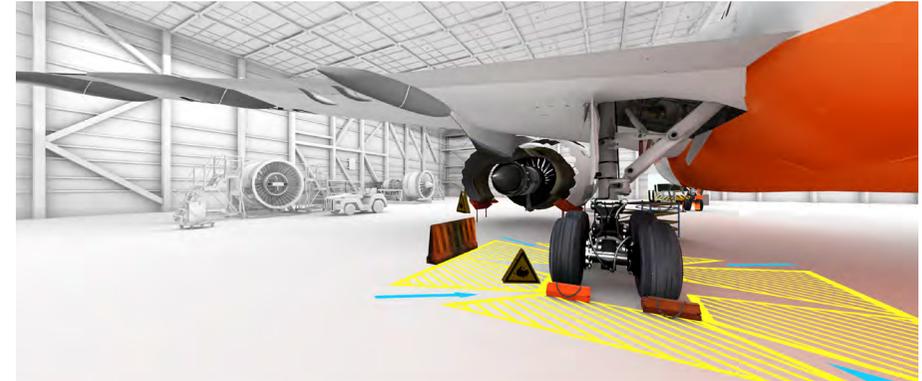
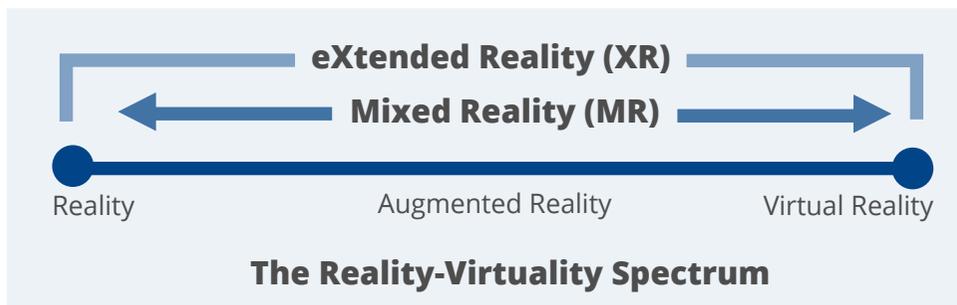
DEFINITIONS

Virtual Reality (VR): Virtual Reality (VR) is an interactive technology which replaces a person's sensory input with computer generated content. VR systems may use Head Mounted Displays (HMDs) and head, body and hand tracking to create the illusion that a person is inside a computer generated Virtual Environment (VE).

Augmented Reality (AR): Augmented Reality (AR) is technology that seamlessly overlays digital content on a person's real surroundings. AR has three key characteristics; (1) it combines real and virtual content, (2) it is interactive in real-time, and (3) the virtual content is registered in three dimensions. AR systems use HMDs, handheld displays, or projectors to create the illusion that virtual imagery is part of the real world.

Mixed Reality (MR): The real world, AR and VR can be placed on a continuum based on how much of the a person's reality is replaced, with the Real World at one end, VR at the other end, and AR in between, Mixed Reality refers to the points along the continuum between Reality and Virtual Reality, but not including the endpoints.

eXtended Reality (XR): The term eXtended Reality (XR) was coined to refer to all of the points along the MR continuum including the endpoints of the Real World and Virtual Reality. The figure below shows the Reality-Virtuality spectrum and the relationship between AR/VR/MR/XR. In this document we use the term XR to refer to AR/VR in general.



VR Example

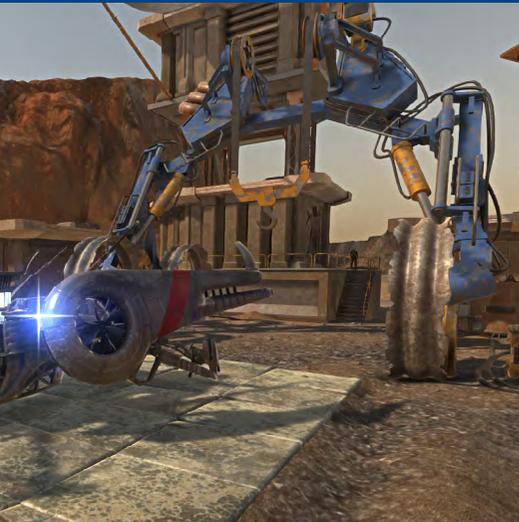
Staples VR is a NZ company using VR for training. In one of their applications Aviation Maintenance Crew can put on a VR HMD and learn how to safely work around an aircraft in a hangar.



AR Example

Quivervision is a NZ company using AR for education and marketing. They produce AR colouring book technology that allows people to colour real pages and then view them through their phones and tablets and see AR content to come to life off the pages, using the colours they used.

THE GLOBAL MARKET



Red River Studio



Many Worlds



Shadow Space

GLOBAL MARKET

- The AR/VR/XR industry is projected to grow to more than \$40B USD by 2023
- Long term, the AR industry is projected to overtake the VR industry
- Over 7 million AR/VR displays will ship in 2020, growing to over 75 million in 2024
- The largest markets are China and the US

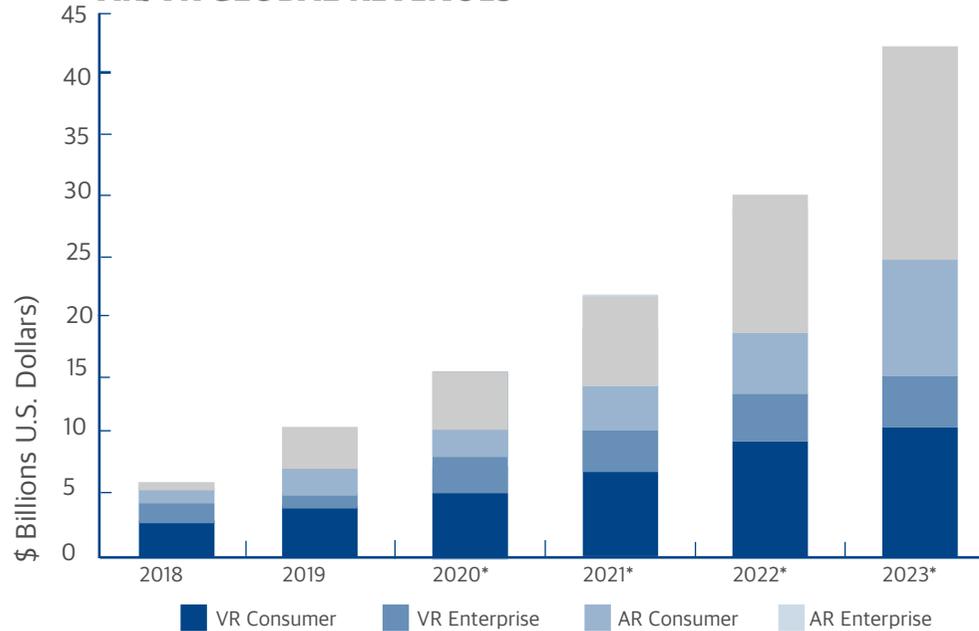
Over the last several years the global AR/VR/XR industry has been growing strongly. Summarizing several different analyst reports, the market is projected to rapidly grow from around \$15 Billion USD in 2020 to more than \$40 Billion USD in 2023. Overall the AR market should overtake the VR market over the long term, with most AR revenue coming from the enterprise space while VR revenue is largely from consumer products.

IDC predicts 7 million AR/VR head mounted displays will be shipped in 2020 with 90% of those being VR displays, and by 2024 there will be over 75 million displays shipping annually with 55% of them AR displays^[1]. Geographically, the largest spending is in the USA and China with around 30% each of global revenue^[2].

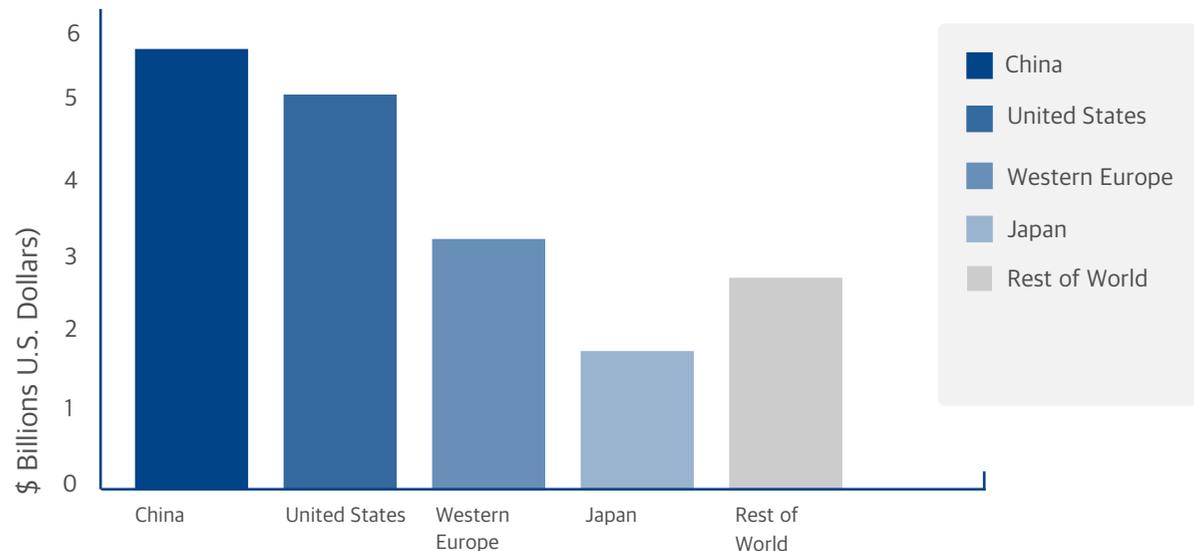
[1] <https://www.idc.com/getdoc.jsp?containerId=prUS46143720>

[2] <https://www.idc.com/getdoc.jsp?containerId=prUS45679219>

AR/VR GLOBAL REVENUES



GLOBAL VR/AR FORECAST SPENDING WORLDWIDE 2020



MARKET SECTORS

- The consumer sector is the largest market section, at \$7B USD in 2020
- Globally most AR/VR companies are working in the Applications space.

VR/AR technologies are employed in many different sectors. According to IDC, these can be organized into Consumer, Distribution and Services, Manufacturing and Resources, Public Sector and Infrastructure sectors^[1]. The consumer sector currently attracts more revenue than the others due to the gaming and entertainment industries. However, by 2025 the growth of AR use in Manufacturing should lead this to be the dominant sector.

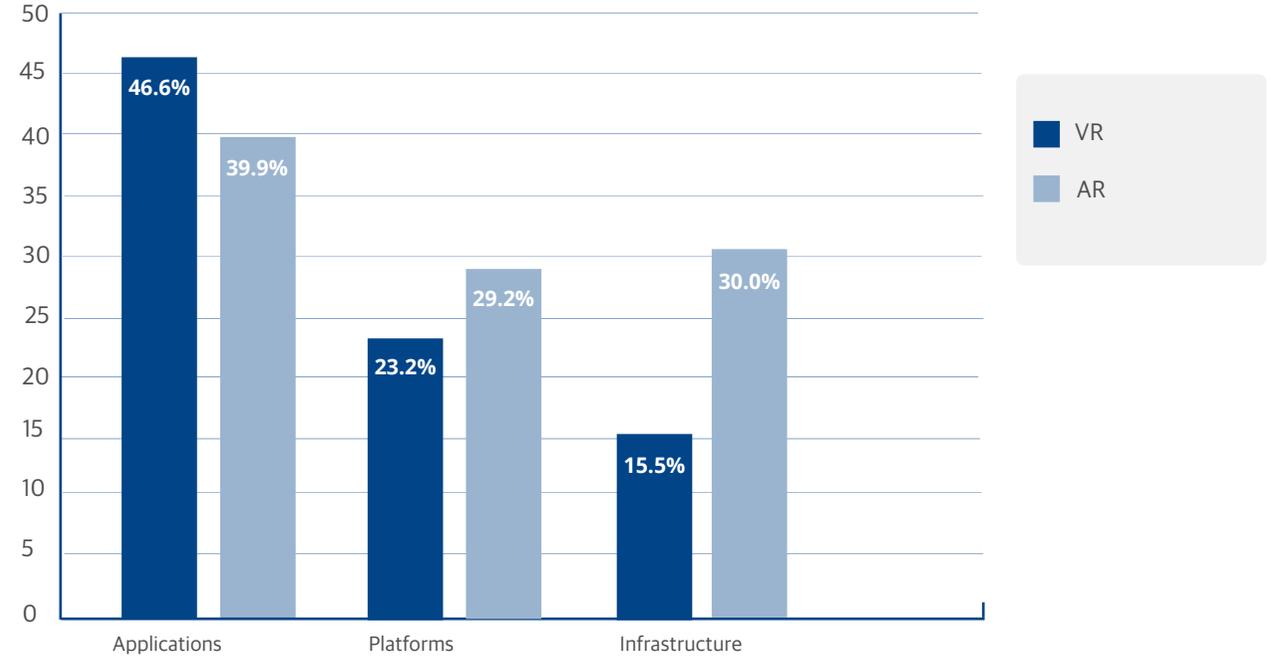
The VR Fund produces an annual AR/VR industry landscape. In 2019 this listed 550 VR companies and 330 AR companies^[2], categorized into the three broad areas of:

- **Infrastructure:** Hardware components that are fundamental to AR/VR experiences.
- **Tools/Platforms:** Software and hardware enabling the creation of AR/VR experiences.
- **Applications:** AR/VR applications/services developed using the tools/platforms and infrastructure.

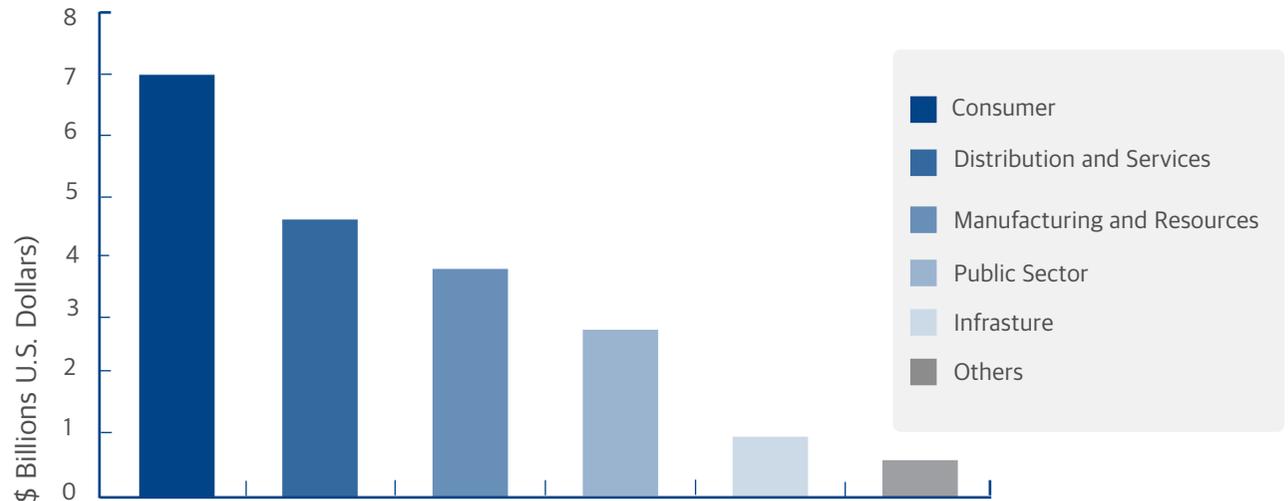
[1] <https://www.idc.com/getdoc.jsp?containerId=prUS45679219>

[2] <https://www.thevrfund.com/landscapes>

VR FUND INDUSTRY BREAKDOWN



GLOBAL VR/AR FORECAST SPENDING BY SEGMENT 2020



COVID-19 IMPACT

- AR/VR/XR technologies are well-placed to find solutions to the COVID-19 crisis
- A COVID-19 free NZ could lead to opportunities in domestic AR/VR production.

COVID-19 is predicted to have a significant impact on the AR/VR/XR industry in the short term, but the market will rebound over the long term. Travel restrictions could have a significant impact on NZ companies recruiting internationally, and on research students joining educational institutions.

Industry Impact

The IDC are predicting a significant impact on shipments of AR/VR HMDs with a 24% decline in the second quarter of 2020^[1], but returning to normal by the end of the year. Superdata forecasts a drop in business for VR Location Based Entertainment due to lack of customers, with 2020 to be one-quarter of 2019^[2] spending, and and by 2023 LBE spending will still be 29% lower than the total in 2019. Digi-Capital predict an overall reduction in global market value of between \$1.5 billion and \$2 billion compared to pre-COVID levels, but a return to a potential \$65 Billion USD global market by 2024^[3].

[1] <https://www.idc.com/getdoc.jsp?containerId=prUS46143720global-revenue-forecast-2018-2023/revenue-forecast-2018-2023/>



VR Conferencing in Zoom, Univ. of Auckland

New Opportunities

There will be new opportunities that will grow the industry, especially in tools for remote collaboration, education and tourism. With the increase in the number of online corporate meetings and events through web conferencing tools, applications can be introduced that further enhance the collaborative experience, using AR/VR technology. For example, researchers at the University of Auckland are creating a system which supports conferencing from Zoom, providing enhanced spatial cues compared to video conferencing.

[2] <https://www.superdataresearch.com/blog/superdata-xr-update>



Australian filmmaker Tony Ayres

COVID-free NZ

Being almost COVID-free has created new opportunities, compared to other locations. In particular, NZ companies can create AR/VR content in a way that would be difficult in other countries, and NZ academics can run research studies without social distancing.

Australian filmmaker Tony Ayres says: *“Quite simply there are increasingly fewer places that are as safe as New Zealand..If you give [companies] reasons why they can make their show in your country you’ve got the chance to benefit from that. I know for a fact people are already looking towards NZ.”*

[3] <https://www.digi-capital.com/news/2020/04/how-covid-19-change-ar-vr-future/>

FUTURE TRENDS

- Social AR/VR and remote collaboration will be increasingly important and prevalent
- Technology developments will make AR/VR displays more socially acceptable
- 5G will have a significant impact on content delivery and networking
- Improved content capture and sensors will improve the user experience
- Interfaces will become more natural with support for speech, gesture and gaze.

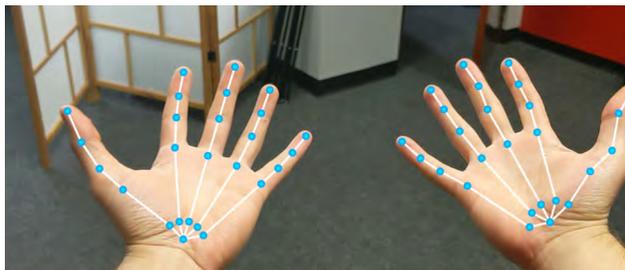
AR/VR/XR experiences are based on display, interaction, tracking, graphics and networking technologies, among others. There are significant enhancements happening in each of these areas, leading to widespread use and industry growth. For example, AR displays in a sunglass form factor, combined with 5G will enable field engineers to live stream a 3D view of their workspace to a remote expert who could use AR to help them with a physical task.

Sensors embedded in VR headsets combined with gesture and gaze tracking will enable sharing of face expressions and non-verbal cues in social VR spaces. This could enable large scale social VR experiences such as concerts, that people can experience from home.



New Display Technology

The development of thin waveguide displays will lead to socially acceptable AR displays which are nearly indistinguishable from normal glasses. Companies are also working on contact lens displays, although these are at least 10-20 years from consumer availability.

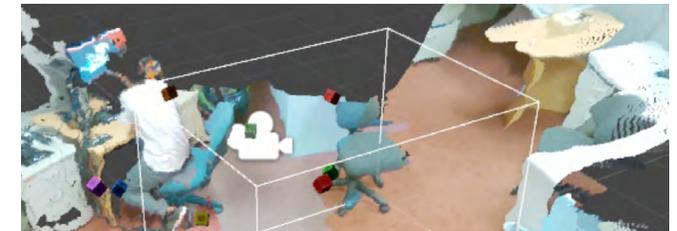


Natural User Interaction

The latest XR devices support hand and eye tracking, enabling people to interact with virtual content as naturally as they do with real objects. Soon sensors for face expression, and physiological responses (heart rate, brain activity) will be added, enabling sharing of rich communication cues, and measuring of people's reaction to XR experiences.

Enhanced Networking

The roll out of 5G will have a significant impact on AR and VR, enabling very high bandwidth and low latency data transmission. Combined with cloud services this will support city scale outdoor AR tracking, high resolution VR experiences, and sharing of rich natural communication cues.



Improved Content Capture

Advanced computer vision techniques and depth sensing hardware are being developed that will enable the rapid capture and virtual reproduction of real people and places. People could live stream 3D models of themselves or their surroundings.



Rich Collaboration

High bandwidth networking, sensing of user state, content capture and sharing of communication cues will enable new types of collaboration, such as having the feeling that you are sharing the same real world experience as another person.

NZ INDUSTRY



DotDot



RealityVirtual

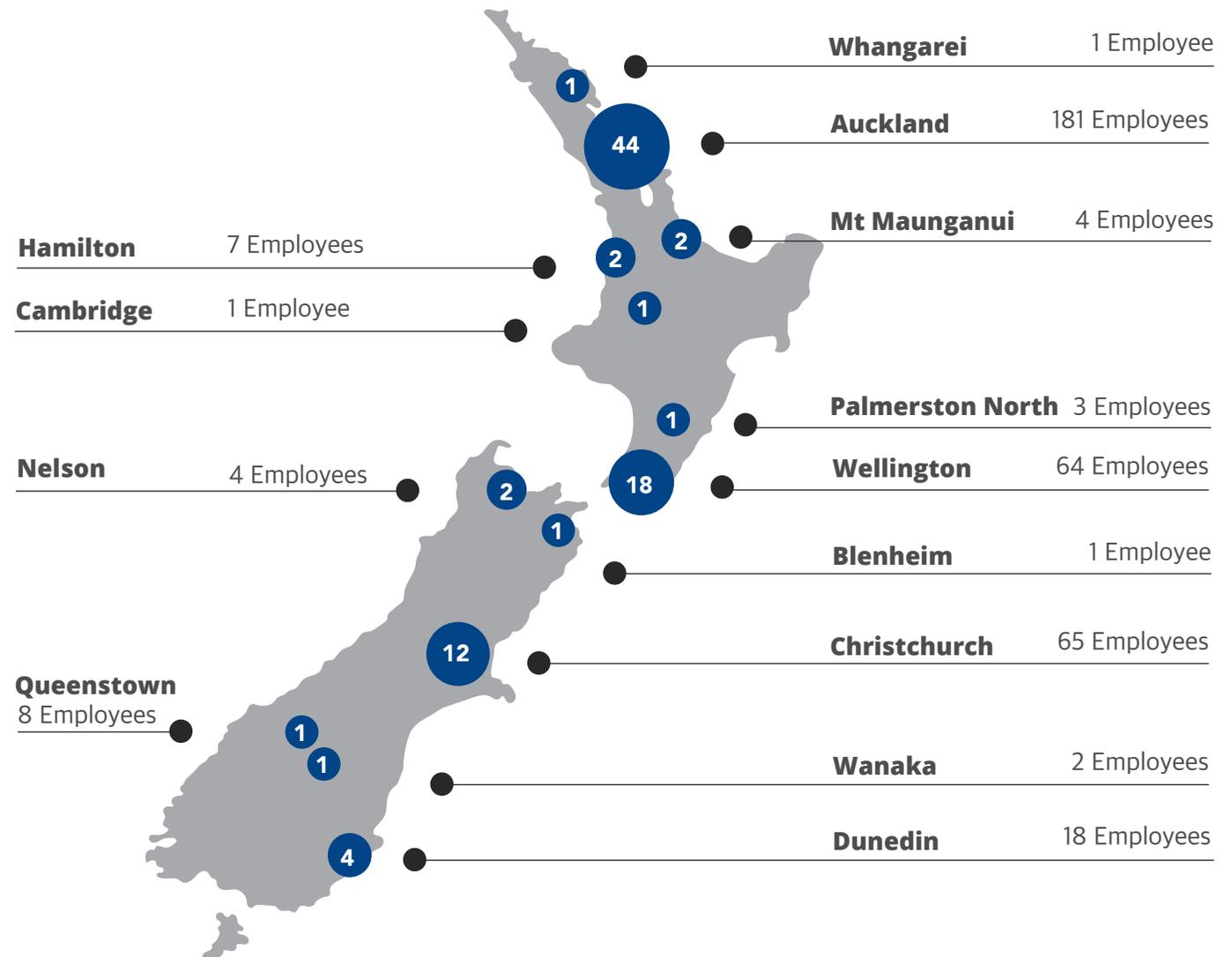


Staples VR

NZ INDUSTRY

Key Learnings

- Almost 90% of the NZ AR/VR industry are working in the application space
- Most NZ companies working on XR have an average of 4 employees working in this space.
- Companies typically work in more than one sector, with Gaming (24), Education (19), and Entertainment (6) the most popular.
- The overall market size is around \$40 million with average earnings of nearly \$90K per employee
- Most company revenue is from local sources, with less than half of XR companies having more than 10% of their revenue from international sources
- Companies that were export focused earned triple the revenue per employee than those which weren't
- There is relatively low engagement between industry and academia.



THE 83 COMPANIES WITH 378 EMPLOYEES WORKING IN XR IN NEW ZEALAND

Applications

Education



VR Game



Enterprise



Tourism



Advertising



Entertainment



Healthcare



Location Based



Social



Sports/Live Events



Tools

Distribution



3D Tools

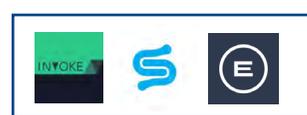


Reality Capture



Infrastructure

Devices



NZ VR LANDSCAPE

Applications

Education



Enterprise



Entertainment



Healthcare



Tourism



AR Game



Advertising



Social



Sports



Tools

Distribution



3D Tools



Reality Capture



Infrastructure

Devices



NZ AR LANDSCAPE

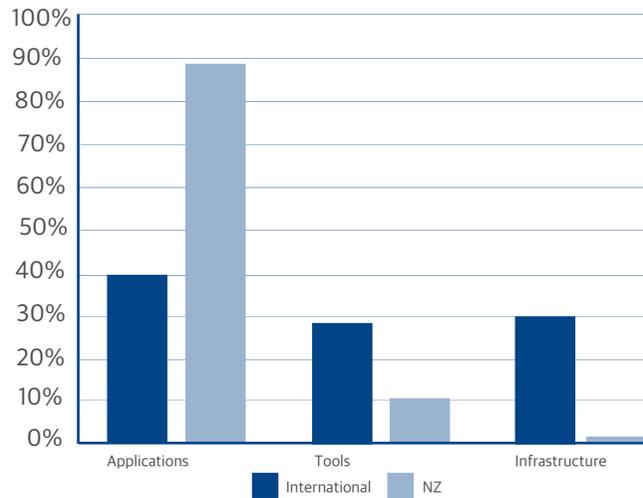
NZ XR INDUSTRY STRENGTHS

- NZ companies mostly work in the AR/VR/XR applications space
- There are few companies working in hardware and low level tools
- NZ is working more in education and tourism than international companies.

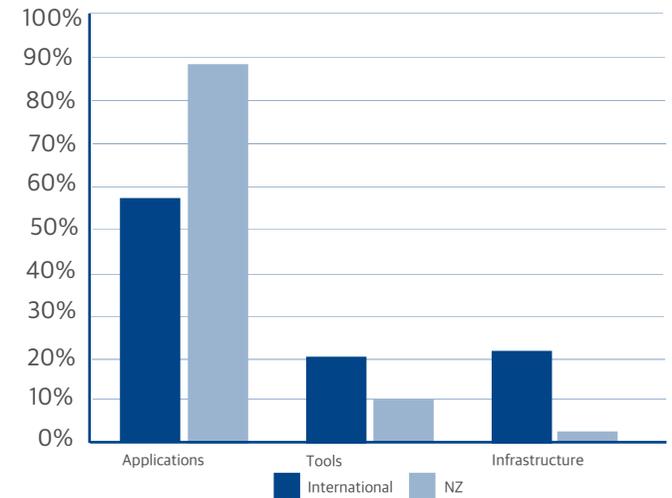
In both the AR and VR markets nearly 90% of the NZ companies working in AR/VR/XR are working in application development, with 10% working in tools and platforms, and almost no companies working on hardware devices and low level infrastructure. The AR and VR Industry breakdown charts show the comparison to the VR Fund collection of international companies, where there is more balance across categories.

The Applications Industry Breakdown chart shows how the NZ AR/VR industry compares to the VR Fund landscape. This shows that in the application space Game/Entertainment, and Education are both areas of strength for NZ companies. NZ has proportionally far more companies working in Education than the International VR Fund companies, but far fewer in Social Networking, and AR Enterprise. Tourism is another area of strength of NZ AR/VR companies. In the VR Fund breakdown, only 2% of VR companies working in Tourism, compared to 8% of NZ VR companies.

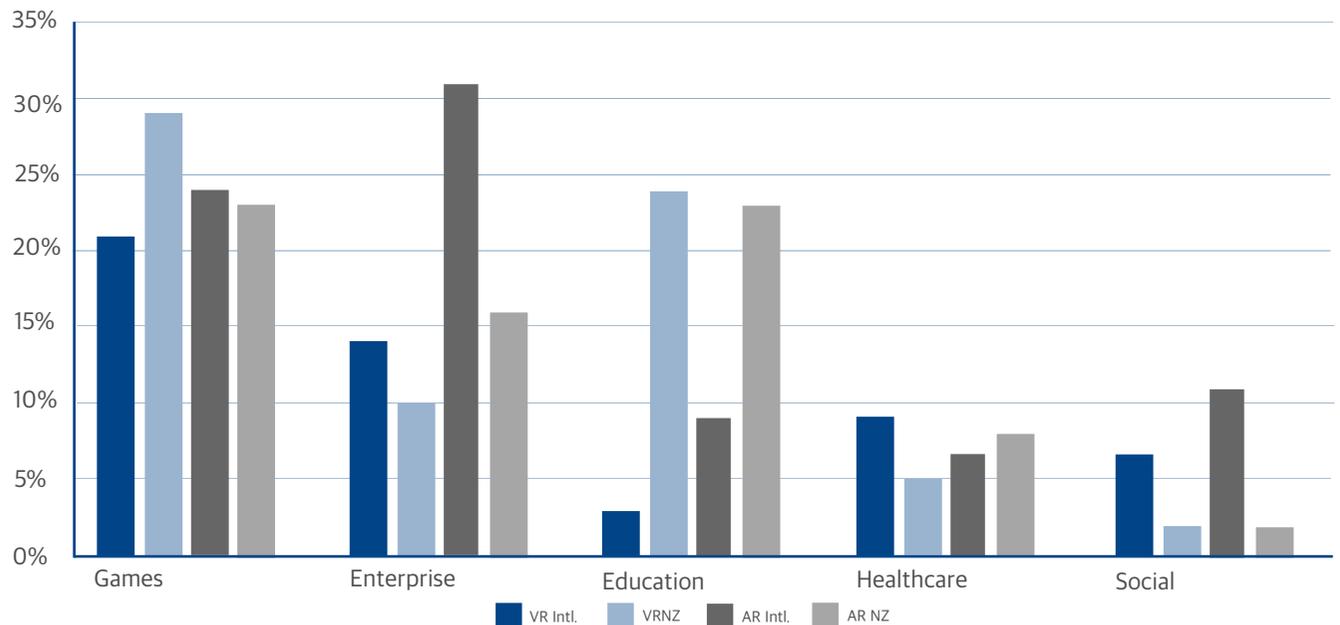
AR INDUSTRY BREAKDOWN



VR INDUSTRY BREAKDOWN



VR APPLICATIONS INDUSTRY BREAKDOWN



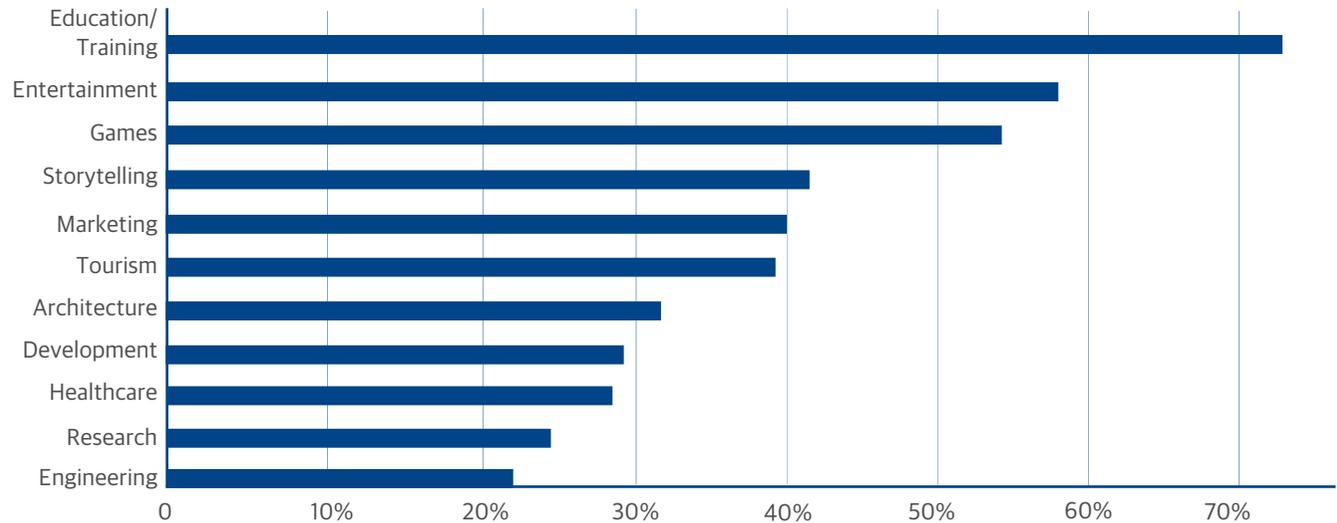
MULTIPLE SECTORS

- Most companies work in more than one sector in the AR/VR/XR space
- There was an average of 4.2 employees per company working in AR/VR/XR
- Education, Entertainment and Games are the most popular sectors.

Another strength of the NZ XR industry is that the companies focusing on XR are agile, working across multiple multiple industry sectors. The right graph shows the percentage of NZ XR companies doing work in each industry sector. Education, Entertainment and Gaming are the most popular sectors with over 50% of the companies working in these areas. On average companies worked in 5.16 sectors, out of the 16 sectors mentioned. This could be because many sectors require similar skills (e.g. 3D content creation for games or entertainment) and so it is relatively easy to target multiple sectors.

The table shows the NZ companies with the largest number of employees working in AR/VR and XR. Across all the companies, there was an average of 4.2 employees per company working on XR projects. Apart from Stretchsense, the largest numbers of XR employees are working at companies in which they form a minority of all of their employees, such as at Datacom.

PERCENTAGE OF NZ XR COMPANIES WORKING IN EACH SECTOR



Companies with the largest number of employees working in XR

No.	Company	Product	Employees
1	StretchSense	Motion Capture Gloves	26
2	Trimble navigation Ltd.	Navigation, Surveying	25
3	Datacom Group Ltd.	AR/VR Software Services	20
4	Weta Digital	AR/VR Content	20
5	Motion Cinema Ltd.	Location Based Entertainment	16
6	Wanderer Ltd.	Gaming	16
7	Weta Workshop	Gaming	15
8	Buildmedia Ltd.	Architectural Vizualisation	9
9	VR Voom Ltd.	Location Based Entertainment	9
10	Eight360	Motion Simulator	8

REVENUE IS SMALL

- Companies earned an average of \$400K NZD/year from AR/VR/XR sources
- Overall AR/VR/XR revenues in NZ is projected to be around \$40 million in 2020
- Average revenue/employee is around \$92K/year.

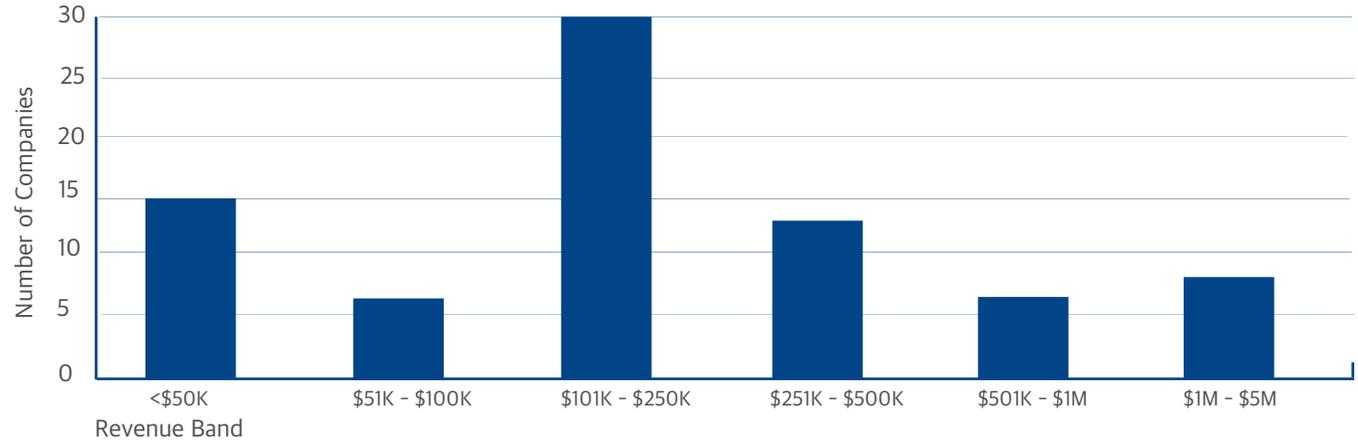
Companies reported on the revenue earned by their AR/VR/XR employees in a number of revenue bands. Overall, companies earned an average of \$400K/year from AR/VR/XR sources, but the median was \$125K showing most companies earned less. Summing all the company revenues, produces a total revenue estimate of \$33 million, and an average revenue/employee of \$92K.

Considering the survey response rate, this shows that the total current XR market value in NZ could be around \$40 million. This compares to over \$200 million in revenue for the NZ computer game industry, and also \$300K revenue per gaming employee^[1].

The table shows the NZ companies working in AR/VR/XR with the highest total estimated revenue from XR sources (XR Revenue), and the highest estimated revenue per employee(\$\$/Person).

[1] <https://futurefive.co.nz/story/nz-gaming-industry-thriving-as-revenue-skyrockets>

COMPANY AR/VR/XR REVENUE



Greatest XR Revenue & XR Revenue/Employee			
Company	XR Revenue	Company	\$\$/Person
Animation Research Ltd	\$1m-5m	Animation Research Ltd	\$500K-1m
Buildmedia Ltd		StaplesVR	
Soul Machines		New Zealand Geographic	\$250K-500K
Staples VR		Soul Machines	
StretchSense		Virtual Medical Coaching	
Virtual Medical Coaching		Buildmedia Ltd	\$125K-250K
Wanderer Limited		Company-X	
Weta Workshop		Method	
Company-X		QuiverVision Limited	
iSPARX		RocketWerkz Studios	
JIX Research	Silverback Academic Media		
New Zealand Geographic	Tripod Digital Ltd.		
QuiverVision Limited	Umajin		
RocketWerkz Studios	Wanderer Limited		

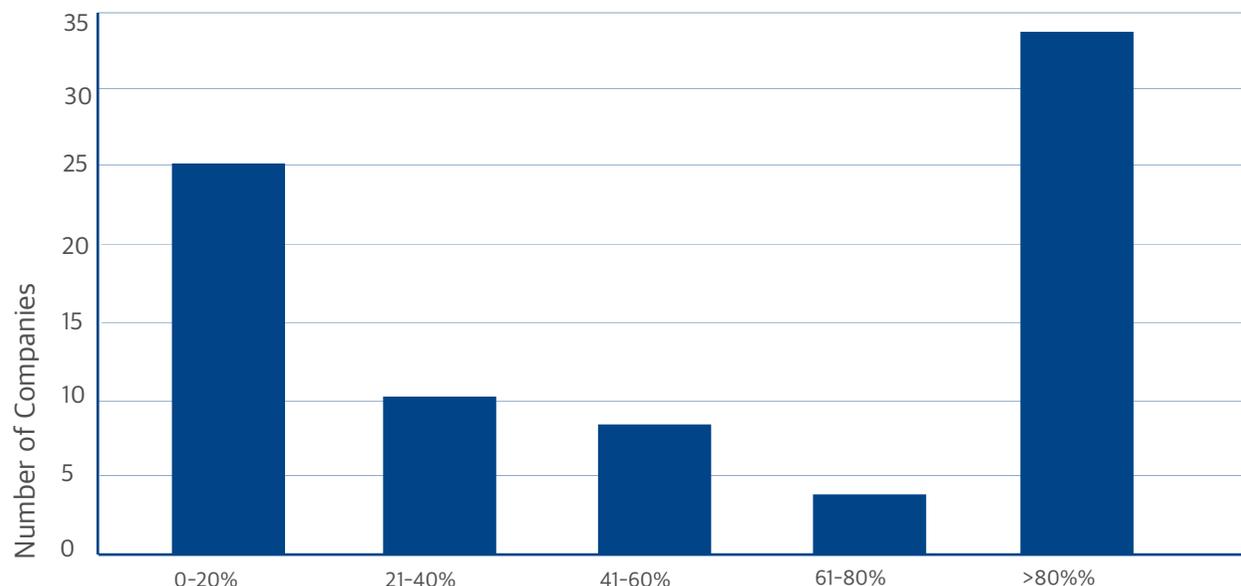
EXPORT FOCUSED COMPANIES EARN MORE

- Over 40% of XR companies earn most of their income from XR sources.
- Companies with a higher percentage of XR income, earned more per employee
- Companies focused on export earnings, earned more per employee.

Based on their revenue, most companies could be placed in one of two categories; (1) Over 80% of their revenue came from AR/VR/XR sources (42% of companies), (2) less than 20% of their revenue came from AR/VR/XR (31% of companies). Companies with 80% or more of their revenue from XR earned \$111K revenue per employee compared to \$55K for companies with 20% or less. Companies in the lowest income bracket tended to be either large companies with a small group of XR employees, or startups with low/no revenue.

Companies that exported more earned more revenue per employee. Those earning more than 80% of their XR income from exports had an average revenue per employee of \$144K, while those with less than 20% of income due to exports only had \$41K. Half of the companies who replied earned less than 10% of their income outside NZ. This shows a significant opportunity to increase earnings through exports.

COMPANY DISTRIBUTION BASED ON REVENUE FROM AR/VR/XR SOURCES



Percentage of Revenue from AR/VR/XR Sources					
Percentage of Revenue from XR Sources	0-20%	21-40%	41-60%	61-80%	>80%
Number of Companies	25	10	8	4	34
Average Revenue per Employee	\$54.5k	\$99.25k	\$136.5k	\$92.9k	\$110.7k

Companies with higher percentage of XR revenue had higher revenue/employee.

Revenue per Employee based on Export Revenue					
Percentage of Revenue from Export	0-20%	21-40%	41-60%	61-80%	>80%
Number of Companies	17	1	3	6	7
Average Revenue per Employee	\$40.9k	\$6.3k	\$270.8k	\$113.6k	\$114k

Companies with higher percentage of export revenue had higher revenue/employee.

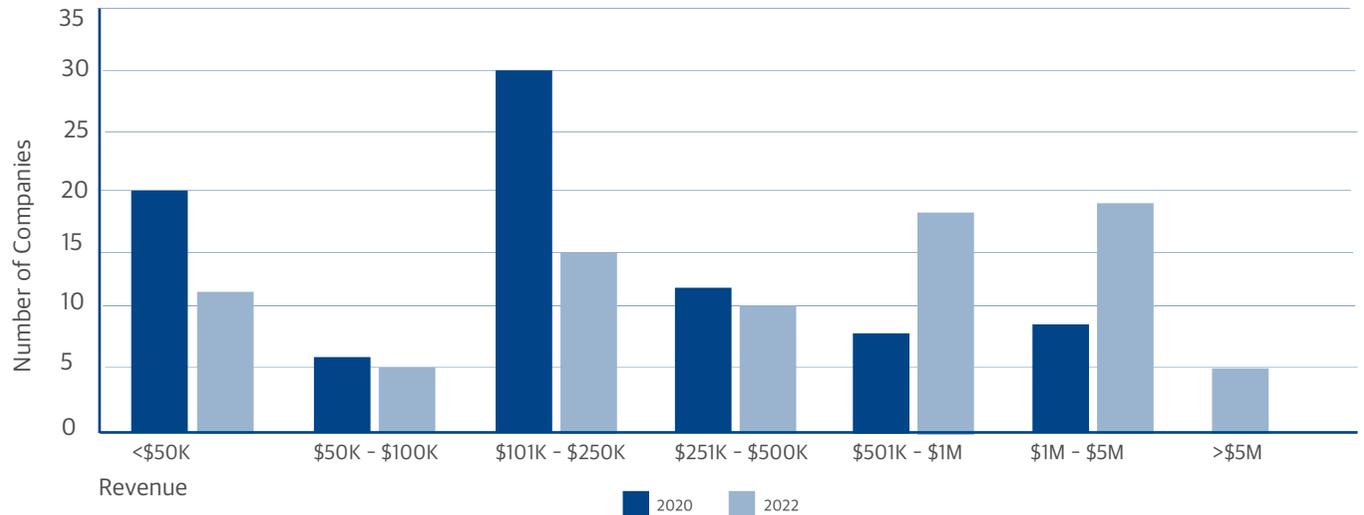
INDUSTRY PROJECTED TO TRIPLE IN REVENUE

- From the companies that responded there are nearly 400 people working in AR/VR/XR
- Most NZ companies projected doubling their AR/VR/XR employees in 2 years
- Revenue is projected to triple by 2023 to over \$100 million for the entire industry.

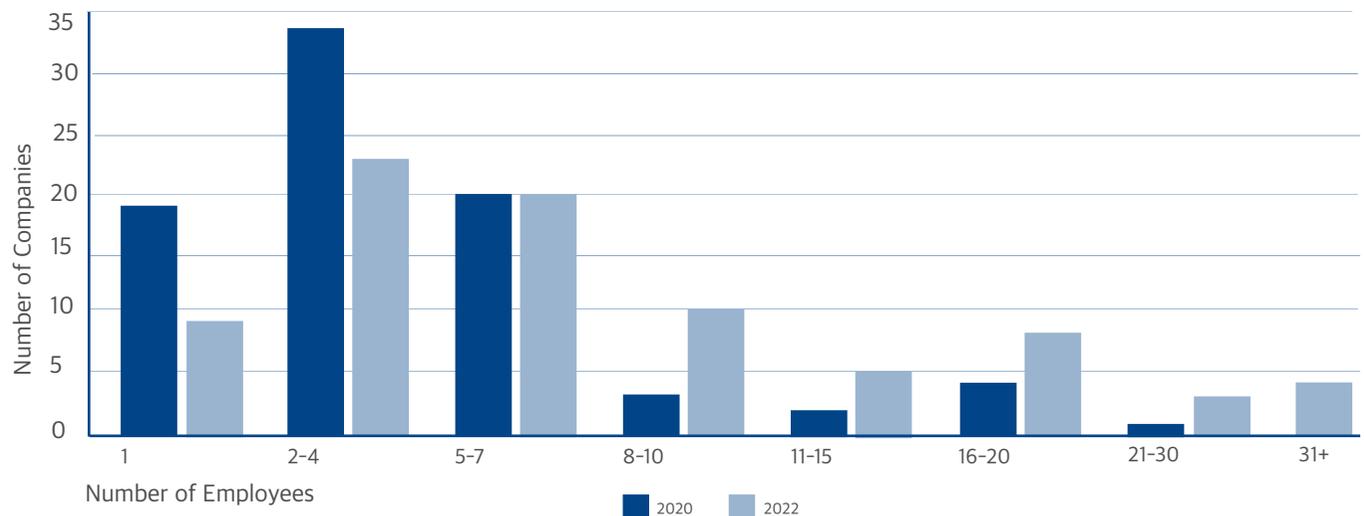
The surveyed companies were asked about their projected growth over the next two years. Generally they projected strong growth in both revenue and employees with an average increase of 303% in revenue and 202% in employee numbers.

Overall, the companies projected that by 2023, there would be more than 691 people working the XR space with over \$101 million in revenue (\$146K/employee). They projected that the average revenue would grow to \$1.28 million with a median revenue of \$600K.

NUMBER OF NZ XR COMPANIES AT EACH REVENUE LEVEL



NUMBER OF COMPANIES WITH DIFFERENT XR EMPLOYEE LEVELS



RESEARCH



University of Canterbury
VR Locomotion



University of Auckland
HyperDrum

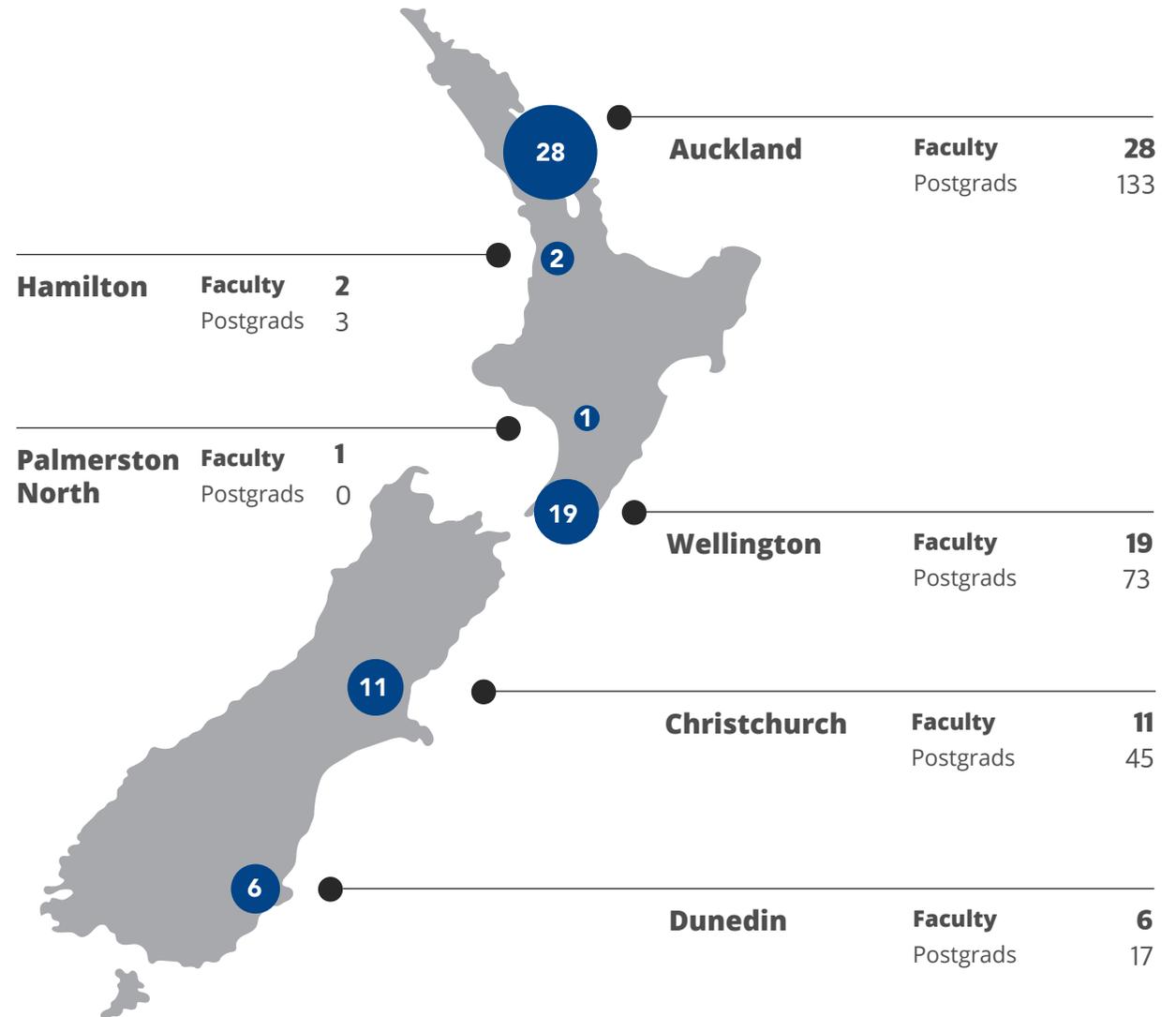


Victoria University of Wellington
DreamFlux

XR RESEARCHERS

Key Findings

- NZ XR researchers have greatest numbers in Training/Education and HCI
- There is relatively little research in NZ in AR/VR/XR hardware
- NZ AR/VR/XR researchers are highly regarded internationally
- Nearly 40% of researchers collaborate with local industry and 25% with international industry
- Around 30% of the NZ XR industry collaborate with a NZ academic institution
- Less than a third of researchers receive any funding from industry or government
- NZ researchers find it easy to collaborate with other NZ researchers.



67 NZ RESEARCHERS WORKING IN AR/VR/XR, SUPERVISING 271 POSTGRADUATE STUDENTS

NZ XR RESEARCHERS

- NZ XR researchers are strongest in Training/Education and HCI
- There is relatively little research in NZ in AR/VR/XR hardware
- NZ AR/VR/XR researchers are highly regarded internationally.

The NZ researchers were asked their key areas of research interest. The most popular areas were in training/education and Human Computer Interaction (HCI)/user experience. Healthcare, visualization and collaboration were also significant areas of strength. The tables show the most impactful NZ researchers, based on their h-index value, and the average number of AR/VR/XR publications per year.

Areas of Research Strength	
Research Area	Number
Training/Education	16
HCI/User Experience	12
Healthcare	9
Visualisation	8
Remote Collaboration	7
Gaming	6
Perception	6
Graphics/Rendering	5
Civil Engineering	5
Computer Vision	5

NZ XR Academics areas of research capability.

International Comparison

NZ researchers are thought to be very strong relative to other XR researchers globally. The International Experts rated the strength of the NZ XR researchers relative to international researchers as 6.4/7.0, where 7 = very good, and 1 = not very good. They rated the Innovation of the NZ XR researchers as 6.2/7.0.

The Most Impactful NZ XR Researchers			
Academic	Institution	h	Pubs
M. Billinghamurst	Univ. Auckland	74	21
H. Regenbrecht	Univ. Otago	33	8
R. Lindeman	Univ. Canterbury	30	18
S. Lukosch	Univ. Canterbury	24	8
T. Langlotz	Univ. Otago	24	8
B. Wuesnche	Univ. Auckland	24	4
V. Gonzalez	Univ. Auckland	23	5
R. Lovreglio	Massey Univ.	20	4
S. Zollmann	Univ. Otago	19	5
S. Mills	Univ. Otago	19	4
N. Baghaei	Massey Univ.	18	4
M. Schnabel	Victoria Univ. Wellington	17	13
S. Nanayakkara	Univ. Auckland	16	10
T. Piumsomboon	Univ. Canterbury	16	4

The most impactful researchers by their Google Scholar h-index number (h), and also their average number of AR/VR/XR publications/year (pubs).

NZ RESEARCH FUNDING

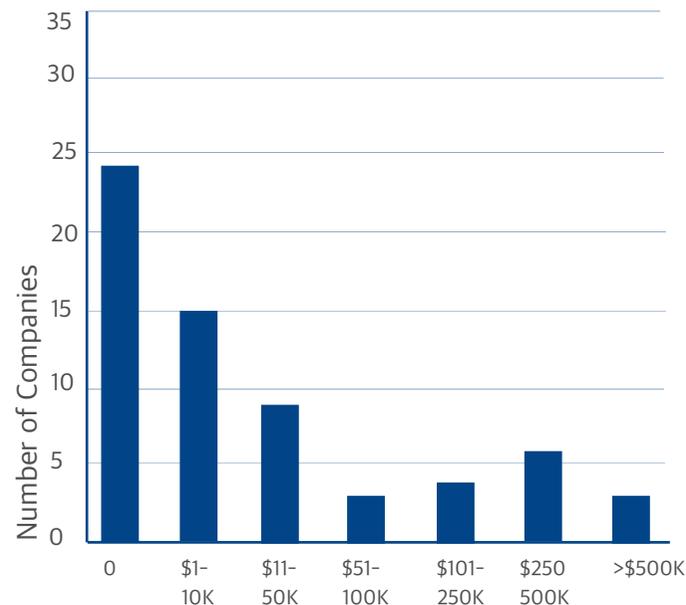
- 28% of NZ researchers are currently receiving non-industry funding
- Only 17% of NZ researchers currently have industry funding
- For those with funding, average funding is \$148K/year from industry and \$75K/year from non-industry.

NZ academic researchers can attract funding from a variety of industry and non-industry sources. Non-industry funding includes public good sources such as the Royal Society of New Zealand (Marsden grants), and MBIE (Smart Ideas, Platform), and others. Industry funding can come from local NZ companies and international companies.

Non-Industry Funding

In general researchers find it difficult to source funding from non-industry sources, ranking this as a 2.28 on a scale of 1 to 7 (where 1 = not very easy, 7 = very easy). Of those who responded, researchers reported receiving an average of \$75K per year in research funding, but this was skewed by several high performers, with most receiving less than \$50,000 per year, and almost a third received no funding at all.

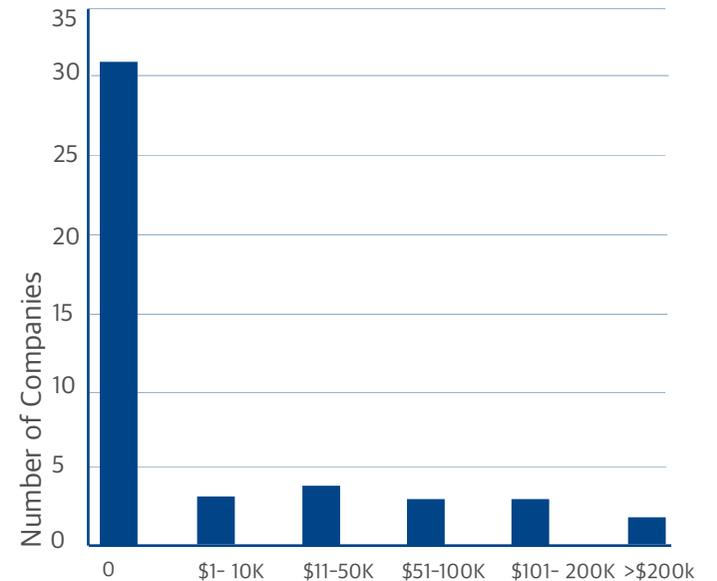
AVERAGE AR/VR/XR NON-INDUSTRY FUNDING /YEAR



Industry Funding

Researchers also find it difficult to source funding from industry sources, rating this as a 2.54 on a scale of 1 to 7. The overall average funding from industry was \$30K per year, but only 11 out of 65 researchers reported receiving any funding at all, with an average amount of \$148K. Although 25 researchers mentioned collaborating with the NZ AR/VR/XR industry and 17 with international partners, only 11 of them received any funding from their industry partners.

AVERAGE AR/VR/XR INDUSTRY FUNDING /YEAR



COLLABORATION BETWEEN RESEARCHERS

- NZ researchers report finding it easy to collaborate with other NZ researchers
- The USD, China and Japan are the leading countries for research collaboration
- Lack of time and funding are the two main obstacles to more collaboration
- NZ researchers could collaborate more with the leading international researchers.

Domestic Collaboration

Researchers reported finding it easy to collaborate both within NZ and moderately easy to collaborate Internationally. On a scale of 1 (not very easy) to 7 (very easy), they rated ease of collaboration with other NZ XR researchers as 5.2, and with international researchers as 4.5.

When researchers were asked which local NZ XR researchers they collaborated with, 72% of those survey listed institutions or people they collaborated with. Those that listed names, reported collaborating with an average of 2.63 people. However most collaboration was within the researchers' own institutions.

Of the named collaborators, 68% were from the respondent's own university. This shows that there is an opportunity for NZ researchers to increase local research collaboration, and especially to connect with collaborators outside of their home institutions.

When asked about the obstacles to academic collaboration, 39% of responses mentioned time, and 33% mentioned funding, especially funding to support international travel and collaboration. The difficulty of meeting people to collaborate with (12%) and lack of research networks (8%) were other popular responses.

International Collaboration

Researchers were asked which international AR/VR/XR researchers they collaborated with. Only 33 only of the 67 researchers said that they had some international collaboration. Of those that named collaborators, they listed a average of 3.1 researchers, from 24 countries.

The USA was the most popular country to collaborate with, with 67% of the active researchers having a collaborator there. Japan (27%), and China (24%) were the next most popular countries to collaborate with. However, only 6 researchers collaborated with any of the top 160 AR or VR researchers in the world. This shows a relatively low level of connection with the strongest XR research groups in the world.

Country	Percentage
USA	67%
Japan	27%
China	24%
Germany	15%
Australia	15%
UK	15%
Austria	12%
Sweden	9%

NZ XR researchers work with XR researchers in the above countries.

MORE INDUSTRY-RESEARCH COLLABORATION POSSIBLE

- 40% of NZ academics collaborate with local companies
- 25% of NZ academics collaborate with an international company
- 31% of NZ companies worked with a local academic institution

NZ researchers reported a moderate amount of collaboration with industry, both inside NZ and internationally. A total of 28 of the 67 academics weren't collaborating with any NZ AR/VR/XR companies, and of those that did (25 or 39%), the average number of companies worked with was 1.6, with no researchers working with more than 4 local companies. The table below shows all of the NZ AR/VR/XR companies that more than two researchers said that they collaborated with.

Leading NZ XR companies worked with	
Company	Number of Researchers
Animation Research Limited	4
Weta	3
MagicLeap	2
Dusk Ltd.	2
Wrestler	2

Only 17 of the academic researchers collaborated with international AR/VR/XR companies with an average of 1.23 companies worked with, and 29 researchers reported no collaborations. The table below shows the leading international companies that researchers worked with.

Researchers were asked how easy it was to collaborate with industry on a scale of 1 to 7 (1 = very easy, 7 = not very easy). For NZ companies the average score was 3.2, while for international companies it was 3.3, slightly below average (4.0).

When asked what was the obstacles to industry collaboration were, 31% of researchers said lack of time, lack of funding (especially for international engagement) was raised by 25%, and lack of contacts/opportunity mentioned by 19%.

International XR companies worked with	
Company	Number of Researchers
Facebook	5
Google	4
Microsoft	3
Square Enix	3
MagicLeap	3
PTC	2

The NZ companies were also asked what academic partnerships that they had, and like the researchers there was relatively moderate collaboration.

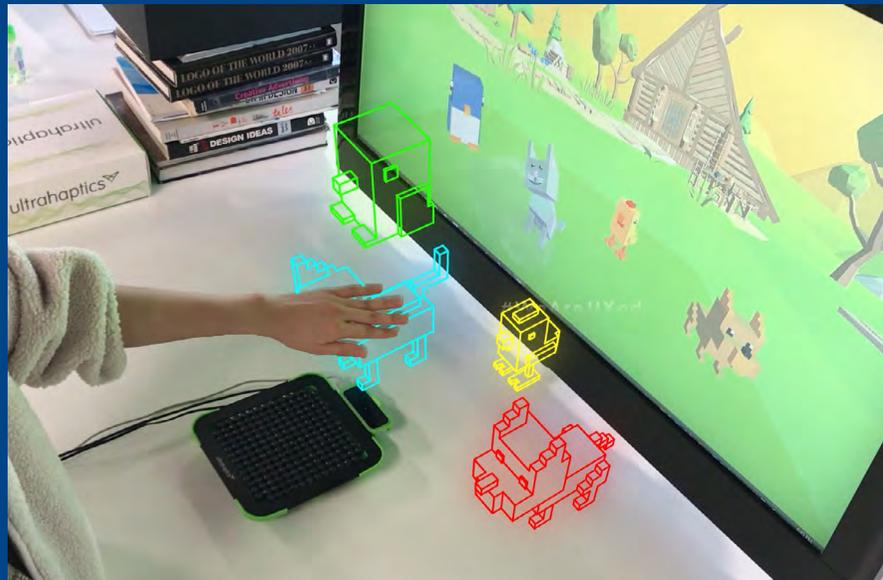
The table below shows the total number of universities and other academic institutions mentioned, and the number of times mentioned. In total only 25 of the 81 companies mentioned any academic partnership for a total of 31%.

Universities NZ XR companies work with	
Institution	Number of Mentions
University of Auckland	12
Victoria University of Wellington	6
The Media Design School	4
Auckland University of Technology	3
Waikato University	2
University of Canterbury	2
UniTec	2

QUALITATIVE ANALYSIS



Rocket Werkz



Jix Reality



Gauge Punk

NZ AR/VR/XR INDUSTRY IN THE GLOBAL CONTEXT

Key Learnings

- NZ's talented and innovative workforce is a key value proposition
- NZ industry innovation, agility and education are key strengths
- Education, Games, and Collaboration are key areas for future growth.
- NZ companies have a low level of collaboration with each other
- NZ companies view investment and user adoption as current business challenges
- Government support is key for future growth of the industry and research.

NZ XR Industry Unique Strengths

- NZ industry/researchers are innovative and strong relative to the global industry
- NZ industry is particularly strong in specific areas of application development
- NZ industry is well aligned to areas of future growth in AR/VR/XR.

Relative to the global XR industry, the international experts felt that NZ industry was well above average in terms of strength and innovation. NZ researchers were seen as particularly innovative and world class. Quality of talent, agility, and education were also seen as key strengths.

NZ companies are particularly strong in application development and in the Education/ Training, and Tourism markets relative to the global industry. Most companies are also working in multiple sectors which enables them to be agile and resilient. International experts felt that NZ is recognized as a leader in Visual Effects and emerging XR technologies and has a strong foundation in media creation such as film.

Another strength of the NZ XR industry is good alignment with global market trends. NZ XR companies are working in or planning to work in XR markets which are predicted to have significant growth in the near future.

Key International R+D Partners

- International partnerships are needed to grow the NZ industry
- NZ companies know the key companies they should partner with
- There is an opportunity for global companies to invest in R+D in NZ.

The International experts felt that for the NZ XR industry to grow it is essential that they form partnerships with international companies that can help bring their products to a global market. NZ companies identified two types of companies they would like to partner with; (1) Multinational companies providing platform technologies, (2) Leaders in the target market sector.

Both international experts and local NZ companies felt that Education/Training and Gaming are key areas for growth in the XR industry. NZ has strengths in these areas and it would be important for NZ companies to find key partners in these sectors.

It is also possible for multinational XR companies to partner and invest in R+D in NZ. This would be dependent on (1) identifying unique local IP, assets or people only available in NZ, (2) having a sufficient local talent pool with XR skills, and (3) NZ Government support across a range of different areas from immigration to tax incentives.

NZ'S TALENTED AND INNOVATIVE XR WORKFORCE

- NZ's talented and innovative workforce is seen as a key value proposition.
- NZ companies thought innovation, agility and education quality are key strengths
- Experts ranked the NZ industry as above average in terms of strength and innovation relative to global industry.

Value Proposition

When asked what was the key value proposition that NZ had compared to other countries, NZ's talented and innovative workforce is seen as a key value proposition. International Experts valued the high Education level and Time Zone benefits, but cost effectiveness was less important to them than what was thought by the local NZ companies. Both local and international respondents felt the quality of XR researchers was a key value proposition.

Value Proposition	
NZ Companies	International Experts
Quality of Talent (12)	Quality of Talent (5)
Creativity (12)	Innovation (4)
Cost Effectiveness (10)	Content Development (4)
Innovation (8)	Quality of Researchers (4)
Prototyping and Testing (6)	Education Level (3)
Quality of Researchers (5)	Time Zone (3)
Content Development (5)	Cost Effectiveness (2)

Numbers in brackets are the number of responses.

Strengths

The NZ companies and International Experts were asked the question "What do you think are NZ's strengths in the AR/VR/XR space?" The table below shows the most common responses. Both local companies and the international experts felt innovation agility, and quality of education were key strengths. International experts felt that the quality of researchers in NZ was also very strong.

Strengths	
NZ Companies	International Experts
Innovation (19)	Good Researchers (6)
Agile (12)	Quality of Talent (5)
Quality of Education (12)	Innovation (3)
Quality of Talent (9)	Quality of Education (3)
Creativity (8)	Location (3)
Small Size (7)	Agile Companies (2)

International Comparison

The International Experts rated the strength of the NZ XR Industry relative to the Global Industry as 5.7/7.0, where 7 = very good, and 1 = not very good. They rated the Innovation of the NZ XR industry as 5.3/7.0.

PARTNERSHIPS COULD IMPROVE

- NZ companies have a low level of collaboration with each other
- Experts felt that NZ companies need to connect with international companies
- Industry and academics had a different expectation of the role of universities.

Companies were asked the question: What key industry, academic, government partnerships does your company have? Almost 25% (20 companies) reported that they had no key partnerships. Of the rest 24 mentioned a university or education provider, 17 mentioned the Callaghan Institute, 5 mentioned international company partners, but only 3 companies mentioned other NZ AR/VR/XR companies.

International Experts felt that it was key for NZ companies to partner with multinational companies to bring their technology to global markets. However, they identified a number of challenges for connecting internationally, including remoteness and distance (38%), and need to raise visibility (19%).

Survey participants were asked the role of universities supporting industry, and academic/industry partnerships.

Industry and international experts felt that the most important role was to provide students and knowledge transfer. Only 8% of NZ companies felt the university should be supporting them by collaborating with industry. In contrast, the researchers felt that the main way they could support the XR industry was by collaborating with it (34%) and conducting applied research (26%). Only three researchers (5%) mentioned how academics should be providing students for industry, and a similar number mentioned teaching courses for industry. This shows that there could be a mismatch between industry and academic expectations.

The role of universities supporting the local XR industry

Industry	Researchers	International Experts
Provide students (24)	Collaborate with industry (22)	Knowledge transfer (6)
Research (20)	Applied research (17)	Validate technology (5)
Collaborate with industry (7)	Networking (14)	Research (5)
Teaching (5)	Basic research (6)	Education (4)
Don't Know (5)	Create tools (4)	International networking (2)
Commercialisation (3)	Provide students (3)	Create startups (2)
Networking (2)	Conduct courses (3)	Use XR in university (2)

INTERNATIONAL INDUSTRY PARTNERSHIPS

- NZ Researchers want to partner with global leading companies in XR
- NZ industry want to partner with game and application companies
- International partnerships are vital for growing the domestic sector
- NZ companies need to raise their international visibility.

International Feedback

When international experts were asked for advice to a NZ company operating in the AR/VR/XR space, 60% of them mentioned the importance of creating international partnerships. Similarly when asked about advice for researchers, 33% of them mentioned creating international collaborations.

However, the international experts also recognized the challenges of connecting internationally. When asked about that, 35% of the respondents mentioned that distance was a key challenge for creating international connections. However in this COVID era, online tools may overcome this. Another important theme was lack of visibility, mentioned in 15% of responses. As an example of this, when the international experts were asked who were the successful NZ XR companies they were familiar with, only 33% of them could list any NZ company, primarily working in the XR space.

For NZ companies it is important for them to build connections with two types of international companies; (1) Large global companies providing XR platform technologies (e.g. Facebook, Microsoft), (2) Leaders in the market sector that that company is working in (e.g. Valve for gaming). For NZ researchers, they should build connections with large multinationals capable of funding research internationally (e.g. Google).

Potential Partnerships

When asked which international AR/VR/XR companies they would like to collaborate with the Academic Researchers listed Facebook, Microsoft and Google as the leading companies. Apart from these companies, the rest were XR technology providers such as HTC, and Unity. When NZ companies were asked to identify the leaders in their markets, they also identified the same companies, but they also identified leading game companies such as Valve, The Void and Niantic Labs. The table below lists the companies listed by NZ industry and researchers as potential partners.

Market	Industry	Researchers
Facebook	12	21
Valve	12	1
Microsoft	11	17
Apple	5	4
Google	5	8
The Void	4	0
HTC	4	4
Niantic	3	0
Magic Leap	2	4
Sony	2	0

Key companies identified as potential partners.

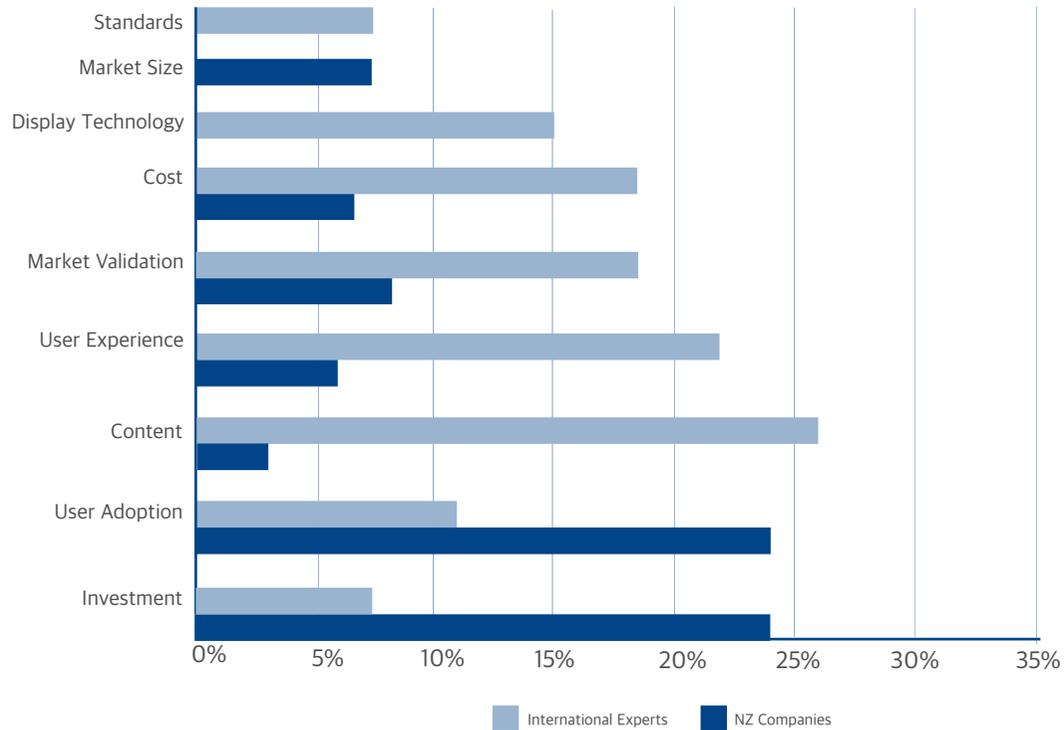
IMMEDIATE CHALLENGES

- Investment and user adoption are the greatest challenges for NZ industry
- International experts viewed content and UX as the greatest challenges
- Industry and academics think different research areas are important.

NZ companies and international experts were asked what they thought were the current business challenges in the AR/VR/XR space. For the NZ companies the main challenges were seen as raising investment (24%) and Lack of User Adoption of the (24%), followed by Market Validation (8%). These were also identified as important by the International Experts, but they felt that Content related issues (26%) and User Experience (UX) (22%) were more important challenges (22%). Only 2% of the NZ companies listed skill shortages as a current challenge.

Asked about key research problems, both industry and international experts highlighted the need for research on better Head Mounted Displays, while the researchers thought AR for education was the biggest need, followed by research into remote collaboration. This shows a need for better communication between industry and academics about research problems.

BUSINESS CHALLENGES FACING THE AR/VR/XR SECTOR IN THE NEXT TWO YEARS



Key research problems that industry needs help with		
Industry	Researchers	International Experts
Better HMDs (12)	AR for Education (15)	Better HMDs (12)
Funding (11)	Remote Collaboration (13)	Interaction Methods (5)
Access to Technology (7)	Interaction Methods (13)	Spatial Understanding (4)
Tracking (6)	Human Factors (4)	Computer Vision (3)
Motion Sickness (5)	Graphics (4)	Content Creation (3)

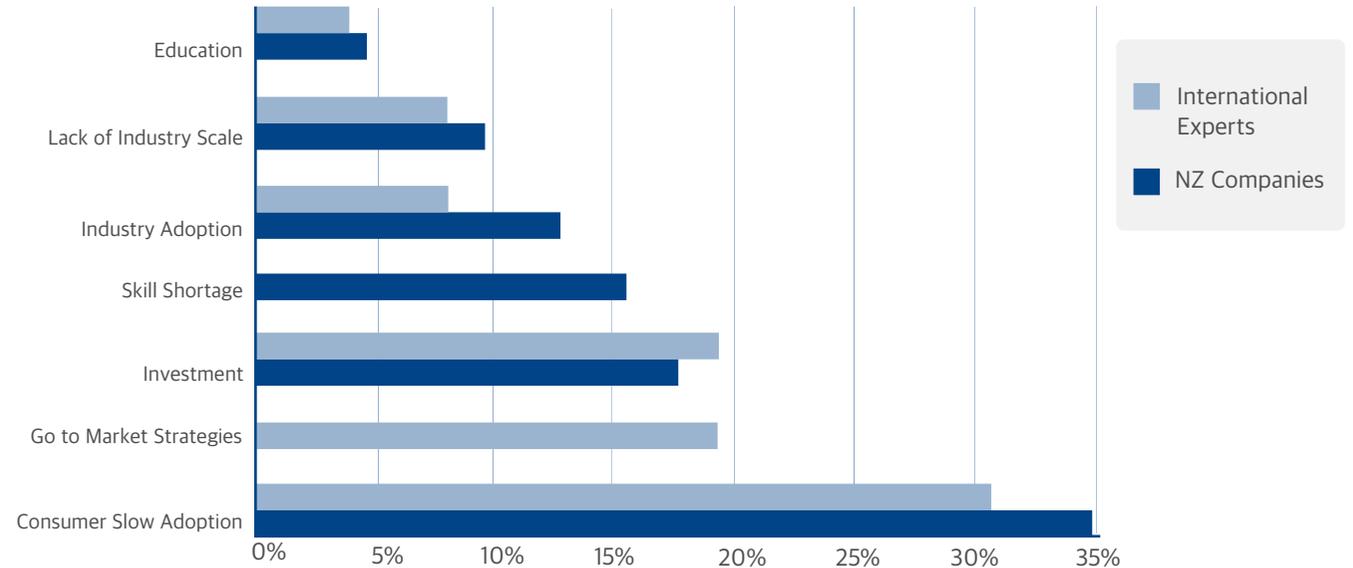
INDUSTRY FUTURE NEEDS

- Investment and support for marketing are the main needs of local industry
- Slow consumer adoption is seen and the biggest business challenge
- 16% of NZ XR companies are worried about future skill shortages.

NZ companies were asked what they think their future needs would be in the next two years. Over 50% of them said investment, followed by support for marketing (40%). They also anticipated needing access to hardware (30%) and XR headsets (29%), as well as education and training for their staff (28%). Not shown on the chart is the relatively small number of companies who felt they would need access to co-working spaces (16%) or an incubator (12%) or who felt they had no needs (7%).

NZ Companies and the international experts both identified slow Consumer Adoption as the biggest challenge facing the XR sector (37% and 33% respectively), with related Industry Adoption also strongly identified (13%). Attracting investment was also seen as an important challenge in the future (17% and 21%). The International Experts identified having a strategy to bring product to market as a significant challenge (21%), but none of the local NZ companies mentioned this. In contrast 16% of the NZ companies were worried about Skill Shortages in the next two years.

BUSINESS CHALLENGES FACING THE AR/VR/XR SECTOR IN THE NEXT TWO YEARS



Industry	Percentage
Investment	52%
Marketing	40%
Hardware	30%
App Hosting	29%
Headset sales	29%
Education	28%
Strategy	26%
Consulting	24%
Development	22%

Industry needs in the next two years.

NZ XR FUTURE GROWTH

- Education, Games, and Collaboration are viewed as key areas for future growth.
- NZ XR companies are planning to work in these key growth areas areas.
- Tourism is viewed as a key growth area for the local NZ market.

There is good alignment between the key areas of future growth identified and where NZ XR companies are wanting to work. The Experts were asked which market segments they thought would be the highest growth areas for the global AR/VR/XR industry over the next two years. Over half of the experts said Education and Training was going to be an area of high growth, while Collaboration (37%) and Gaming (37%) were also seen as areas of high growth.

Market	Responses
Training	56%
Collaboration	37%
Gaming	37%
Healthcare	22%
Industrial	22%
Enterprise	22%
Entertainment	15%
Design	15%

Expert Picks of Markets with High Growth

The NZ companies were asked which markets they were likely to provide products/services into within the next two years. The table below shows the results. These align well with the areas of growth identified by the International Experts with Training and Education being worked on by 70% of the companies. However, over half of the NZ companies expect to work in Tourism, a area not identified as a high growth market by the Experts. This reflects the significance of the local NZ tourism industry. Collaboration was not given as an option to the NZ companies.

Market	Responses
Training	70%
Games	57%
Tourism	53%
Entertainment	52%
Storytelling	47%
Industrial	43%
Marketing	42%
Healthcare	32%
Research	33%
Development	25%

The markets NZ XR companies plan to work in over the next two years.

The NZ companies were asked which sectors of the NZ economy AR/VR/XR could contribute to. The table below shows the results align well with both where the Experts predict for high growth and where NZ XR companies are planning to work. One exception is tourism, showing that NZ companies predict a strong benefit to the NZ tourism industry, and so are planning to work in this space. Only 10% of responses identified collaboration as an area where XR could have significant impact, far less than what the International Experts predict. This is an area that NZ companies could work more in.

Market	Responses
Training	54%
Tourism	36%
Entertainment	24%
Games	16%
Healthcare	13%
Industry	12%
Collaboration	10%
Marketing	5%
Design	4%

The sectors of the NZ economy where AR/VR/XR could have the greatest impact.

BETTER GOVERNMENT SUPPORT

- NZ companies and researchers want funding support from government
- International experts felt that targeted projects and funding is important
- Support for industry/academic networking was also seen as important.

International Experts

From an international perspective, the experts were asked the question: “What do you think the Government should do to support their local AR/VR/XR industry?”. The table below shows their answers. As can be seen, the international experts also thought that funding was important, but they recommended funding targeted projects, research centres of excellence, or creating investment funds.

International Experts	
Fund Targeted Projects/ Trials	22%
Fund Research Centres	19%
Support Education/Internships	19%
Create Investment Funds	15%
Support Industry Partnerships	15%
Support Incubators/Startups	15%

What International Experts thought the Government should be doing to support their local XR industry.

NZ Companies

Companies were asked the question: “What are the key things that the NZ Government could be doing to support the local AR/VR/XR industry?”. Overwhelmingly companies wanted financial support, with this being mentioned in 55% of the responses. A common message that came through was the smart use of funding, and creating targeted application of funds, such as a content creation fund. In addition, improving industry collaboration (19%) and promoting NZ products on the world market were two key things that industry feels that the government should do to support AR/VR. One emerging theme was that the Government could be supporting community building to better connect local companies.

NZ Companies	
Providing Funding/Grants	55%
Improve Industry/Collaboration	19%
Promote NZ Companies	12%
Nothing	7%
Identify Real Use Cases	6%
Promote the Local Market	2%
AR/VR use in Schools	2%

What NZ XR companies thought that the NZ Government should be doing to support them.

NZ Researchers

When asked “What should the NZ government be doing to support AR/VR/XR researchers?” most of the researchers (70%) identified funding as an issue, with some mentioning targeted funding (28%) towards content creation/production, or a specific AR/VR/XR fund. Other popular responses were creating links between university and industry, support for international networking, student and early career/postdoc support and establishment of research clusters. Several people also mentioned overcoming structural issues, such as Creative NZ not supporting funding for game development. The table below shows the main responses.

Researcher Support	
Funding	43%
Targeted Funding	28%
International Networking	9%
Student Support	9%
Early Career Support	6%
Research Clusters	6%

What NZ XR researchers thought that the NZ Government should be doing to support them.

ATTRACTING INTERNATIONAL INVESTMENT

- Research investment requires strong support for universities and identifying research not done elsewhere
- Conducting R+D in NZ requires access to unique IP or people only available in NZ
- Government incentives and industry co-investment were seen as important for attracting investment.

Investment in NZ Research

The international experts we asked what would need to happen for their company to invest in AR/VR/XR research in NZ. This could be either in academia or in local NZ industry.

Of those that replied there were several themes. First, it is important to have an alignment between the research in NZ and the company's product road map, and strategic direction. It is especially important for local researchers and industry to be solving a problem that the international company isn't already solving.

A second factor was a strong local research community, including more local government support for universities, and the opportunity to enter into university collaborations.

A third theme is support by the NZ government, such as co-investment in research, tax breaks, or other subsidies and financial support.

Finally, some companies mentioned the need to have a local market and NZ customers with significant customer commitments and strong customer relationships. Establishing relationships with NZ industry will be key for this.

One respondent made the important point that investment in research depends on the existing investments and research relationships, so NZ needs to position itself well in the global XR research marketplace.

Moving R+D into NZ

The experts were also asked what would need to happen for their company to move some researchers into NZ and develop a significant local NZ presence.

The answers mostly fell into the categories of unique IP/research capability, sufficient talented people, and Government support.

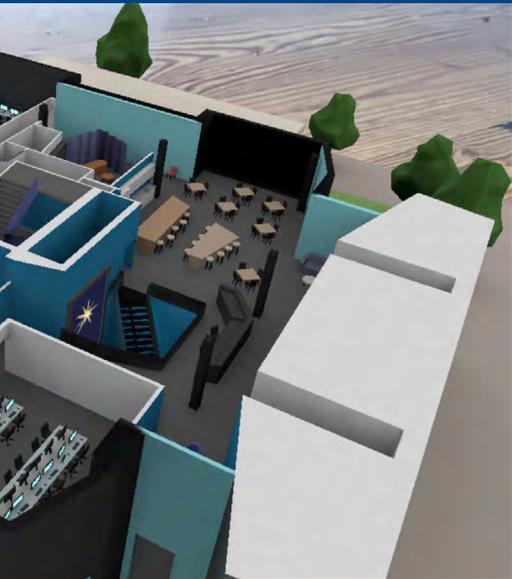
Respondents mentioned the importance of identifying unique IP, assets or people that are only in NZ, or local ground breaking research.

It was seen as important to have a sufficient local talent pool with unique skills in XR research problem domains and a general pool of strong engineering resources to supplement company researchers brought into NZ. This could be achieved through collaboration with local universities and partnering with local industry.

A third theme was Government support, in a range of different areas, including visas, access to funding/business support, human resource support, tax breaks and subsidies.

One respondent mentioned that moving researchers into NZ would require an overall review of NZ vs. effort/risk/benefit of opening remote office in other locations - include review of state of research/industry, wage scales, etc.

SUMMARY



Guerilla Digital



MR360 LightLabs Inc.



Beyond Studio

SUMMARY

The global AR/VR/XR industry is projected to have strong growth which will enable a thriving industry in NZ. NZ has a large number of local AR/VR/XR companies working in high growth areas and very strong researchers.

The NZ companies are mostly small, but expect to double the number of people in the industry in two years, and triple the current revenue. Key to this will be increasing the export revenues, and collaborating with academic partners.

NZ is viewed as a very innovative country for AR/VR/XR research and development. With the right government incentives, multinational companies could invest in research in NZ, and even move their own research teams into the country.

New Zealand has:

- A growing NZ AR/VR industry
- Small, agile companies with strong talent
- Companies working in multiple sectors
- Very strong academic researchers
- Good alignment with projected market growth

However, the sector needs to:

- Increase export focus
- Raise the industry profile
- Create a stronger community
- Increase industry/research collaboration
- Engage more with international partners.

“NZ has the intellectual resources to be a prominent player in the VR/AR/XR industry that is growing exponentially worldwide. A VR/AR/XR industry could add substantially to a sustainable knowledge economy for NZ, providing green products that can be delivered at the speed of light...”



—Tom Furness, VR Pioneer, University of Washington

“NZ has critical technology expertise in computer graphics and simulation that underpins XR. NZ research also explores the more meaningful, human-centric aspects that XR needs, such as empathic computing, and how human-like to make AI characters.”



—Jacki Morie, Senior Advisor, XPrize

“NZ has a lot to offer in XR content and application development. It provides innovative and fresh ideas, good pockets of talent, and cultural alignment with North American priorities and values from where much of the investment is being directed.”



—Hayes Raffle, AR/VR UX Lead, Google

“NZ has had long history of innovation in computer graphics that carries over to XR. Compared to other countries, NZ has a strong academic and research community.”



—Brian Cabral, Director of Engineering, Facebook

APPENDIX

NZ XR COMPANIES

Breakdown: 82 Companies in Total

Companies working only in AR: 12

Companies working only in VR: 35

Companies working in both AR and VR: 35

Companies

Name	URL	Categories
8i	https://www.8i.com/	(VR) Reality Capture
Actuality Limited	https://www.actuality.nz/	(VR) Enterprise
Animation Research Ltd	https://arl.co.nz/	(VR) Sports/Live Events, Tourism, Social Media, Entertainment, Healthcare, Education (AR) Healthcare, Education
Ascend Reality	https://www.ascendreality.co.nz/	(AR) Enterprise, Advertising
Augmented Reality Applications (ARA Journeys)	https://www.arajourneys.com/	(AR) Gaming, Healthcare, Education
Augusto	https://www.augusto.co.nz/	(VR) Entertainment, Advertising
Augview Ltd	https://www.augview.net/	(AR) Enterprise
Beyond Studio	http://www.beyond.fun/	(VR) Gaming (AR) Gaming
Black Tortoise	http://www.blacktortoise.co.nz/	(AR) Gaming, Enterprise, Healthcare, Education, Advertising
Bright Light Interstellar Limited	http://brightlight.rocks/	(VR) Gaming, Education, 3D Tools
Buildmedia Ltd	https://www.buildmedia.com/	(VR) Enterprise, Advertising, Distribution (AR) Enterprise, Advertising
Capability Group Limited	https://capabilitygroup.co.nz/	(VR) Education
CEREBRALFIX LIMITED	https://cerebralfix.com/	(VR) Healthcare, Education
Company-X	https://www.companyx.com/	(VR) Enterprise, Healthcare, Education (AR) Enterprise, Healthcare, Education
Corvecto Limited	https://corvecto.com/	(VR) Enterprise, Healthcare, Education, 3D Tools (AR) Enterprise, Healthcare, Education
Curiat Limited	https://www.curiat.co.nz/	(AR) Enterprise, Healthcare, Education

Companies

Name	URL	Categories
Dappa Drama Pvt Ltd	http://www.dappadrama.com/	(VR) Entertainment, Education
Datacom Group Limited	https://www.datacom.co.nz/	(VR) Tourism, Entertainment, Healthcare, Education (AR) Enterprise, Healthcare, Education
Detalock Studios Ltd	https://detalockstudios.com/	(VR) Education
DOT DOT LIMITED (DOTDOT)	https://dotdot.studio/	(VR) Gaming, Entertainment, Enterprise, Education (AR) Gaming, Entertainment
Drumleaf (trading as Dot Dot Ltd)	http://drumleaf.com/	(VR) Gaming, Entertainment, Enterprise, Education (AR) Gaming
Dusk	https://dusk.nz/	(VR) Tourism, Entertainment, Education
Eight 360 Limited / Eight360	https://www.eight360.com/	(VR) Haptic Input - Treadmill
Envisage AR	https://www.envisage-ar.com/	(AR) Social, Next Generation Reality Capture
Eyemobi Ltd	http://www.eyemobi.com/	(VR) Gaming, Education (AR) Entertainment
Flightless	https://www.flightless.co.nz/	(VR) Gaming
Gaugepunk Ltd	https://www.gaugepunk.com/	(VR) Gaming
Geo AR Games	https://www.geoargames.com/	(VR) Gaming, Tourism, Entertainment, Education (AR) Gaming, Tourism, Education
Graham Parker t/a Graham Parker	https://www.virtualrealityrental.co.nz/	(VR) Location Based
Graphic Monk Limited	https://graphicmonk.com/	(VR) Entertainment, Reality Capture
Guerilla Digital	https://guerilla.digital/	(VR) Advertising (AR) Entertainment, Advertising
Hiamo Limited	https://hiamo.nz/	(VR) Education (AR) Tourism, Education
I Want To Experience	https://www.iwanttoexperience.com/	(VR) Entertainment
Illumine Limited	https://www.illumine.nz/	(VR) Tourism, Enterprise, Education, Advertising (AR) Enterprise, Education

Companies

Name	URL	Categories
Imersia Ltd / Imersia Ltd	http://www.imersia.com/	(VR) Distribution (AR) Distribution
ImmerseMe Limited	https://immerseme.co/	(VR) Social, Education
InGame Limited	http://www.ingame.co.nz/	(VR) Gaming, Enterprise, Education, Advertising (AR) Entertainment, Education
Internet marketing solutions Ltd trading as topVIEW	https://www.topview.co.nz/	(VR) Tourism, Enterprise, Education, Advertising
Invoke Limited	http://www.invokear.com/	(VR) Hand Input (AR) Input Components
iSPARX - Immersive Space Programme Limited	https://isparx.group/	(VR) Distribution, 3D Tools (AR) Distribution, 3D Tools
Jaffa Jam Limited	https://jaffajam.com/	(AR) Gaming
JIX Limited trading as JIX Research	https://www.jix.co.nz/	(VR) Entertainment, Education (AR) Entertainment, Education
Kowhai Media Ltd T/A New Zealand Geographic	https://www.nzgeo.com/	(VR) Entertainment, Education, Reality Capture (AR) Education, Reality Capture
lucidtripper.com	http://lucidtripper.com/	(VR) Entertainment
Many Worlds Limited	https://www.manyworlds.co.nz/	(VR) Gaming, Entertainment, Advertising (AR) Gaming, Advertising
Method Studios Limited, Method	https://method.digital/	(VR) Entertainment, Education, Advertising (AR) Tourism, Entertainment, Education
MR360 LightLabs Inc. (Victoria University of Wellington)	https://www.wellingtonuniventures.nz/portfolio/immersive-lighting-for-an-authentic-mixed-reality-experience/	(VR) Tourism, Education (AR) Social, Entertainment, Enterprise
Metia Interactive Ltd	https://www.metia.co.nz/	(VR) Gaming, Education***
Mind Game Media	https://www.mindgamemedia.co.nz/	(VR) Gaming, Education
Miramar Creative Limited	https://www.miramarcreative.nz/	(VR) Entertainment, Education

Companies

Name	URL	Categories
Mixt LTD	https://mixtstudio.co.nz/	(VR) Entertainment, Enterprise, Advertising (AR) Gaming
Motion Cinema Limited t/a Thrillzone	https://thrillzone.co.nz/	(VR) Tourism, Entertainment
Moving Pxl Ltd	https://www.showboat.co.nz/	(VR) Tourism, Entertainment, Education (AR) Education
Patternsnap Ltd	https://www.patternsnap.com/	(VR) Enterprise
Perceptual Engineering	http://www.perceptual.engineering/	(VR) Entertainment
QuiverVision Limited	https://quivervision.com/	(VR) Gaming, Entertainment, Education, Distribution (AR) Entertainment, Education
Reactar Ltd	https://www.homear.io/	(AR) Enterprise
realityvirtual.co	http://www.realityvirtual.co/	(VR) Tourism, Entertainment, Enterprise, Education, Reality Capture
Realm VR Ltd	https://www.realmvr.co.nz/	(VR) Entertainment
Red Crater Software Solutions. Trading company: BIM Holoview Ltd	http://redcrater.co.nz/	(AR) Enterprise
Red River Studio	http://red-river.studio/	(VR) Gaming, Entertainment, Enterprise
RocketWerkz Studios Limited	https://rocketwerkz.com/	(VR) Gaming
Runaway Play Ltd	http://www.runawayplay.com/	(VR) Gaming (AR) Gaming
Sensor Holdings Limited trading as StretchSense	https://stretchsense.com/	(VR) Gaming, Hand Input
Shadow Space Limited	http://www.shadow.space/	(VR) Enterprise, Advertising (AR) Enterprise
Silverback Academic Media	https://scipad.co.nz/	(AR) Education
Soul Machines	https://www.soulmachines.com/	(VR) Entertainment, Healthcare, Education, Advertising, 3D Tools

Companies

Name	URL	Categories
Staples Productions LTD Trading as StaplesVR	https://www.staplesvr.com/	(VR) Tourism, Entertainment, Enterprise, Healthcare, Education, Advertising (AR) Gaming, Tourism, Enterprise, Healthcare, Education
Sysdoc Ltd	https://www.sysdoc.com/	(VR) Education
TechLeap Ltd	https://enrolmy.com/techleap	(VR) Education (AR) Education
TECKLABS	https://www.tecklabs.co.nz/	(AR) Healthcare, Education
The VR Club	https://www.vrclub.co.nz/	(VR) Location Based, Entertainment
Tripod Digital Ltd.	https://tripod-digital.co.nz/	(AR) Entertainment, Advertising
Umajin	https://www.umajin.com/	(VR) Entertainment, Education, Distribution, 3D Tools (AR) Gaming, Enterprise, Education, Distribution, 3D Tools
Veepa Ltd	http://basicsdigital.com/ventures/virtual-reality-training/	(VR) Enterprise, Education (AR) Enterprise, Education
VersoVR	https://www.versovr.com/	(VR) Gaming, Entertainment, Reality Capture (AR) Gaming, Entertainment, Reality Capture
Virtual Medical Coaching	https://virtualmedicalcoaching.com/	(VR) Healthcare, Education (AR) Healthcare, Education
VR Lab LTD		(VR) Enterprise
VR Voom Limited	https://www.vrvoom.co.nz/	(VR) Location Based, Entertainment, Education
Wanderer Limited	https://www.wanderervr.com/	(VR) Gaming
Weta Workshop	https://www.wetaworkshop.com/	(VR) Gaming, Entertainment (AR) Gaming
Workbright eLearning	https://www.workbright.co.nz/	(VR) Education (AR) Education

Academic Researchers

First Name	Last Name	Institution	Area of Expertise
Auckland University of Technology			
Stefan	Marks	Auckland University of Technology	Data Visualisation, Collaboration
Minh	Nyguyen	Auckland University of Technology	AR for educational purposes and beyond
Patrick	van Esch	Auckland University of Technology	Consumer behaviour and AR/VR.
Massey University			
Nilufar	Baghaei	Massey University	Mental Health, Education, User studies
Zhenan	Feng	Massey University	Earthquake evacuation
Lucas	Haley	Massey University	Human experience and sensory replacement
Ruggiero	Lovreglio	Massey University	Human behavior in disasters, testing safety system, safety training
Daniel	Paes	Massey University	Visual perception, presence, training in VR for architectural design, construction, and workforce training applications.
Alexander	Schnack	Massey University	HMDs, eye tracking, calibration
University of Auckland			
Vicente	Gonzalez	University of Auckland	Civil Engineering, Construction Engineering and Management, Earthquake/Tsunami Evacuation, Education.
Harvey	Ho	University of Auckland	Virtual surgery, virtual carcass cutting
Minas	Liarokapis	University of Auckland	AR/VR Based Teleoperation of Robotic Arm Hand Systems
Alex	Shaw	University of Auckland	Applications of AR/VR/XR in Health and Education.
Robert	Amor	University of Auckland	VR/AR visualisation for architecture/construction, interaction with building information models (BIM).
Huidong	Bai	University of Auckland	Mobile/Wearable AR Interaction, XR Remote Collaboration

Academic Researchers

First Name	Last Name	Institution	Area of Expertise
Amit	Barde	University of Auckland	Spatial Audio, Physiological Sensors in AR/VR/XR
Mark	Billinghurst	University of Auckland	Remote Collaboration, Empathic computing, User Interfaces, Mobile AR
Allan	Fowler	University of Auckland	User Experience, Application Development, Measuring cognition
Nasser	Giacaman	University of Auckland	AR and VR for mobile phones
Thomas	Gregory	University of Auckland	Using VR for empathy
Yinan	Liu	University of Auckland	Generating digital and physical hybrid environments. Intuitive interaction and spatial behavior.
Danielle	Lottridge	University of Auckland	VR/AR, creativity, health and rehabilitation
Bruce	MacDonald	University of Auckland	AR and VR use in robotics
Dermott	McMeel	University of Auckland	Perception
Suranga	Nanayakkara	University of Auckland	Sensory Substitution/Assistive Augmentations
Yun	Pai	University of Auckland	Effects of AR/VR/XR on human behavior, perception, and physiological state
Uwe	Rieger	University of Auckland	Cyber-physical systems, cross reality, tangible media
Sophie	Tamati	University of Auckland	Language acquisition and cultural sustainability (especially te reo Maori and tikanga Maori)
Burkhard	Wuensche	University of Auckland	Usability, training/healthcare applications, 3D content generation, 3D interfaces, exergaming
Xun	Xu	University of Auckland	AR for enhancing interfaces of production equipment; VR/XR for product development
Zexuan	Zhu	University of Auckland	The application of AR in smart manufacturing
University of Canterbury			
Adrian	Clark	University of Canterbury	Vision based tracking, Applications of AR, Interaction in AR
Simon	Hoermann	University of Canterbury	Health and Wellbeing, Simulations
Sungchul	Jung	University of Canterbury	Mixed Reality and Human Computer Interaction, virtual avatars, sensory feedback, Human perception and cognition
Rob	Lindeman	University of Canterbury	Long-term effects; Multi-sensory VR; 360-degree video; Game Applications; Tourism
Heide	Lukosch	University of Canterbury	VR Games, VR/AR environments for learning and training, AR for remote collaboration

Academic Researchers

First Name	Last Name	Institution	Area of Expertise
Stephan	Lukosch	University of Canterbury	AR applied games for training, AR systems for feedback and awareness, AR systems for collaboration
Tanja	Mitrovic	University of Canterbury	Education applications, Intelligent Tutoring
Andrew	Phelps	University of Canterbury	Rendering, composition, spatial presence, telepresence, user experience
Thammathip	Piumsomboon	University of Canterbury	Interaction, collaboration, perception
Bhuvaneswari	Sarupuri	University of Canterbury	Locomotion in VR, Active skill transfer using XR, Multisensory VR experiences
Richard	Li	University of Canterbury	Applied research of VR (e.g., VR enabled learning)
University of Otago			
Tobias	Langlotz	University of Otago	Computational Glasses, Telepresence and Virtual Tourism, Display technologies for AR glasses, AR Interaction techniques
Steven	Mills	University of Otago	Computer vision to support interactive experiences
Antoni	Moore	University of Otago	Geographic applications of AR/VR; Virtual Geographic Environments;
Alexander	Plopski	University of Otago	VR applications for shopper research, VR online shopping
Holger	Regenbrecht	University of Otago	Industrial Applications, Presence, Telepresence, Virtual Neurorehabilitation
Stefanie	Zollmann	University of Otago	Visualisation, localisation and tracking, 3D reconstruction, near eye displays
University of Waikato			
Michael	Cree	University of Waikato	Time-of-flight range imaging cameras, Structure from video motion
Lee	Streeter	University of Waikato	3D imaging, Time-of-flight range imaging.
Victoria University of Wellington			
Ken	Anjyo	Victoria University of Wellington	Avatars
Craig	Anslow	Victoria University of Wellington	Immersive Analytics, Simulation, XR for Digital Health
Andrew	Chalmers	Victoria University of Wellington	VR games, virtual worlds, education
Neil	Dodgson	Victoria University of Wellington	Stereoscopic display, landscape-scale outdoor AR
Areito	Echevarria	Victoria University of Wellington	Interactive narrative, basic psychology research.

Academic Researchers

First Name	Last Name	Institution	Area of Expertise
Leon	Gurevitch	Victoria University of Wellington	AR/VR practical deployment, theoretical and historical development.
Byron	Mallett	Victoria University of Wellington	VR user interfaces and collaborative interaction design
Simon	McCallum	Victoria University of Wellington	Games in XR, Education using XR, Healthcare and Usability
Tane	Moleta	Victoria University of Wellington	Serious games, Architectural/ Design Education, Parametric Design
Nadia	Pantidi	Victoria University of Wellington	Human Computer Interaction, User Experience
Taehyun	Rhee	Victoria University of Wellington	Cinematic XR, Rendering, Immersive Capturing/Modeling/Visualisation, Remote Collaboration, Future media technology
Miriam	Ross	Victoria University of Wellington	Cinematic VR, Experimental VR, Interactive Narrative, History of VR
Marc	Schnabel	Victoria University of Wellington	Architecture, Design, Film, Digital Heritage, Intelligent Cities, Building Science, Game
Raqi	Syed	Victoria University of Wellington	Realtime rendering for VR, Realtime VFX, narrative storytelling
Fanglue	Zhang	Victoria University of Wellington	Image-based Rendering, image/video understanding and enhancement
Junhong	Zhao	Victoria University of Wellington	Machine learning on image based lighting
Andre	Brown	Victoria University of Wellington	Urban representation, simulation, design processes
Christian	Schott	Victoria University of Wellington	Experiential education through VR, sustainability and empathy through VR, tourism

INTERNATIONAL EXPERTS

International Experts

First Name	Company	Position	Country
ARman Atoyan	ARLOOPA Inc.	CEO	Armenia
Richard Broo	Wemersive Inc	CEO	USA
Brian Cabral	Facebook	Engineering Director	USA
Tipatat Chennavasin	The Venture Reality Fund	General Partner	USA
Devon Copley	Imeve	CEO	USA
Charlie Fink	Fobes	Columnist	USA
Thomas Furness	University of Washington	Professor	USA
Alvin Graylin	HTC	China President	China
Sinem Guven	IBM	Research Manager	USA
Ori Inbar	AugmentedReality.org	CEO	USA
Linda Jacobson	Virtual World Society	Director	U.S.
Wonwoo Lee	Samsung Research	Staff Engineer	South Korea
Ferris Lu	Forebright Capital Management Limited	Executive Director	China
Takashi Maki	Ricoh co.,ltd.	Senior R&D Engineer	Japan
Matt Miesnieks	Niantic	Advisor	USA
Jacquelyn F Morie	All These Worlds, LLC	Founder	USA
Dan Newell	Tangis Corp	Founder	USA
Leif Oppermann	Fraunhofer Institute for Applied Information Technology FIT	Head of Mixed Reality Team	Germany
Babak Parviz	Amazon	Vice President	USA
Jason Quarberg	PTC	Sales Manager ANZ	Australia
Hayes Raffle	Google	UX Lead, AR Devices	USA
Gerhard Reitmayr	Qualcomm	Senior Director	USA
Driancourt Remi	Square Enix Co., Ltd.	Division Head	Japan

International Experts

First Name	Company	Position	Country
Rene Schulte	Valorem Reply	Director, Global Innovation	Germany
Wolfgang Stelzle	REFLEKT GmbH	CEO	Germany
Neil Trevett	NVIDIA / Khronos	VP / President	USA
Dongdong Weng	Beijing Institute of Technology	Researcher	China

CONTACT INFORMATION

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The Ministry of Business, Innovation, and Employment

