The Irish Immersive Economy

Irish Immersive Technology Industry Landscape 2022

APRIL 2022

Immersive Technologies Skillnet

Animation Skillnet

Screen Skillnet

EIRMERSIVE

Acknowledgements

Prepared for:
Immersive Technologies Skillnet
Animation Skillnet
Screen Skillnet
Skillnet Ireland

Animation, Screen, and Immersive Technologies Skillnets provide subsidised talent development solutions to the Animation, Screen, and Immersive Technology (Games, VR/AR VP etc.) sectors in Ireland through high-end, bespoke upskilling initiatives that are designed and delivered by industry specialists. The objective of Immersive Technologies Skillnet is to expand the immersive technology capability of Irish businesses through subsidised learning and development programmes.

Prepared by:

Eirmersive is the voice of the Immersive Sector in Ireland. Our vision:

- Enable the opportunity for immersive technology to be an enabler and catalyst for transformation and new business growth in Ireland.
- Position Ireland as a global player in the immersive technology sector through connecting our thriving high growth, hi-tech enterprise and start-up ecosystem to facilitate transformational change.
- Support and enable innovative immersive technology businesses to be ground-breaking and game changing world leaders in innovation and R&D.

Pivotal Edtech

Pivotal EdTech was formed in 2021 to bring edtech and other technologies to market through research, commercialisation and investment readiness.

Authors:

Jonny Cosgrove, Camille Donegan, James Corbett, Fiona Kilkelly, Pauline Logan, Jonathan Dempsey and Emmet Burke.

The authors would like to acknowledge the guidance provided by Susan Talbot (Immersive Technologies Skillnet), Barbara Deignan (Screen Skillnet), Sean Smith (Animation Skillnet) and Gareth Lee (Screen Ireland) through the development of this report.

Photo Credits:

Mark Stedman (Emperor 101), Conor Mc Cabe (ARVR Innovate), Allen Kiely (MusicXTech), Tynesight Media Services (SXSW). Also thanks to photo contributions from Vologrames, Utility AR, Mersus Technologies, The Performance Corporation and The Civic Theatre.

Table of Contents

"There are significant pockets of activity but its usage is not widespread."

Immersive Technologies Research Group in Higher Education

Foreword

Foreword

Skillnet

Immersive technologies have evolved rapidly in recent years as technological advances impact business models, while societal shifts demand increasingly sophisticated and human-centred immersive content, applications and services.

For Ireland to be a global leader in this space, we need to ensure the immersive technologies talent base reflects not just the current business demands but the challenges of future growth in existing and new markets.

This report outlines Ireland's current immersive technology capacity and capabilities and makes recommendations that support business growth across a range of sectors and supports the attraction of foreign-direct investment within this sector.

Central to this will be developing a robust skills and talent pipeline, a world class research and development framework and relevant business supports to start-ups and scale-ups.

The report also offers practical ways in which Ireland can drive productivity and innovation in all areas of the immersive tech ecosystem nationwide through talent.

I would like to acknowledge all of those who contributed to this research report. Particular thanks are due to the many enterprises, employees and stakeholders who contributed their time and efforts. I would also like to express my thanks to Eirmersive and Pivotal EdTech. Finally, I would like to thank the Immersive Technologies Skillnet, Animation Skillnet and Screen Skillnet for managing and leading this innovative study to a successful conclusion.

Tracey Donnery
Director of Communications and Policy

Eirmersive

The genesis of this report grew out of the foresight of Immersive Technologies Skillnet, as a response to a direct need to better understand Ireland's emerging immersive technology ecosystem. This in turn is in response to what has been a growing demand from industry itself, to articulate Ireland's unique voice and contribution to the national and global immersive technology marketplace. It is only by digging deeper into who this growing community of innovators are, what new products, services and experiences are disrupting the consumer and enterprise markets and then by capturing the value this is generating, that we are able to understand the growth potential of the future. It also helps us identify the challenges, particularly in the face of rapid adoption, as well as pointing to the risk of missing this global opportunity should our response to those challenges not be targeted and swift.

I remember one of my early conversations as Chair of Eirmersive, in one of numerous industry consultations we led to define how a new industry network would support this nascent industry, that brought sharply into focus the importance of this work. This particular company wanted to set up an immersive tech office in Ireland but did not know where to begin or who to go to for support. How many near opportunities are not being identified and how many new disruptive and transformative applications of immersive technology are not happening because of the lack of a joined up and informed ecosystem?

This report will go some way to address that and help inform how key government stakeholders can go further in supporting the needs of this emerging sector. It also begins a long overdue journey in celebrating this vibrant, passionate and growing sector, sharing in its successes and increasing its well deserved profile on an international market.

Fiona Kilkelly
Chair Eirmersive

"Working with immersive technology would help to future proof the business."

Content creator and consultant

Executive Summary

Executive Summary

The Irish Immersive Technology sector is worth over €43 million, with huge future potential and employs over 750 people in Ireland. It is a well connected, thriving, and outward looking sector ready to take up a global opportunity. However, given the barriers to growth outlined in this report, the immersive market will require significant strategic support to capitalise on these new opportunities in the short term and to be in a stronger position to innovate on a global scale in the future.

Animation, Screen, Immersive Technologies Skillnets and Pivotal Edtech, have produced a comprehensive domestic immersive technologies ecosystem study. This is critical to understanding Ireland's capacity and capabilities to grow within the global immersive ecosystem.

The barriers that exist:

- The Immersive Technology skills gap
- Lack of funds to capitalise on market opportunities
- Low awareness of the potential for Immersive Technologies
- Lack of networking, knowledge sharing, connecting and collaboration.
- Ireland is behind other countries in Government investment in Immersive Technologies.

See further details on barriers identified.

The opportunities that exist:

- Build upon Ireland's export strengths.
- Building Ireland's immersive talent pool.
- The emerging immersive technologies ecosystem in Ireland.

See further details on opportunities identified.

The key messages/findings identified:

- There is opportunity for Irish immersive tech businesses to excel on a global scale.
- Irish businesses are already driving value from immersive technologies.
- There is an emerging immersive ecosystem with a focus on Dublin and hot spots growing regional activity.
- Irish immersive businesses are exporting to Europe and internationally.
- A shortage of skilled people, difficulty accessing funding, low market awareness and a low level of investment in accessible facilities are barriers to growth in this nascent market.
- The sector consists of multinational companies investing heavily in immersive technologies and start ups and scale ups with an ambition to escalate their R&D and investment.
- Irish Immersive technology businesses expect to invest more in immersive technologies in the next 12 months.
- Businesses new to the market are exploring new applications and considering investment.
- Ireland has a vibrant immersive technologies research and development landscape with regional hotspots.
- Low levels of Venture Capital investment reflecting nascent market but number of high profile success stories.
- Executives from major technology companies believe that Ireland is at a relative disadvantage in the Immersive Technology Space.

See further details on key messages/findings identified.

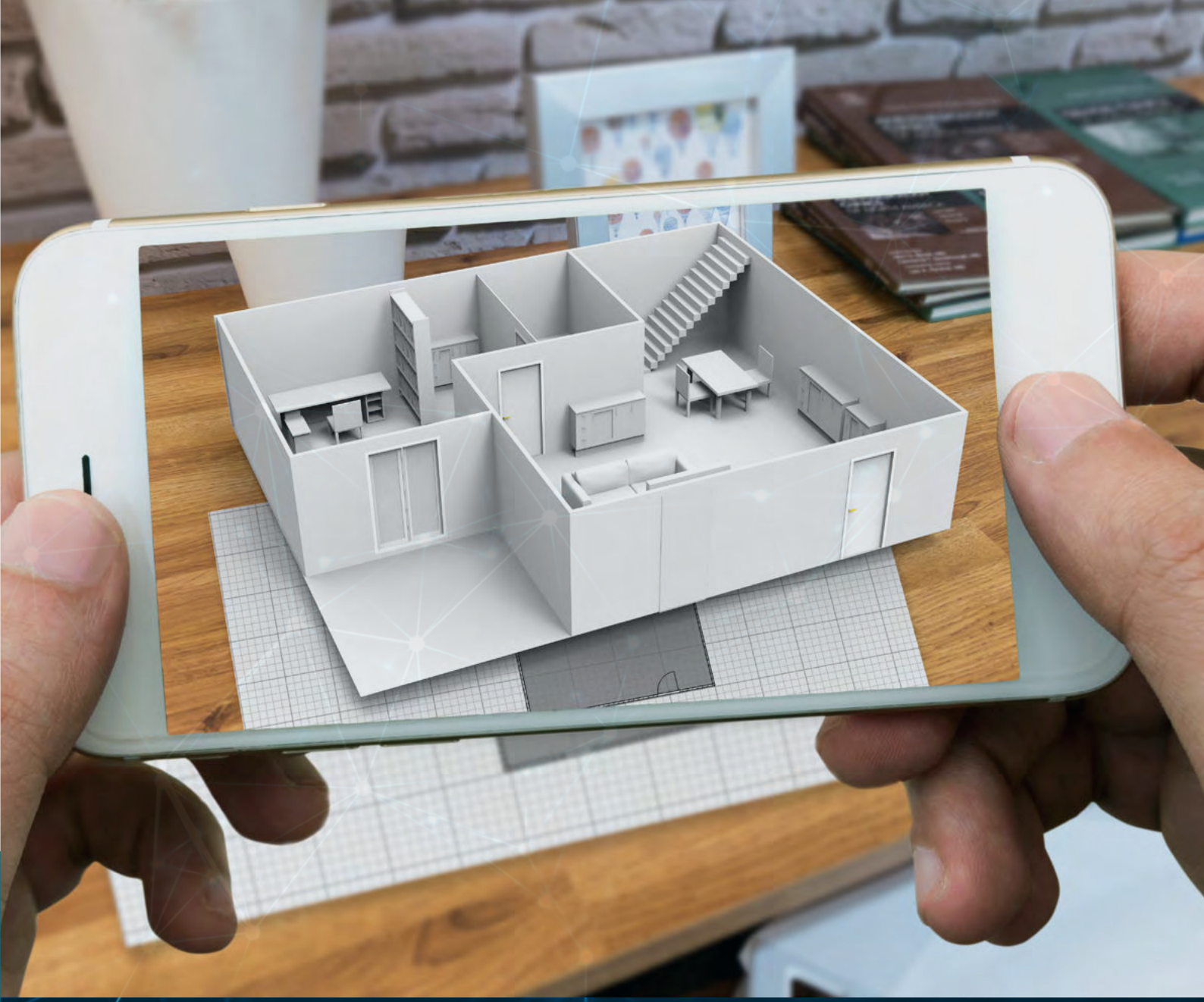
This report recommends:

- Create an Immersive Technology Strategic Roadmap for Growth.
- Build greater awareness of the enabling and transformative potential of immersive technology through a campaign which provides hands on opportunities to try out immersive content, applications and experiences, showcases companies and their products, builds use-cases and sign posts to intelligence, advice, guidance and support.
- Direct targeted funding for new programmes which support applied research and prototype development to help innovators and companies experiment with and apply immersive tech within business, products, services, and entertainment.
- Provide business and development support to then scale up these ideas and take them to market.
- Create a new fund which provides access to equipment and hardware to showcase and demo use of immersive tech in a wide range of sectors, enabling businesses to explore what immersive technology is and how they can utilise it in their businesses today and in the future
- Empower regional organisations to provide bespoke support for regional businesses, to hot desk, network, pitch to clients and avail of wider support targeted at high growth tech sector and broker introductions, collaborations and greater engagement between industries working in or looking to work in immersive tech on the ground locally.
- Support greater cross sector collaboration, enable the fertilisation of new ideas and incentivise leading edge R&D to help drive innovation. This can be achieved by empowering support networks on the ground.
- Prioritise promotion of immersive technologies sector in international markets through feasibility studies of the market opportunities in international markets, embed within Team Ireland approach to markets and support from IDA and Enterprise Ireland to take up the range of international collaboration opportunities such as digital Missions and Trade Shows and Government or European funded collaborative R&D programmes between universities.

See further details on recommendations.

"Despite some experience in the AR/VR sector (Ireland) there is much to learn, the startup / business cannot shoulder all of the R+D costs especially if they are working on original concepts and application of AR/VR."

Software, Content Creation and Consultancy Company



Overview

Introduction

This report maps the current Irish Immersive tech sector, its market drivers, growth application areas, barriers, opportunities and needs to support productivity and growth.

Its intention is to help better understand Ireland's capacity and capabilities in order to put in place the supports needed to aid business growth, attract FDI and evolve workforce design & development and talent retention.

The report will help not only better inform the sector itself, but also those looking to work in the sector in the future and the enablers who can help drive productivity and innovation in all areas of the immersive tech ecosystem nationwide.

Eirmersive and Pivotal Edtech were selected to perform the study.

This project is funded by Skillnet Ireland under the "Accelerating Innovation and Business Transformation Through Talent Industry Insights" programme.
See acknowledgements.

Background

The global impact of Covid-19 has created opportunities along with challenges for the global and in particular European immersive markets, including Ireland. However, the longer-term growth opportunities for AR/VR may emerge even stronger. The COVID-19 pandemic has created a shift in mind-set. With so many employees working remotely, augmented and virtual reality are being considered as necessary tools to engage with consumers, audiences and drive new business models within and across organisations. This shift in priorities, with a greater focus on ROI and productivity and efficiency gains, continues to ramp up interest in AR and VR led by the 'remote everything' digital times we are experiencing today.

Existing digital technologies, when combined with emerging technologies such as AR and VR, can be a catalyst for transformation and new business growth in Ireland, creating new opportunities for Irish immersive businesses in the global market. Ireland's technology sector and creative industries are in an excellent position to reap the rewards of the current growth in technological momentum, particularly as low latency 5G begins to roll out and decentralisation becomes a viable option.

Methodology

The study comprised of research led by Eirmersive and Pivotal EdTech with:

- Market analysis
- Survey (128 responses)
- Interviews (45 interviews)
- Recommendations

The pool of respondents included:

- Companies that use or plan to use immersive technologies in how they conduct business.
- Investors in AR/VR
- Researchers in Higher Education Institutions and in specialist research centres
- National and regional agencies that support enterprise and innovation
- Companies that provide AR/VR products and services

This study was carried out between November 2021 and February 2022, and the information gathered was collected with the agreement that feedback would not be published attributed to individual companies or representatives.

The 128 respondents to the survey are listed in Appendix A and the 45 Participants in the interviews are listed in Appendix B.

Scope

Immersive Technologies are used for a wide range of purposes across a range of sectors domestically in Ireland. The focus of this report is on the current domestic immersive technology activity i.e. AR/VR activity in Ireland and from Ireland. This will include market drivers, growth application areas, barriers, opportunities and what is needed to support productivity and growth. A further area of research is required to perform a review of where Ireland ranks in comparison to global immersive technology hubs.

Glossary

For the purpose of this report, we refer to the following terms frequently[1]:

Virtual Reality (VR) Immerses you in a fully digital environment, either computer generated or recorded from the physical world, through a headset or surrounding display.

Augmented Reality (AR) Presents digital information, objects or media in the physical world through a mobile device or headset.

Extended Reality (XR) The full spectrum of technologies and experiences from the partly digital world of AR to the fully immersive experience of VR.

Immersive Technologies covers VR and AR.

R&I is Research and Innovation.

"Adoption rate by SMEs is slow. More education, events and awareness needed."

Research group specialising in immersive technologies

"Awareness among potential customers of a variety of use cases."

Early stage immersive technology Content Creator

chapter ONE

Global Market

If there is a time for AR and VR to demonstrate where it has value, it is now. The pandemic has accelerated the use of immersive technology as a transformative technology in a wide range of industries globally, from business operations, remote working, design and collaboration, remote assistance, training and even in consumer markets.[2] Businesses working directly in immersive technology are transcending national and international boundaries, opening up new markets, creating new opportunities for businesses new to the AR and VR market, levelling the playing field and reaching new users, consumers and audiences.

Analyst projections and real world evidence are pointing to a fast expanding immersive technologies sector globally, creating market opportunities for Irish immersive technology firms both in Ireland and internationally. An indication of the acceleration that is happening in the consumer market is that global shipments for virtual reality (VR) headsets jumped 52.4% year on year.[3]

According to IDC, enterprise users have moved beyond exploratory and pilot use cases and into broader deployments, the market for AR and VR headsets is expected to grow from $4.3 billion in 2021 to $36 billion in 2025, suggesting CAGR of 68% over this five year period, driven initially by "demand for robust gaming solutions".[4]

Why now? What are the key drivers for change?

Many organisations moved toward remote work during the pandemic, with around 80% of global corporate remote work policies supporting a shift to virtual and mixed forms of team collaboration, transforming attitudes and practices in many organisations.[5] A recent study of 300 US-based business and technology leaders carried out by Forrester revealed that approximately one-third (34%) of companies using immersive technologies today did not use them pre-pandemic and over half (54%) accelerated their use due to the pandemic. Similarly, 80% of workers were using collaboration tools for work in 2021, up from just over half of workers in 2019, an increase of 44% since the pandemic began.[6]

The availability of much better connectivity speeds, such as with the increased availability of 5G, is encouraging the adoption of immersive technologies and applications that are bandwidth intensive. This quotation from a recent IDC report captures current sentiment on the technology:

"AR/VR has slowly changed from curiosity to a valuable tool. Whereas initial devices and experiences highlighted how these devices worked, newer and future versions will underscore convenience and productivity for end users."[7]

Immersive technologies are being more widely used now. Unity in its 2021 Technology Trends Report, found that 63% of firms used immersive tech, such as real time 3D, AR, VR to navigate the challenges of Covid-19.[8] Meta announced in October 2021 that it was creating 10,000 jobs in the EU to help build the 'metaverse.'[9] Other companies like Nike are creating teams such as 'Metaverse Engineering' to work on their 'virtual focused' activities.[10] Accenture alone announced the purchase of 60,000 Oculus headsets in late 2021 for VR training and future efforts to engage with their customers.[11]

More VR headsets are being purchased than ever before. The Times reports (Jan 2021) that the sales of VR headsets have risen by 350% as those trapped at home seek a safe way to escape the lockdown showing an increase in device penetration in the home market.[12] Whether live esports with competitors from across the globe, experiencing the Royal Shakespeare Company's new play through AR on your mobile, watching music performances streamed in VR such as Jean Michelle Jarre's New Year Concert, or visiting the Louvre or the Rocky Mountains from the comfort of your home, these technologies can transform the way we engage with arts, sports and leisure experiences – and with each other.

The largest organisations in the world have made their intentions clear regarding immersive technology. Multinational companies, many with their European headquarters in Ireland, are pivoting significant resources towards the metaverse and immersive technology, including Meta, Apple, Nike, Disney and Microsoft and others with a commitment to being early adopters in their own sectors.

chapter **TWO**

Domestic Sector

What is the size and value of the immersive tech sector in Ireland?

The total value of companies surveyed for this report came to over €43 million based on reported turnover. The number employed in immersive technology companies in the domestic sector surveyed for this report is estimated to be over 750. This is a considerable underestimate of the total number as it excludes multinationals and domestic companies that didn't take part in the survey.

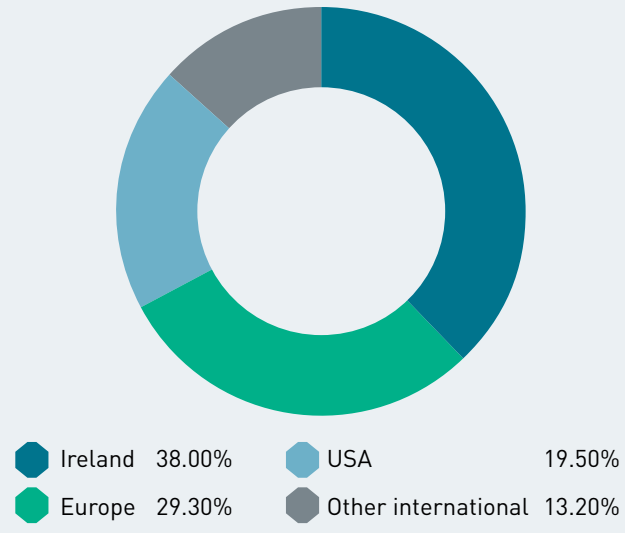
The evidence generated by our survey with industry suggests a deeper exploration and analysis of the Irish market would prove valuable. The figures we have pointed to here are at best an underestimate as not all companies in the sector took part or provided the estimate, including some of the very large players (Master Card, Meta etc). It is a good starting point, producing a minimum value of the sector.

Exports

The immersive technologies sector is outwardly focused. Ireland was the most mentioned location for customers, with Europe, USA and other markets also mentioned by high numbers of respondents. The Irish market is relatively small to justify investment on its own, so many companies are born global, looking for customers internationally earlier in their development than their UK counterparts, for example.[13]

FIGURE 1 ▸ Breakdown of where customers are located

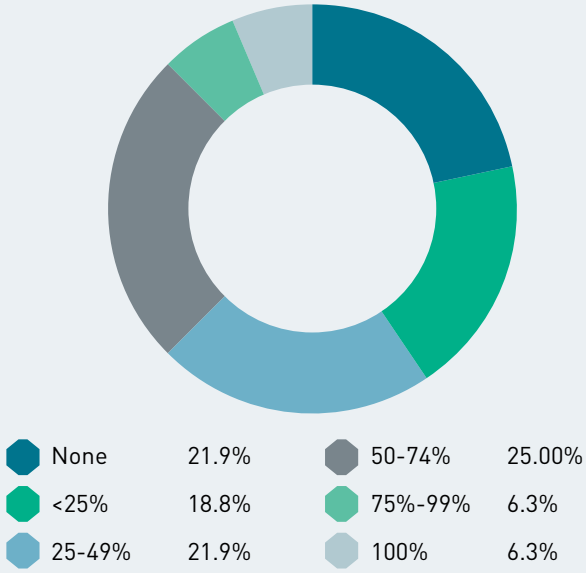
Source: Survey data



Looking at the specialist Immersive Technology businesses, almost 80% are exporting:

FIGURE 2 ▸ Proportion of Immersive Technology specialist company sales that are exported

Source: Survey data

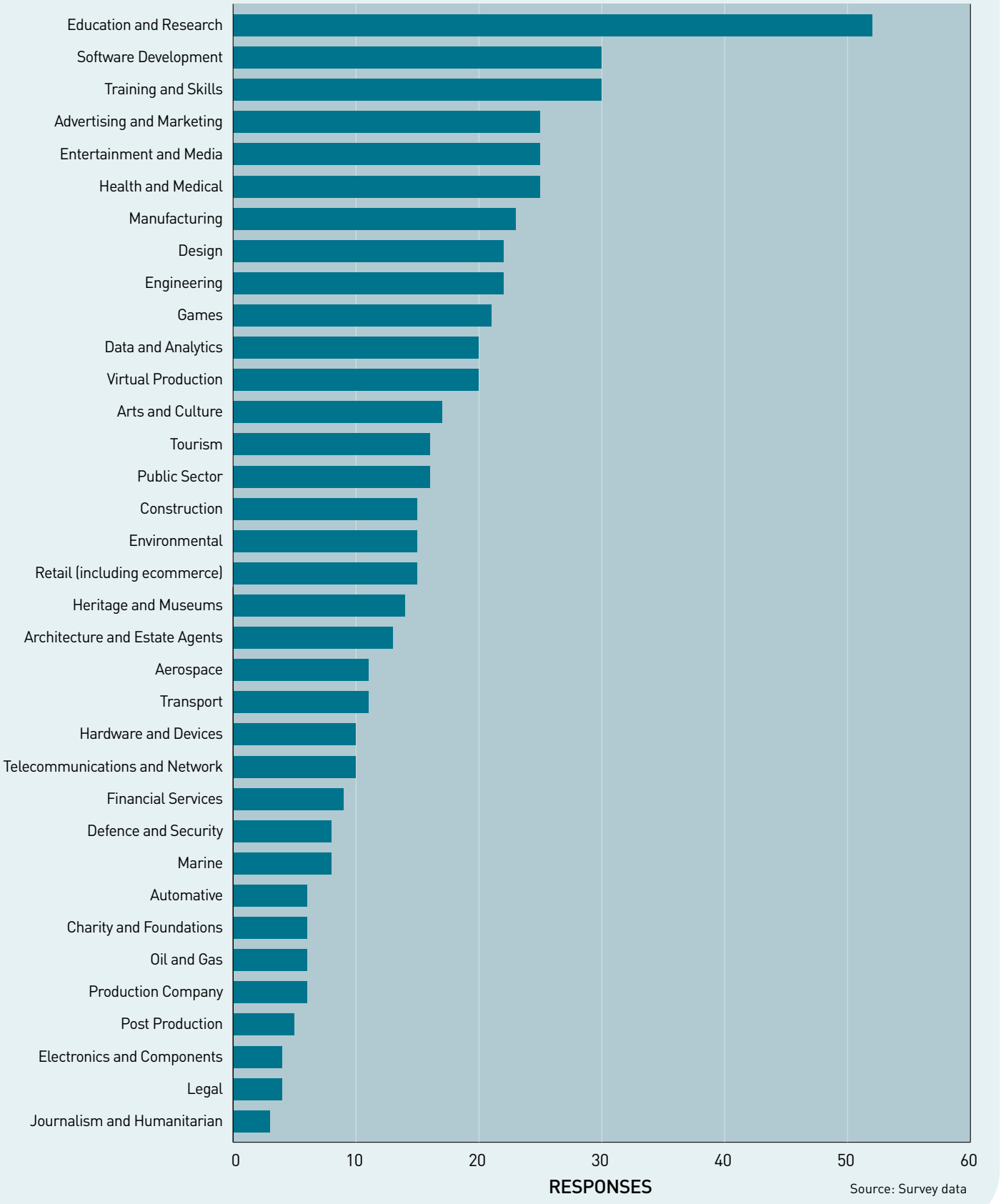


What sectors are using Immersive Tech and to what degree/scale?

The potential for Ireland to be a part of the growing immersive technology market was reflected in comments from people in the sector interviewed for this report. For some immersive technology firms, there has been a dramatic change from needing to evangelise about the potential for immersive technologies to experiencing increasing levels of inbound contact by companies. These businesses want to know more about the potential of the technologies and how to use them to solve business problems. Immersive technologies is entering a growth phase that will accelerate further as improved hardware is brought to market and offers a rich vein of growth for Irish companies and Ireland based divisions of multinational companies.

According to the survey, the most common areas in which Immersive Technologies are being applied are Education and Research, Software Development and Training and Skills, but it is being used in a long list of sectors as the chart and table show and is outlined in the Market for Immersive Technologies section and Chapter 4 - Application Growth Areas.

FIGURE 3 ▸ Breakdown of application markets for repondents



See Chapter Four - Application Growth Areas for the full list.

Where Immersive Tech is Driving Value

The survey showed that the most common way immersive technologies add value is **process** (improvements in organisation and efficiency), followed closely by **product** (ability to develop new products) and then **culture and market**. Note that many respondents mentioned more than one.

How immersive tech is driving value	Number of mentions
Process i.e. improvements in organisation and efficiency	38
Product i.e. the ability to develop new products/ faster prototyping, and to increase the visibility of the company as an innovator	33
Culture i.e. changing the culture of the organisation	25
Market i.e. the ability to expand the markets the company targets	21

Source: Survey data

Many of the respondents mentioned the specific ways in which Immersive Technology adds value, with one Games company saying it is *"literally the backbone of our offering here"* and a Consultancy saying *"All of the above. Engagement with policy makers, stakeholders and the community to provide a better understanding of our designs through visualisation"*.

The survey showed that immersive technologies are being applied across a very wide range of sectors, highlighting the diversity of markets and of the immersive technologies specialist companies in Ireland. See Chapter 4 - Application Growth Areas.

What impact is Immersive Technology having?

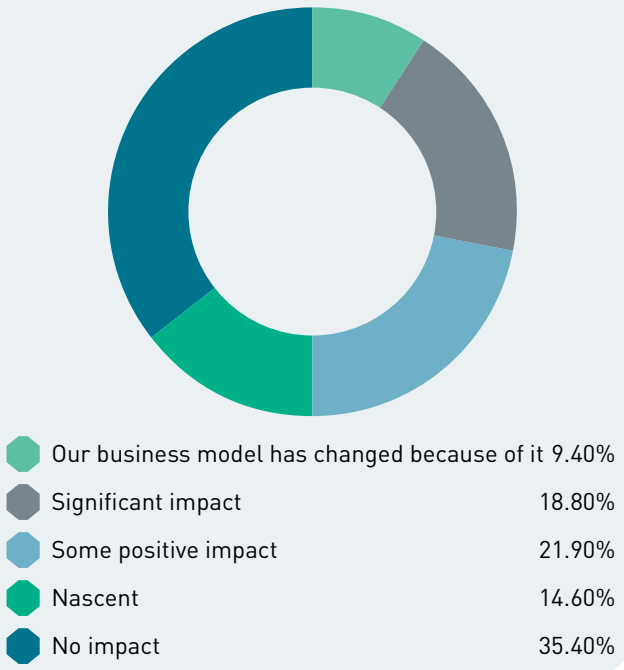
For most of the respondents for whom immersive technologies accounts for less than 50% of revenue, it has had an impact ranging from some positive effect (21.9%), to changing the whole business model (9.4%):

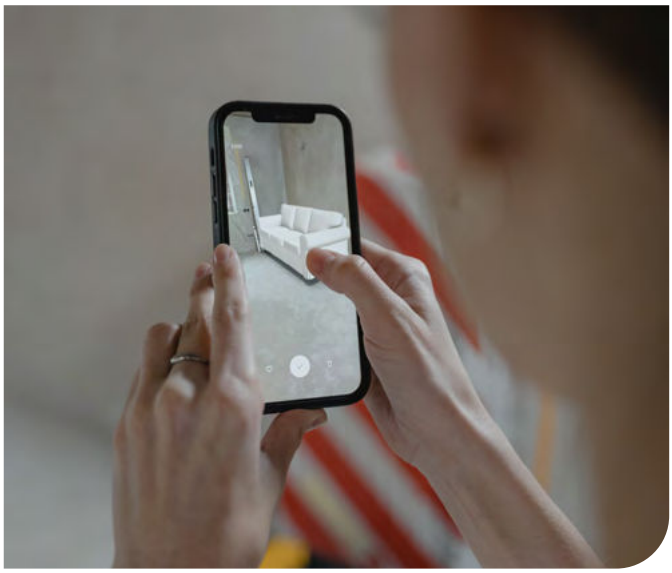
- 35% who said it had no impact so far are looking at the area and expecting to find opportunities in the future
- 21.9% who see some positive impact so far are in the main trying different ways of working with AR or VR and educating customers about what is possible
- 18.8% who said that it had a significant impact mentioned the establishment of specialist Immersive technology teams and designated spaces in their organisations
- 14.6% who described the impact as nascent are still at an early stage of assessing value and are trying or planning to try different applications
- 9.4% of the respondents said that their business model has changed

Source: Survey data

FIGURE 4 ▸ Impact on respondents where Immersive Technology not a majority of turnover

Source: Survey data





There are diverse reasons for some respondents not yet using Immersive Technologies.

24% or those surveyed stated that they are not currently using Immersive Technologies. They relate this to a lack of knowledge, they don't feel it offers any solution to them yet or it's too expensive still. Some are close to using it and are currently investigating possibilities for their organisation.

What is the growth potential of the domestic immersive technologies market?

Domestic Innovation: Use Cases

These are some stand out examples identified in the interviews of where Irish immersive technology companies are creating huge value across a range of sectors:

- More effective and efficient education and training
- Digital twins reducing cost and improving efficiencies, including for conducting regulatory audit without disturbing sterile environments
- Better and more cost-effective design
- Cheaper, better and more environmentally friendly building design, consultation, construction and building maintenance
- Effective collaboration without the need to travel and meet in person
- Transformation of sales, marketing and customer service, with enhanced customer satisfaction

Lacking the knowledge or skills to adapt Immersive Technologies:

[We have a] lack of knowledge, skills, know-how. However we would be very interested in using this technology as part of our teaching and learning strategies. It would be great to be able to show virtual examples of concepts and add gaming elements to provide textbook material support to learners.

Looking for evidence of how it could be of value, suggesting a need for wider communications of the benefits:

Require clear use case and budget.

Feel the costs are still too high:

While very powerful tools until recently cost to interest/uptake has been prohibitive.

See as not relevant to them yet:

We work with clients who specialise in it but it has not been relevant/needed in our own business yet.

Felt they didn't know enough about it:

Haven't got a real awareness of what it is or how it works.

Thought that technology is not yet able to do what they would require:

It has not come up as a client request as yet. Most of what we do needs to report to client LMS through SCORM. AR and VR doesn't have that support as yet.

See Chapter 4 for overviews of some of the key vertical markets for use cases of immersive technologies and 11 domestic company case studies for examples of how immersive technologies are being used.

Future Domestic Investment in Immersive Technologies

The majority are either certain they will be making a major investment (22.2%) or are exploring new applications (40.5%), with a further 18.5% seeing a small possibility of investing. 40.5% or 51 organisations from this group are actively exploring new investment over the next year. This suggests a significant ramp up in demand for Immersive Technologies.

In addition to those who are *definitely* making major investments, another 58.8% are exploring new applications or are considering the possibility of investment. This suggests a strong upsurge in the use of Immersive Technologies in the 12 months ahead.

"More customers need to have a VR or AR headset in their home."

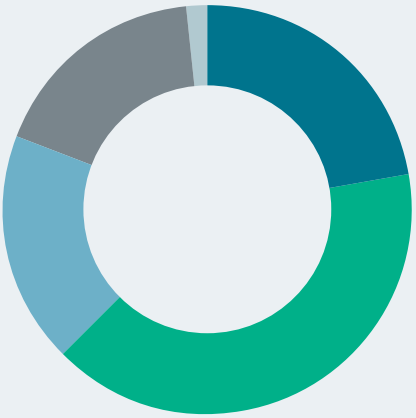
Content Creation Company

The majority of respondents plan to invest in Immersive Technologies in the next 12 months:

- Certainty of major investment 22.2%
- Exploring new applications 40.5%
- Possibly investing 18.3%)
- Remaining the same 17.5%
- Less investment 1.6%

FIGURE 5 ▸ Planning investment in Immersive Technology in next 12 months?

Source: Survey data



Major Investment	22.50%
Exploring new applications	40.50%
Small possibility of investing	18.30%
Remain the same	17.50%
Less investment	1.60%

chapter **THREE**

Domestic Immersive Technologies Sector Profile

What Immersive Technologies businesses are operational in Ireland?

There are at least 32 immersive technologies focused businesses in operation in 2022.

- There were 128 responses to the survey of which 32 stated that the Immersive Technology sector accounted for the majority of their turnover.
- This group of 32 majority Immersive Technologies Companies is not exhaustive as it consists of survey respondents only. In addition, more than 47 companies derive some (but less than 50%) revenue from immersive technologies.

	Number of respondents
Immersive Technologies Companies (50% + of turnover)	32
Companies using Immersive Technologies (up to 49% of turnover)	47
Accounts for no part of turnover	47
Total Responses to question (2 didn't answer this question)	126

Source: Survey data

Size profile - the breakdown of sizes of Immersive Technology firms

The early stage of development of this sector in Ireland is illustrated by the small size of the majority of specialist companies. According to the survey:

- Specialist immersive technology companies range in turnover from less than €100,000 to €5 million, with the majority (68.8%) having turnover of less than €250,000.
- 68.8% of all of current specialist immersive technology companies have 10 or less employees.

FIGURE 6 ▸ Breakdown of size of Immersive Technology firms (majority of turnover)

Source: Survey data

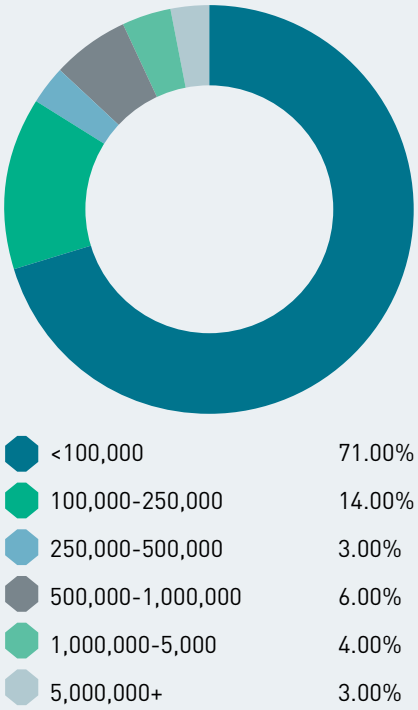
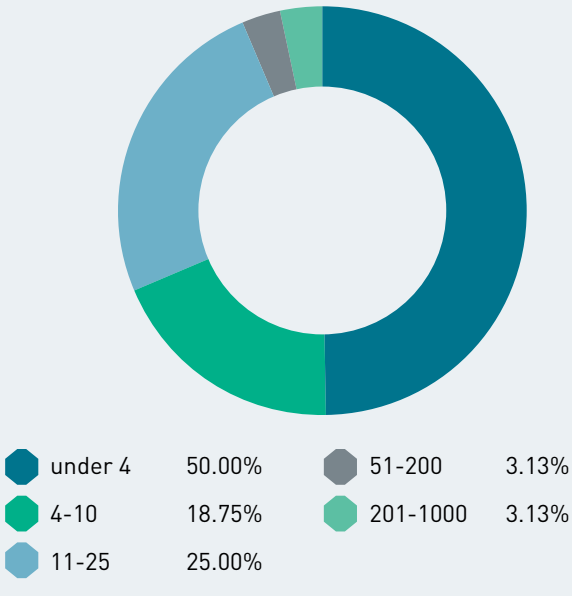


FIGURE 7 ▸ Breakdown of specialist Immersive Technology companies by number of employees

Source: Survey data



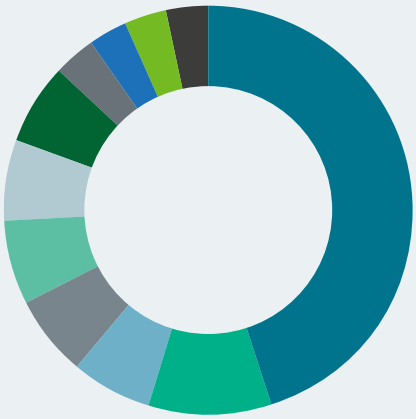
Within what Geographic area is the innovation happening in Ireland?

The breakdown of respondents by county shows that this is currently a sector concentrated in Dublin with 50% of respondents, but with clusters also based in Cork, Limerick, Sligo, Waterford and Westmeath. The East (Dublin) accounts for half of the respondents, with the Midwest and South accounting for another 29%.

This table shows the top counties for responses.

FIGURE 8 ▸ Number of responses by County (Immersive Technology more than 50% turnover)

Source: Survey data

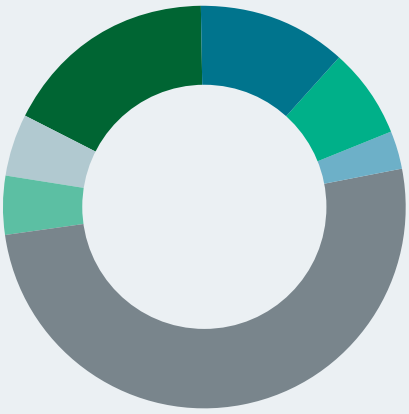


Dublin	45.16%	Westmeath	6.45%
Cork	9.68%	Donegal	3.23%
Waterford	6.45%	Kerry	3.23%
Limerick	6.45%	Carlow	3.23%
Tipperary	6.45%	Meath	3.23%
Wicklow	6.45%		

This chart shows the geographic distribution of respondents to the survey, categorised by Enterprise Ireland regions:

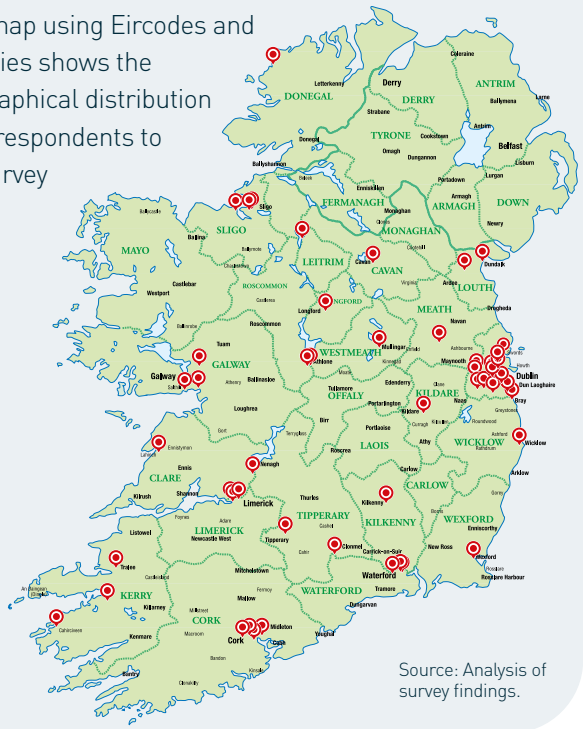
FIGURE 9 ▸ Number of responses by Enterprise Ireland Region (Immersive Technology more than 50% turnover)

Source: Survey data



Mid West (Clare, Limerick, Tipperary, Kerry)	11.90%
Borders (Donegal, Sligo, Leitrim, Louth, Cavan, Monaghan)	7.14%
West (Galway and Mayo)	3.17%
East (Dublin)	50.79%
Mid East (Meath, Kildare, Wicklow)	4.76%
Midlands (Westmeath, Offaly, Longford, Laois)	4.76%
South (Cork, Waterford, Wexford, Kilkenny, Carlow)	17.46%

This map using Eircodes and Counties shows the geographical distribution of all respondents to the survey



Source: Analysis of survey findings.

Regional Innovation

Many regions around the country have strengths that can support the emergence of innovative immersive technologies companies outside of Dublin, including a network of immersive technologies research centres, new strategic government funded initiatives for digital businesses and a focus on community building in regional hubs in line with Powering the Regions, Enterprise Ireland's overarching national plan underpinned by nine regional specific plans to drive scale and expand the reach of indigenous enterprise.[14]

Innovation 2020 set out how the Technological Universities will contribute to the development of higher education regional clusters.[15]

Clusters, such as IDEAM (Irish Digital Engineering and Advanced Manufacturing) are "Industry-driven, university-fuelled, government supported" and are a one-stop-shop for Manufacturing SMEs in all aspects of digital transformation.

The Ludgate West Cork Cluster Map is an example of how the natural clusters emerging in regions are being mapped and supported.

Regional development is a high priority for Enterprise Ireland as part of their new strategy Leading in a changing world. Strategy 2022–2024 and regional development organisations such as the Western Development Commission (WDC) provide targeted support to creative startups including immersive technologies. Galway-Mayo Institute of Technology (GMIT) has teamed up with WDC to form Creative Enterprise West (Crew Digital) which is launching a new incubator programme targeting Ireland's creative digital and tech entrepreneurs.

Given the relative size and scale of Ireland in comparison to more complex geographical ecosystems, an opportunity exists to connect and amplify these types of national activities, which could leverage opportunities for the Irish immersive sector as a whole.

In the Gaming sector, a new €1.9m digital gaming hub in Strandhill, Co Sligo is being funded by the Government and Enterprise Ireland's Regional Enterprise Development Fund, and will provide a flexible workspace and support for companies in the digital gaming sector.

The Galway Film Centre supports virtual production and for example, with Galway 2020, in association with Screen Talent Europe, ran a series of online seminars in 2021 on Virtual Production. Screen Wexford are running a series of Immersive masterclasses, primarily for film-makers in the Wexford region, as part of the Immersive Wexford programme funded by Screen Ireland and Wexford County Council.

Immersive Technologies Skillnet established in 2020, has been supporting training initiatives specifically for the immersive sector by offering public and in company training for practical applications like Unreal Engine, Unity and Blender to Leadership Development and VR: Storytelling, Design and Creation Tools as well as Bootcamps in Virtual Production. Many of the programmes offered are cross sectoral.

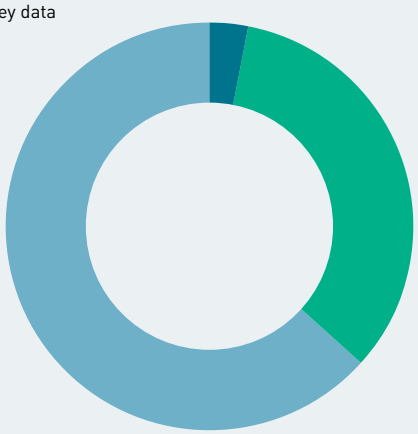
Expectations around future growth in their Immersive Technologies business

The next 12 months

The majority of respondents (63%) expect their Immersive Technologies business to grow in the next 12 months, 33.6% expect the same level of business and only 3.3% expect less business.

FIGURE 10 ▸ Expectations about how Immersive Technologies will develop in next 12 months

Source: Survey data

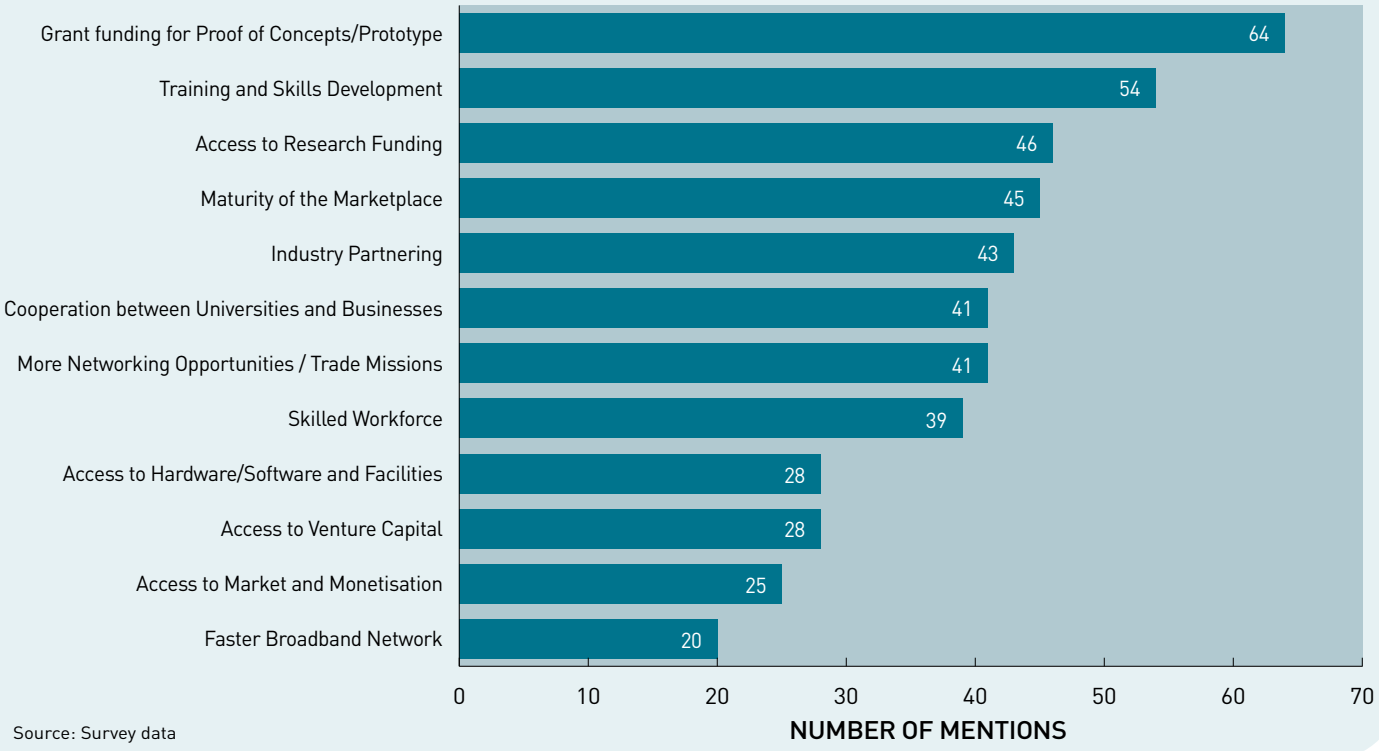


Less business	3.28%
The same business	33.61%
Grow	63.11%

What do immersive companies/industry need from the Irish Ecosystem?

These are the main needs listed by survey respondents from the Irish Ecosystem:

FIGURE 11 ▸ What would help respondents to develop their Immersive Technology activities in the future?



Source: Survey data

"One barrier is the misconception of what XR is or what it can do...it's value or purpose is still perceived as for just entertainment purposes."

Immersive technology researcher in Higher Education Institution

chapter **FOUR**

Application Growth Areas

Architecture and Construction

Overview of sector in Ireland

The Irish construction industry is substantial, generating output of €27.6bn in 2019 and employing 147,100 people.[16] Following the pandemic, growth has resumed and is expected to be enhanced by the €4 billion-per-year Housing for All plan aimed at building 300,000 new homes by the end of 2030.[17]

Growth in Immersive Technologies use in that sector internationally

Research by Forrester for Unity in 2021 showed the AEC [Architecture, Engineering and Construction] industry is anticipated to increase immersive tech use by 115% over the next 12 to 24 months, outpacing any other industry included in the study.[18] Immersive technologies can add huge value through the full supply chain of the built environment, with immersive technologies maturing in their use and being brought together in a continuum from design to Building Information Management (BIM). VR is being used for more effective consultation and stakeholder engagement pre-planning and for detecting clashes and to facilitate redesign pre-build, something that saves time and money and becomes more important as prefabrication off-site increases. AR is used for quality assurance by being able to overlay plans on the physical build on site to confirm compliance with specifications, speeding up the build, to allow the client to be able to see embedded information to show where services are and to identify specifications of items needing to be replaced, making maintenance much more efficient.

Use cases in Ireland - from interviews with industry participants

Insights into the positive impact of immersive technologies on the construction industry can be gained by this comment at a 2021 conference by Michael Galbraith, Immersive Technology Specialist at ARUP, that in Ireland ARUP has adopted immersive technology "to mitigate any design problems, to identify constraints, improve the design, pick the best design and show people what that would look like. Immersive technology not only plays a part in visualization but ensures that we choose the best potential outcome for projects".[19]

While the potential is recognised here, the view from some participants in this research was that the sector in Ireland has yet to embrace the many use cases in projects. Use is limited to pockets of activity, with companies like ARUP preparing for the use of immersive technologies by using the technologies initially, as procurements do not yet require them as part of the engagement.

The use of technologies will be driven by European legislation and by organisations with significant buying power such as REITs (Real Estate Investment Trusts) who want to realise efficiencies.

Education

Overview of sector in Ireland

There is a strong infrastructure for training and education in Ireland for adults, on top of the primary and secondary sectors:

- 16 Education and Training Boards, which deliver most further education courses
- 22 Higher Education Institutions[20].

Growth in Immersive Technologies use in that sector internationally

Global spending on artificial and virtual reality in education is expected to soar from $1.8 billion to $12.6 billion annually over the next four years, with corporate applications moving into higher education and, more recently, starting to move into primary and secondary.[21]

Use cases in Ireland - from interviews with industry participants

A number of Irish immersive technology companies are making learning experiences possible that would otherwise be out of reach. For example, SchooVR is partnering with UCD's School of Education to trial experiences to a cluster of schools in Laois and Offaly enabling children to experience a safari, the surface of Mars or molecules in 3D without leaving the classroom. Virtual/augmented reality software company Immersive VR Education provides an educational platform for students to learn through experience in Ireland and in a number of export markets. CleverBooks is providing schools with an Augmented Classroom application and WordsWorth Learning (WWL) offers a system that helps children and adults overcome dyslexia as well as other reading and spelling disorders.

An educator made this observation: "AR for primary school children learning to read and spell offers them the power to engage and enrich their learning experiences, increase their retention of knowledge and improve their understanding."

While immersive technologies are taught in higher education, for instance within business courses in DBS, technical courses in DKIT and built environment courses in TU Dublin, the technologies are not yet widely used in teaching and learning.

Training

Overview of sector in Ireland

Enterprises invest in training their employees when they come on board and on an ongoing basis. There are nearly 1,700 companies employing more than 275,000 people in the Foreign Direct Investment sector alone[22], a sector that invests heavily in training.

Growth in Immersive Technologies use in that sector internationally

Training is already one of the leading commercial markets for immersive technologies, accounting for a world market of $1.3 billion in 2020 according to IDC.[23]

Use cases in Ireland - from interviews with industry participants

VR is used effectively for training in cases where it would be high risk to people or property or high cost to train someone in situ, for instance in off-shore facilities, with companies like VRAI in Dublin working with the off-shore wind farm sector among others. It is useful for more standard training too, for instance for important Health

and Safety training, making the material much more real than traditional delivery through slide presentations or eLearning, delivering the material in a way that is much more effective in engaging the learner and achieving better outcomes. A number of respondents mentioned that VR training has proven highly successful with higher-efficiency in delivery of training (shorter delivery times) and much more impact on operations than elearning, with one large multinational company saying that eight hours of elearning material could be delivered in one hour through VR. Irish platform Engage VR has recorded retention rates as high as 90% in plant-room training for a client, far exceeding norms, meaning employees were much more proficient than if they engaged with the material in theory alone.

VR makes it possible to achieve similar behaviour change in a repeatable way without high performer colleagues required for traditional role plays. An example of this is Immersive Sales Star training implemented by Irish insurance company FBD. They used virtual reality and achieved customer engagement and conversion targets in the compliance environment more quickly than with previously used approaches, with new staff members saying after their first customer engagement that they felt like they had "done it before".

Use of Augmented Reality training accelerated during Covid-19, with experts remotely viewing what employees can see on site and guiding them through tasks or with information being provided automatically on steps to take and Dublin company UtilityAR supporting an Irish and international client base by providing smart glasses and the software needed.

Entertainment and the Arts

Overview of sector in Ireland

The immersive landscape in Ireland is abundant with energy, passion and talent. Creativity must combine with technical abilities, social media capabilities and commercialisation to realise potential. The sector draws creatives from fields with transferable skills such as film, video, theatre, visual arts, dance and music with experiences often created by cross-disciplinary teams. The Arts sector in Ireland, incorporating Arts, Entertainment and Recreation contributed over €1.16bn in Gross Value added to the economy, directly supporting 55,000 jobs, of which 67% were outside of Dublin, in the last quarter of 2019.[24]

Growth in Immersive Technologies use in that sector internationally

AR and VR in entertainment and media globally are on a strong growth trajectory and are expected to grow at a CAGR of 31.8% US$45.20 billion by 2027. Sectors in which AR and VR will be used include the film industry, the live events industry, sports, gaming, theme parks/ amusement parks.[25]

Theatre-makers and musicians all over the globe are producing shows through social VR platforms such as Altspace, Engage and VRChat eg. Jean Michel-Jarre held a virtual conference and live stream to over 75 million viewers.[26]

The UK has a thriving Immersive arts sector thanks to the boost from publicly-funded initiatives such as Audience of the Future (£39.3 million in funding) and CreativeXR. Leading arts organisations such as the National Theatre, BFI and The Royal Shakespeare Company have had several immersive shows to date.

Use cases in Ireland - from interviews with industry participants

In Ireland there are several VR Arcades including Zero Latency in Dublin, Fury VR in Limerick or Virtual Reality World in Galway. While the pandemic led to a long pause in activities, Susanna Murphy from Zero Latency says that "the business is performing really strongly and was riding the crest of a wave in the months leading up to the pandemic in March 2020".

Irish National Opera, is part of an EU funded project called Traction that will tour the 32 counties of Ireland between summer 2022/2023 presenting a community co-created VR opera called Out of the Ordinary/ As an nGnách directed by Jo Mangan and has already been in receipt of the prestigious Fedora Digital Prize.[27]

Throughout the country, individual artists are receiving bursary grants from the Arts Council to support their exploration and experimentation in the immersive storytelling field. Maureen Kennelly, Director of the Arts Council highlights the importance they place on immersive technology:

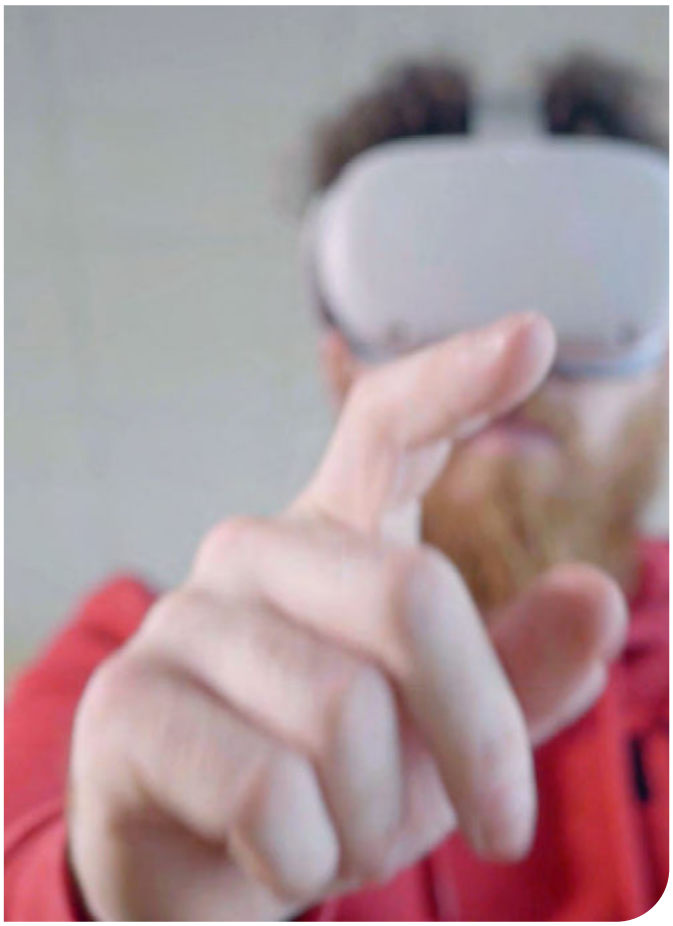
> "The Arts Council is currently developing a digital policy to enhance and build on existing capacity in the Digital Arts Sector. We recognise that throughout history, artists have been at the forefront of technological innovation. Today, immersive technology provides exciting opportunities for artists and the public alike. The aim of our digital policy is to ensure that the Arts Council and the arts sector have the knowledge, skills, and funding to support and sustain evolving digital artistic activity including artists and arts organisations working in the immersive space."

Individual artists like Elaine Hoey[28] who has exhibited VR art experiences at both IMMA and the Science Gallery Dublin, are creating virtual worlds and experiences at a world class level. In terms of skills for artists and creatives looking to work in emerging technologies like VR, AR or MR, bodies like Immersive Technologies Skillnet, Crew Digital, Immersive Wexford and artistic residency programmes like the Space programme from The Performance Corporation provide a non-outcome based place to explore, conceptualise and make.

James Riordan is a theatre maker who has been working with immersive technologies as part of his artistic practice:

> "I started exploring and creating immersive work after being introduced to artists across Europe who were making VR and AR work. Working on Ar Ais Arís[29] was a fantastic experience as we got to introduce new audiences to headsets and had a hugely positive response from audiences."

Companies like Vologrames, Algorithm, Piranha Bar, Pink Kong, WarDucks and Noho are already shining examples of companies to watch in the immersive space globally. The gaming sector is a major user of immersive technologies in entertainment. WarDucks has had success with several VR games including Rollercoaster Legends, which was the first roller coaster game on Playstation VR.



On the traditional broadcasting side, the national broadcaster RTE has adopted and adapted AR to enhance viewer experiences in sport, news and current affairs and have been active in supporting 360 filmmaking with their dedicated page on rte.ie [30].

According to Grace Dinan, Viz Artist, Real Time & XR Graphics Specialist at RTÉ, "the design and implementation of virtual sets, augmented reality graphics and mixed reality content by some Saudi Arabian and UAE broadcasters is very advanced." She also noted that "the pandemic was an accelerator for software-based broadcast solutions, while it wasn't always possible to transport equipment or have the crew present at venues."

Screen Ireland and Animation Ireland with the support of Immersive Technologies Skillnet and Eirmersive have recently launched their Animation Innovation and Immersive Development Fund 2022 following the success of the fund in 2021.[31] The €350,000 fund will be invested in new innovative, high concept development and immersive storytelling opportunities within the Animation and Immersive Storytelling sector.

Healthcare

Overview of sector in Ireland

Current healthcare expenditure in Ireland amounted to €23.8 billion in 2019, of which 74% was by government, 14% by voluntary healthcare providers and 12% household direct payments.[32] In addition, there is a cluster of major medtech and pharmaceutical businesses in Ireland and there are many partnerships taking place between large medtech companies and pharma companies and innovative Irish startups and SMEs.[33]

Growth in Immersive Technologies use in that sector internationally

The market size for AR and VR in Healthcare is expected to reach $4.3 billion by 2027 at CAGR 23.6%. Healthcare providers use VR and AR technologies to improve their customers' experiences by effectively engaging them in healthcare activities.[34]

Health care is projected to be the area most disrupted by immersive technologies in 2022.[35]

Use cases in Ireland - from interviews with industry participants

Immersive technologies are being used in healthcare in Ireland in a number of different areas, for example:

- VR is highly effective in its use in training of healthcare professionals, for instance for training of emergency doctors in trauma situations by the Royal College of Surgeons in Ireland.
- VR is used to assist treatment, e.g. by immersing patients with dementia in calming environments at Hollybrook Lodge nursing home, which is part of St James's Hospital in Dublin.
- It is used to enhance wellness, by companies such as Psychreality who use the presence effect of VR and present realistic phobia situations, so psychologists can be more effective in treatment.
- UCD-based Strohab aims to use the neuroplasticity powers of VR to rewire the brain, along with other advanced technologies, to enhance outcomes for stroke victims.
- Smart D8, part of Dublin City Council's Smart Dublin Programme, aims to support health and wellness in the Dublin 8 community, similar to the parent programme's aims in areas such as engineering, emergency services and civic events across the city. The Solas VR meditation startup is part of this initiative.

According to one researcher spoken to, it has been shown that doctors training via simulation result in less patients dying, indicating that immersive healthcare training has better outcomes.

Manufacturing and Engineering

Overview of sector in Ireland

The Manufacturing Sector in Ireland consists of some of the leading international companies as well as major domestic players in Biopharma, Medtech, Technology and in Engineering.[36] The sector employed 213,755 people in 2020.[37]

Growth in Immersive Technologies use in that sector internationally

Manufacturing is the sector which is anticipated to be transformed most from immersive applications and in particular advanced manufacturing activities.[38]

Use cases in Ireland - from interviews with industry participants

Though not yet in widespread use in Ireland, there are multiple proven successful uses of immersive technologies in manufacturing and engineering.

- Companies are using AR for training and for remote monitoring and assistance.
- VR is becoming established for design collaboration and prototyping, for shorter design cycles with better outcomes.

Companies like Cork based Digisoft and sister company Cybertwin are creating digital twins that have been augmented with embedded operating procedures and successfully used for training and also even for regulatory audit, removing disruption to sterile operating environments. Athlone based Mersus builds VR environments for training in life sciences companies that they say must be sophisticated, high quality and accurate in detail.

All companies spoken to agreed that immersive technologies have the potential for very significant growth in industry and engineering, but that action is needed to support the sector and maximise benefits and competitiveness, similar to actions by authorities in competing countries. Contributors in research and industry indicated that some in industry feel threatened where they typically work using standalone systems with unconnected systems run with embedded software instead of Industry 4.0 type technologies (e.g. Artificial Intelligence, Internet of Things etc). There can be fear of immersive technologies and other technologies from top management to the shop floor, with a lack of suitably qualified or trained staff available, with these factors slowing the rate of adoption.

All relevant companies spoken to believe that awareness of the value of immersive technologies implementations is needed at leadership level in organisations so they have an appetite to consider propositions for unfamiliar technologies, that there is need for support for Proof of Concepts, that these need to be showcased in an accessible and well marketed way and that support is needed for development of skills for the implementation of these new approaches in operations. Only with coordinated actions will industry move from current ways of working to successfully using new technologies in operations, including immersive technologies, Internet of Things, Machine Learning and Artificial Intelligence.

Retail

Overview of sector in Ireland

Retail is Ireland's largest Industry and the largest private sector employer, employing almost 300,000 workers. 37,400 retail and wholesale businesses in Ireland employ less than 10 people. The sector generates the largest contribution to the Irish exchequer of circa €7bn annually.[39]

Growth in Immersive Technologies use in that sector internationally

The global market for augmented and virtual reality in retail, which claims to offer consumers a more enjoyable and personalised shopper experience, is projected to reach $7 billion by 2023, up from just $1 billion in 2018.[40] Immersive technologies are now being used by major international retailers such as IKEA Place, Shopify, Asos and Pinterest recently added augmented reality furniture shopping to its app.[41] One example is that Dyson will enable customers to test its hairdryers, straighteners and stylers from the comfort of their home through virtual reality.[42]

Use cases in Ireland

Irish company Plop is bringing Augmented Reality to retailers to allow customers to place furniture in a room in their own home to make advertising more effective and the shopping experience more real. Their technology makes it possible for Plop to enable shoppers to virtually try on hats or shoes to enhance the buying process.

Irish company SKMMP has developed an enterprise supply chain optimisation product for the luxury wholesale fashion industry in the form of a virtual showroom which hosts multiple designer fashion collection catalogues.

> "SKMMP has been creating Virtual showrooms and using AR commercially for the past 4 years", says Aileen Carville, Founder and CEO. "Once perceived as whimsical we introduced a whole new medium for brands to migrate from static Web2 into a more immersive 'realistic' visualisation. Brands are now eagerly shifting their priority to blended AR / VR / Real experiences and product appropriation. For the Fashion industry this is a real opportunity to digitally catalogue skills and archives for future generations while enabling self expression and representation in the Metaverse with 3d wearables and AR filters".

An Irish company Voila is offering a technology that will give retailers the ability to allow customers to virtually try on jewellery.

Contributors to the study in retail and in advertising believe that size of the Irish market can limit the business case for investment, but that the Meta announcement and expected launch of better hardware will radically change the landscape and that the Irish sector is well positioned with entrepreneurial talent to benefit from the upturn they are already beginning to see in other markets.[43] They say that to work, immersive technologies shopping experiences must be built on strong data and business processes encompassed with eCommerce 3.0, enabling Virtual Try Ons and good experience in completion of purchases.

TU Dublin Marketing Lecturer and expert in immersive technologies for retail, Paula Kilgarriffe, said that while VR is already in use for luxury shopping experiences and for ultra-personalisation, it will in time become a normal part of the retail mix. AR and VR enables brands to create experiential content for customers and potential customers, better engaging customers in a fun way and to deliver marketing messages effectively.

Enterprise Software

Overview of sector in Ireland

In Ireland in 2018, the combined employment in Services, Distribution and Financial/Insurance was 1.2 million, across nearly 214,000 enterprises.[44] The multinational ICT sector alone employs 37,000 people[45].

Growth of Immersive Technologies in that sector internationally

The post pandemic increase in the use of immersive technologies in the Enterprise Market is demonstrated by the tripling in sales of extended reality headsets to enterprises in 2020 and they are on track to grow by another 74% to 1.4 million units in 2021, before doubling again in 2022. Enterprises are expected to buy more than 30 million extended reality headsets cumulatively in the period from 2021 to 2025.[46]

Use cases in Ireland - from interviews with industry participants

Irish companies are creating solutions for enterprises. For instance, meetingRoom has developed a solution that is focussed on helping large enterprises create and use virtual spaces where they can collaborate in ways that is difficult in the Zoom-like environments that many have become used to and includes tools to help with brainstorming and workshopping. Engage VR creates enterprise spaces for training, collaboration and events and aims to create full enterprise campuses, where all organisational functions can be represented, and recently hosted an event for 2,000 corporate employees.

Immersive technologies are being used to reimagine customer services with approaches that are counterintuitive to what might be traditionally expected. One service provider referenced an overseas project in which VR was used together with AI powered chatbot technology servicing the transactional needs of customers via an avatar in an in-person retail environment, with strong customer satisfaction scores. Elsewhere, customers' needs are being served online also in VR, but with a real person embodied in avatar form to meet the need for personal, human and interactive experience in the online channel, also backed by strong customer feedback.

As immersive technologies develop, they will become more and more a part of how enterprises function, being driven by, and supporting, remote working, but also in customer communications and customer service.

Tourism

Overview of sector in Ireland

The Tourism sector in Ireland is an important part of the Irish economy, employing over 260,000 people in 2019. Expenditure by tourists visiting Ireland (excluding receipts paid to Irish carriers by foreign visitors) was estimated to be worth €5.6 billion in 2019, accounted for by 9.7 million tourists.[47]

Growth in Immersive Technologies use in that sector internationally

The value of VR in the global tourism sector stood at $74.6 million in 2018 and is estimated to reach $304.4 million by 2023, with a compound annual growth rate of 32.5%.[48]

VR technology development allows users to have a realistic tourism experience in their desired location. Virtual reality goes beyond video to offer even more immersive experiences and can be used for shows and concerts as well as other tourist attractions[49]. In addition to responding to the Covid 19 travel restrictions, VR also opens the door to experiencing parts of the world where visitors would cause environmental damage or to save cultural sites.

Use cases in Ireland - from interviews with industry participants

VR is used to bring Irish artefacts or full experiences to people in their own country as a way for them to have an initial experience and to encourage them to visit Ireland and can be an additional booking channel for travel or for hotel bookings.

AR is used to enhance visitor experiences by providing information during visits to museums or other attractions, with Irish companies such as Digisoft, Emagine, Imvizar and Wanderful active in the sector.

The feedback from interviews with people in the sector is that after the severe restrictions on tourism resulting from Covid-19, there is an expectation that there will be increased investment by tourism organisations in enhancing their marketing and their offerings to meet rising expectations among emerging markets. Consumers from countries where immersive technologies are already part of leisure and tourist experiences, such as China, have the expectation that they will be part of their foreign visits too.

The following pages include a selection of case studies of Irish immersive technology companies across a range of sectors. These highlight the significant impact already being made by immersive technologies today.

Emagine

VR training helping to meet carbon emission targets

Sector: Training

Local training in the South East

Waterford Wexford Training Services (WWTS) is a part of Waterford Wexford Education Training Board, offering apprenticeships and training in areas including automotive, construction, engineering, hairdressing, packaging and pharmaceutical cleanroom operations.

Challenges meeting emissions targets

They faced a challenge to improve training in skills to retrofit buildings to Near Zero Energy Standards, enhancing skills acquisition and increasing the number of people trained to meet Ireland's targets for reduction of carbon emissions.

Opportunities for training on retrofit projects are limited and scaling of facilities to train larger numbers in workshops is difficult.

How Immersive Technologies were used

WWTS worked with Waterford based creative agency, Emagine to implement the learning goals and curriculum of the Near Zero programme into a Virtual Reality Training Simulator, a space for trainees to practice and acquire skills required for a Near Zero retrofit without expensive waste.

Impact of the Training Simulator

*According to **Michael O'Brien, Innovation and Development Manager with Waterford and Wexford Education and Training Board,** the training simulator is highly effective in giving trainees confidence and the ability to apply their new skills more effectively in real world projects:*

"This is not a gimmick. Virtual Reality allows our students to learn specific skills in a highly immersive environment. They receive immediate formative feedback which facilitates long term memory retention and overall improved performance."

The VR training approach is scalable to help Ireland train enough people in Near Zero retrofitting and achieve emissions targets and is highly effective.

HSE CAMHS

VR reducing anxiety in young people

Sector: Healthcare

Caring for the mental health of our young people

CAMHS is Ireland's Child and Adolescent Mental Health Services, part of the Health Services Executive, providing specialist treatment and care to young people up to 18 years of age suffering from depression, anxiety, eating disorders and other conditions, through multidisciplinary teams.

Increased demand

CAMHS is a vital support for many families, who would struggle to cope without its support. CAMHS also struggles to meet increasing demand, with research showing that reported anxiety almost doubled in the seven years prior to 2019, even before the effects of the Covid-19 pandemic.

How Immersive Technologies were used

When Senior Occupational Therapists at Galway Roscommon CAMHS, Niamh Morrin and Fiona Mulvey, became aware of Virtual Reality and evidence that its immersive qualities and emotional engagement can have profound results in treating anxiety, they decided it could help the service increase its reach to address the anxiety that many young people experience going to school.

Working with south Dublin company, Adaptas Training, they ran workshops with young people to co-create a series of VR experiences that young people engage with. Users embody Dala, a gender neutral character anxious about going to school, who uses the "Pathfinder phone app" in the VR experience that coaches users to identify triggers and solutions to help them overcome their anxious thoughts and feelings.

"Without this collaboration Dala would not exist. The teenagers created Dala, and in unique, innovative ways, we could never have imagined, answered the question ... 'How does anxious Dala get to school?"
Niamh Morrin, CAMHS

Impact of Immersive Technologies

There was a 45% reduction in reported anxiety among initial users with 100% indicating that the VR experience would help with school anxiety, with young people suffering from anxiety also finding it easier to engage with Dala than with traditional treatment.

This project received the Healthcare Collaboration Award from the Health Tech Innovation Awards 2021.

Galway Roscommon CAMHS now want to take the VR experience nationally across the CAMHS service and to work with others to make it more accessible and have developed support materials to make it easier for others to introduce Dala to students for bigger impact.

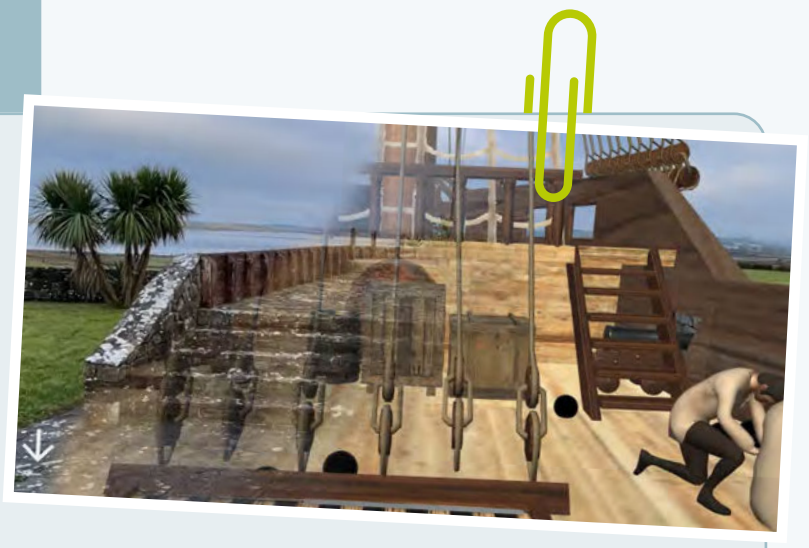
Imvizar

AR bringing visitor experiences alive

Sector: Tourism

Enhancing visitor experiences across the world

Imvizar is an award-winning Dublin startup that has created life-sized, location-specific Augmented Reality experiences for attractions in Ireland, Europe and the United States.



Storytelling makes a difference

Storytelling has the power to transform visitor experiences, and augmented reality has the power to transform storytelling. It is proven that if a visitor feels an emotional connection to the story they are told, they are much more likely to remember and enjoy it.

How Immersive Technologies are used

With AR we can rebuild a castle from ruins, bring historical characters back to life or 'walk' someone around the Pyramids of Egypt and for the first time give them a sense for what life was like 4,000 years ago.

AR makes it possible to build visitor experiences without depending on the availability of a guide, with visitors gaining an engaging visual storytelling experience and leaving having learned about the historical context of the attraction and connecting with the lived experiences of figures related to the place.

Impacting visitor attractions

Imvizar aims to help visitor attractions benefit from immersive experiences in two ways.

The first is by making engaging visitor experiences, while offering a business proposition that makes it easier for attractions to introduce AR to their visitors. With no need for attractions to create and maintain their own content or publish their own apps, they can keep costs down and gain an additional revenue stream.

The second is that the company plans to go a step further in 2022 and will open up their mobile application for any AR studio to add their experiences and creations. They aim to make finding an AR experience as simple as searching on YouTube, so attractions with AR experiences will become discoverable and open to a wider audience.

Mc VR Designs

VR makes better buildings

Sector: Architecture

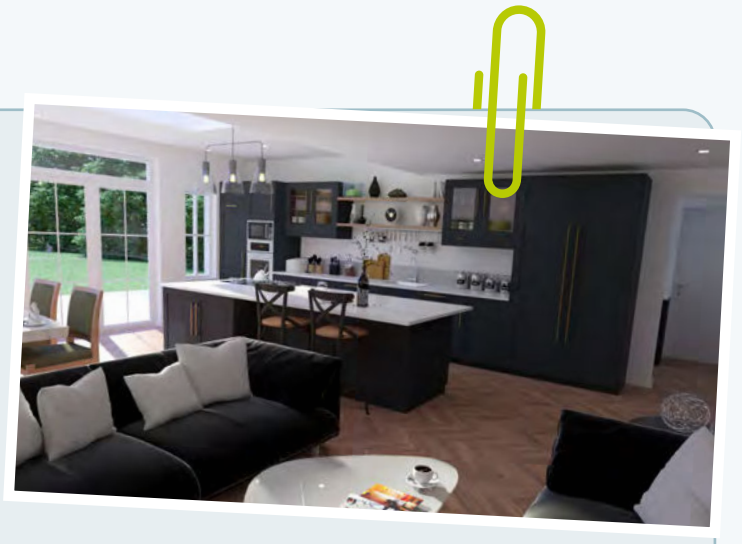
Transformation of the building industry

Augmented Reality and Virtual Reality are becoming key to the presentation of building designs for discussion with clients at concept stage, for public consultation, for client review of near final designs, for clash detection and for building management, streamlining the process from start to finish. Industry sources indicate that AR and VR will completely transform construction and building maintenance within a few years.

Limerick company Mc VR Designs specialises in Virtual Reality visualisations for domestic and commercial projects and is one of the early providers of services in what will be a radically different building industry supply chain in the near future.

Changing needs of the industry

In construction, there are difficult aspects at each stage of the process. For example, it can be difficult for clients not used to plans to visualise from drawings what buildings will look like and the same applies for public consultations. In addition, with the increase of prefabrication of buildings off site, it can be costly and disruptive if clashes are detected only at construction stage. Building maintenance can be difficult where there is not a ready record of what services are hidden behind walls.



How Immersive Technologies are used

Mc VR Design's clients are architects, builders, engineers, interior designers and homeowners who, with Mc VR's help, are able to better present developments to their clients before they are built. Clients can walk through the development and experience different uses, building configurations, layouts, materials, textures and colours.

"It was a service we thought about for some time as it was adding an extra expense to the cost of building our home, but so glad we did, as it showed up problems even before we started to build. We saw things we loved and also things that needed some more attention".
Catherine Going, Mc VR client

Mc VR Designs have been successful early movers in VR for internal and external visualisations and show the way for how things will change in the built environment.

meetingRoom

Virtual Space-as-a-Service for Enterprise-Grade Collaboration

Sector: Enterprise Software

meetingRoom has built a secure and scalable end-to-end VR enterprise VR collaboration solution, where users are immersed in the virtual work environment, with adoption being driven through the VR for Work programme.

Changing needs in a world of work

Organisations are unlikely to go back to the office-only model from before the pandemic and they need improved collaboration tools for hybrid working.

There is a limit to collaboration in a two-dimensional video environment, where colleagues and customers cannot be "in the room together".

Dispersed teams need better engagement and access from anywhere, to all their sites and assets, if they are to be effective working remotely from each other.

Although organisations have shown they are willing to adopt immersive technology, they can struggle to roll out VR to large workforces.

Configurable VR for Enterprise

Secure Virtual Space-as-a-Service bridges in-person and virtual collaboration. MeetingRoom allows enterprises to configure their own spaces in seconds and access real-world sites anywhere.

What difference has it made?

Where it has made a real difference has been in the type of sessions that do not work well on standard video calls, such as workshops, brainstorming, site tours and audits, all of which are critical to the Fortune 500 companies that are currently using it ahead of a public launch in 2022. Equally important to them are the security and compliance comfort the system gives them, and the ease of adoption through the VR for Work programme that supports organisations to roll out the system.

According to a customer in a major international energy company, "meetingRoom is differentiating itself from its competitors with a laser focus on enterprise tools and capabilities"

Plop

Augmented Reality in the marketing mix

Sector: Retail

Social media is established in marketing to consumers, as prospective customers have moved progressively away from newsprint and TV and as the number of ways of engaging them online increases.

Dublin based Plop works with retailers to add AR to their marketing mix, allowing furniture buyers to see on their devices what furniture will look like in their houses or to virtually try on everything from hats to sneakers.

Michael Murphy Furniture

Michael Murphy Furniture has seven furniture stores across Ireland. They wondered if their older customers would take to the use of Augmented Reality.

They worked with Plop to introduce AR online, including in retargeting advertisements, offering the opportunity for prospective customers who had been considering their furniture to place furniture into their homes to see how it looks, without the need to worry about the technology, as it works seamlessly with Facebook, Instagram or in the browser.

The company also worked with Plop to introduce AR as part of the sales journey in store, being able to demonstrate the extended range, even furniture that is not in stock at the particular store, and giving their customers links, so that they can consider a sofa or other piece of furniture in their homes to help in the decision making process.

Acceptance

AR has soon become accepted among staff as a key part of the sales process and Jennifer Lonergan, Marketing and eCommerce Manager, talking about an older couple who visited their New Ross store for the first time to purchase furniture that they had placed in their home in Augmented Reality says: "It was fantastic reassurance for us as well that the technology is super simple to use".

SchooVR

Immersive Technology in Education in Ireland

Sector: Education

Educational potential

Virtual reality enables students to experience things they would never get to see in real life, like history lessons where they can experience events that shaped society or where students get to examine rare artefacts up close.

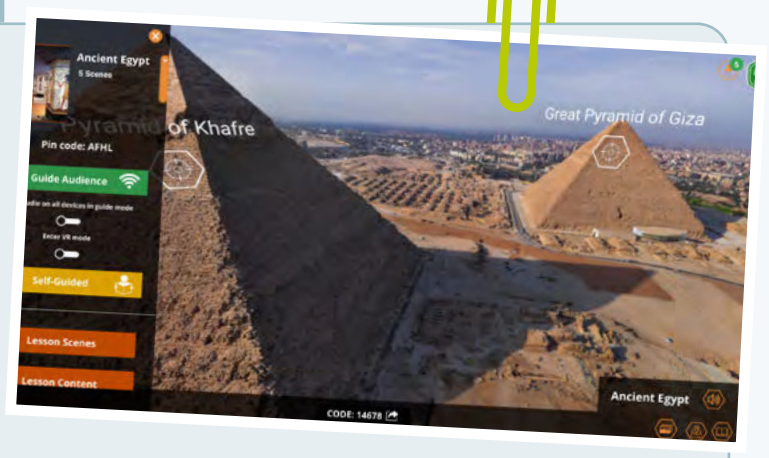
Augmented reality adds information onto physical objects, such as showing the workings inside the human body of the person in front of you.

Making potential reality

While augmented reality and virtual reality are recognised as offering significant educational advantages, there is much work to do to realise their potential in formal education.

Mark Baldwin is Managing Director of SchooVR in Tallaght in Dublin specialising in AR and VR for education. A teacher by training, Mark's and SchooVR's focus is on changing education through AR and VR.

In addition to teaching content, it is vital that the use of immersive technologies is aligned with subject specifications and curricula. "There is also a need to break down the misconception that immersive technologies are used for novelty and help people to realise that they are serious pedagogical tools for geography, history, modern foreign languages, science and other subjects", he says.



Bringing it National

SchooVR teamed up in 2021 with Rachel Farrell, UCD Assistant Professor and Director of the University's Professional Master of Education to create a collaborative project entitled Immersive Technology in Education: A Collaborative Learning Initiative.

SchooVR is also working in partnership with UCD on a trial project together with Laois Education Centre and the 21 national Teacher Education Centres on a project under Creative Clusters, a pilot initiative funded by the Department of Education through the Schools Excellence Fund.

These projects make use of the SchooVR platform that includes a library of interactive AR and VR assets that teachers and students use to build curriculum-aligned experiences in the browser that can then be viewed on any smart device.

These and other projects are taking AR and VR a step closer to their potential in education and will open up a world of experiences for students.

CyberTwin

Full steam ahead for Digital Twin of Charter Survey Vessel

Sector: Off-Shore Energy

Digital Twins

Digital Twins are copies in Virtual Reality of physical spaces and objects that are true to the physical version in scale and detail. They have many examples of use cases that drive value.

- They are used in the automotive industry to design cars more quickly and cost effectively, addressing issues even before tooling.
- They are used in the pharmaceutical industry for regulatory auditors to access standard operating procedures and operations data in VR without the need to disturb sterile facilities.
- They are used to optimise warehouse design and operations before physical facilities are ready to be used.

New ways of visiting the ship

Irish Mainport Holdings is based in Ballintemple in Cork from where it charters its fleet of specialist ships. Their most recent addition is a research and survey vessel, 'Mainport Geo', that had its refit for use in the off-shore energy sector completed in October 2020. With Covid, the company needed to find new ways of showing the ship to prospective customers. They approached Cork city based, digital twin specialist, CyberTwin, to create a virtual representation of the ship.

Impact of Immersive Technologies

The digital twin has proved very useful during Covid. It has enabled prospective clients "to get an in-depth insight into the ships comforts and capabilities without having to step on board", according to MacDara Lynch, Business and Operations Executive. "Our favourite feature is the 'Tour' feature which allows us to send a link to a client which brings them to the exact location of the ship they wish to inspect."

Now a standard part of customer engagement, it will be used long after business has returned to normal, as it allows geological researchers to understand the characteristics of the ship without travel and without disrupting charter activities.

Vologrames

AR/VR in Fashion and the Creative Arts

Sector: Technology

One of the areas with highest growth and interest for immersive technologies is the fashion industry. From big brands promoting virtual catwalks in the metaverse to creating exclusive collections on Fortnite or Roblox, the fashion industry is looking at a new generation of users and technologies to disrupt, evolve and find new ways of engaging their audience.

Virtual Art Director

Vologrames partnered with the Fashion Innovation Agency at the London College of Fashion and with digital agency dandelion + burdock to create a unique immersive experience. The original concept, titled Pose XR, is a virtual tool that allows the users to art direct their own fashion shoot.

How AR/VR was used

The experience features a set of volumetric video sequences of model Jade McSorley captured at the London College of Fashion with around 70 DSLR cameras and reconstructed using Vologrames technology for volumetric video production, and allows the users to choose between different looks for the model, lighting, setting, props, and, of course, makes them the virtual photographer.

Pose XR was launched at the Victoria and Albert Museum in London on the weekend of the 24th September 2021 as part of Digital Design Weekend and London Design Festival, where attendees could play with the experience at an installation. The project can also be experienced on a web browser where 3D content is streamed to the device, so users can access the experience no matter what device they are using.

Only the beginning

"The explosion of interest in digital fashion and 'the metaverse' has largely, to date, focused on commerce. What has yet to be explored in any depth is the huge implications on creativity. PoseXR is a glimpse into the limitless boundaries of creating virtual worlds."
Matthew Drinkwater, Head of Fashion Innovation Agency

WarDucks

Virtual worlds at the touch of a button

Sector: Gaming

Making an impact on the gaming world

Dublin based WarDucks was founded in 2013 and has a track record of technical excellence, successfully developing augmented reality, virtual reality and mobile games, topping the charts with many. Apple CEO Tim Cook visited the Warducks studio in 2020, interested in knowing more about their work in AR, which he believes is one of the few "profound technologies" and which he sees as key to the future of Apple.

Making the Metaverse

The WarDucks team hit a problem in the course of developing a Metaverse game. They wanted to create rich and realistic cityscapes and landscapes, but the tools available were limited in what they could generate, producing flat maps with limited topographical detail.

How immersive technologies were used

With the alternative being an almost impossibly laborious task of building cities from scratch, the team set about development of a solution that would take in data from different publicly available data sources and combine it to create rich visualisations.

They enhanced the tool to give their developers control to configure how the worlds would appear, such as seasonal differences or day and night, and added capabilities to give artists control of how things look.

Choosing data sources and configuring preferences, the Warducks Mapping Platform creates worlds automatically.

Impact of Immersive Technologies

WarDucks will now be the first to market with titles in 3D built from data that reflect what exists in the real world.

UtilityAR

Industry from a different perspective

Sector: Industry

Technology transforming industry

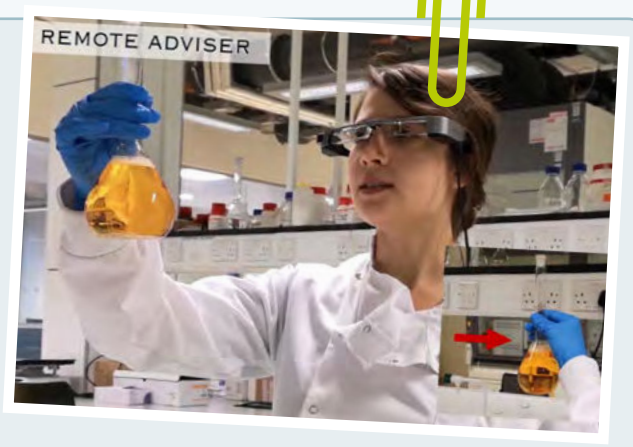
Founders of Dublin based company UtilityAR Patrick Liddy and Aidan McDonnell previously worked together in successful start-up, Activation Energy. When they became aware of Augmented Reality they realised that it would transform industry and saw an opportunity to develop software solutions that would make it usable by manufacturing companies and other organisations.

Augmented Reality

Augmented Reality has proved effective in enhancing retention of training material, in automatically providing step-by-step guidance of employees through procedures and can give information to engineers of what cannot be seen, e.g. services behind a wall. Staff can react more effectively to issues affecting production and get things more quickly back on track, with pre-defined instructions, or get the help of an expert in another part of the world without the need for travel.

It is used to both guide operatives through procedures and to record the carrying out of procedures by taking pictures to create an audit trail to provide to customers and regulators.

They get work done much faster, safer and cheaper.



Smart Glasses

UtilityAR supplies enterprise grade software for use with a variety of smart glasses to its almost 100 customers in Ireland, Europe and beyond, mainly in the pharma, data centre and utility sectors.

They use these glasses to see information superimposed on the physical world and to record and share their work.

Information may be images, video, holograms or instructions to guide them on the steps in the process they are carrying out.

Everything's changed, but we're at the start of the journey

How Smart Glasses are being used with Augmented Reality has changed industry forever, but according to Patrick Liddy, Utility co-founder and Customer Success Manager: *"Customers like ESB in energy, Takeda in biopharma and Transport for Wales are seeing real benefits from AR, but the truth is that we have only started to scratch the surface in rolling out these capabilities."*

chapter **FIVE**

R&D in Ireland

The researchers in immersive technologies in Ireland

Ireland has a vibrant immersive technologies research and development landscape, with research taking place across the country in higher education institutions, in dedicated research centres, in immersive technology companies and in large multinational companies under innovation budgets. The following is a non-exhaustive list of institutions that focus on immersive technologies in Ireland today.

Higher Education based research is concerned with deep technology development, with the relationship between immersive technologies technology and other technologies. Domestic groups that have also received funding under various European and other programmes include:

- **TCD's V-SENSE** (Extending Visual Sensation through Image-Based Visual Computing) and **TU Dublin's Viral** (Virtual Interaction Research Lab) are examples of HEI based research groups that work independently and also have commercial connections through collaborations with industry - Vologrames is a notable spin out from V-SENSE concerned with smart volumetric video capture.
- **ARETE** (Augmented Reality Interactive Educational System) project led by University College Dublin's Professor Eleni Mangina is an example of an AR focused project and it recently secured €3.9 million EU funding under Horizon 2020 for a project that aims to bring augmented reality learning content to students across Europe. Collaborators include UCD School of Computer Science and Irish companies Clever Books and Wordsworth Learning.
- University of Limerick headquartered **CONFIRM** is a Science Foundation Ireland research centre in Smart Manufacturing. In 2021 CONFIRM launched its Future Wireless Innovation Test-Bed in a purpose-built manufacturing research facility.[50] This test-bed will offer manufacturers the chance to build smarter factories and take advantage of technologies that include Augmented Reality.
- **MAVRIC** (Mixed Augmented Virtual Reality and Immersive Computing) Research lab in UCC. MAVRIC is an interdisciplinary research lab headed up by Professor David Murphy addressing various aspects of immersive multimodal systems.
- Nimbus Research Centre in Cork has established a Mixed Reality Innovation Lab and has a strong focus on the use of immersive technologies technologies with data communications for physical systems e.g in energy, environment and healthcare.[51]
- DCU's Performance Engineering Laboratory research group includes quality and performance-related issues of adaptive multimedia streaming as well as performance of content delivery over both wired and wireless networks across various devices.This research is being applied to many projects including EU H2020 funded Newton and TRACTION.
- The Walton Institute in Waterford carries out research into areas such as AR/VR Perception and Social Cognition Training using AR/VR and emphasises the use of immersive technologies and related technologies for smart communities, smart costal, smart cities, High Performance Computing and Agritech
- The ACE AgriTech Centre of Excellence in Kerry delivers e-learning and virtual reality platforms for learning and development to the AgriTech sector and other sectors, including retail. ACE is focused on immersive technologies and is a Public Private Partnership between Munster Technological University, Kerry County Council and three agricultural equipment companies, Dairymaster, McHale Engineering, Abbey Machinery.
- Irish Manufacturing Research (IMR) leads a 200+ company network enabling large scale collaborative research group across 4 key themes; Digitisation, Automation & Advanced Control, Design for Manufacturing and Sustainable Manufacturing. IMR has over 100 staff with 70+ subject matter experts in all aspects of Industry 4.0. XR [AR+VR] Adopt is an IMR project that aims to "develop and test solutions to the technology, safety, user adoption and integration challenges our partners face when adopting XR technology... XR technology has proven to offer huge value across a wide range of use cases. XR-Adopt is a collaboration of 10 companies, each sharing challenging use cases that XR offers a cost effective solution to. The outcomes are applicable to a significant proportion of Irish industry."[52]

Role of research groups in supporting the emerging sector

Participants in the survey commented that as an early stage sector, research at all levels will make an important contribution to the development and adoption of immersive technologies.

Research can help the sector to address **ethical, accessibility and inclusive design issues** as they arise and help to put working frameworks in place. For instance, several interviewees referenced the implications for child safety and compliance with child protection legislation and how **health and safety implications** will need to be considered.

Data protection and privacy is another issue that will call for extensive research and development. Face recognition technology has the potential to track where people are looking and to infer information about them, for example a user's height. Companies will need guidance to understand if there are implications for their data protection obligations.

There were some references to Non-fungible tokens (NFTs) which rely on blockchain technology, as a means of protecting the Intellectual Property in ARVR content, but research and guidance are needed in this area.

Research within large technology companies

Alongside public research, dedicated research centres and innovation departments in large companies work with and focus on domain specific implementation of immersive technologies, how they can be combined with other technologies and explore and prove value that is specific to domain use cases.

Immersive technologies companies carry out research and development to further the value proposition they offer to their customers and often rely on R&D Tax Credits to fund this work.

"Generally, I think we need to build an awareness of how this technology can be integrated into the learning ecosystem."

Content creation, consultancy company

chapter **SIX**

Investment Landscape

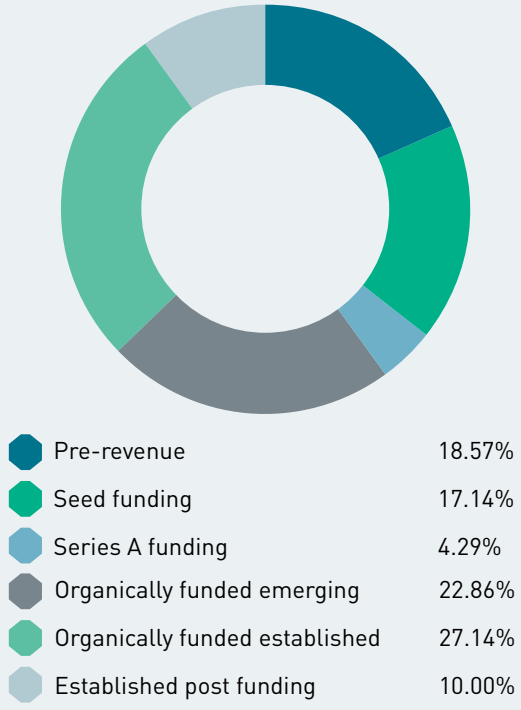
According to the research, the sector in Ireland is funded by their founders, by personal contacts of the founders (commonly referred to as Friends and Family), by Angel Investors or Venture Capital Funds with co-investment by Enterprise Ireland and through revenues from services provided to customers.

Company fundraising stage

The majority of respondents (62.9%) for whom this was relevant are start-ups, i.e. at Pre-Revenue, Seed funding, Series A or organically funded emerging stages. This confirms that the sector is at an early stage of development with innovative companies coming through.

FIGURE 12 ▸ Stage of funding of respondents

Source: Survey data



The following is not an exhaustive list of early and follow on stage funding avenues within Ireland.

Early Stage

Accelerators

There is a network of support for innovative start-ups from Dogpatch Labs Dublin and its regional partners Portershed Galway, Republic of Work Cork, and RDI Hub Kerry through mentorship-driven accelerator and pre-accelerator programmes, and pre-seed funding to entrepreneurs across Ireland.

Private/Angel Investment

There are various seed capital funds and entities focused on private investment including HBAN Ireland and DBIC Ventures who work with early-stage technology and other companies to prepare them for investment and co-invest with angel investors and Enterprise Ireland.

A new €90 million fund for early-stage start-ups launched in February 2022 and is expected to be fully invested within three years. It is funded equally by the Department of Enterprise, the European Investment Fund and the Irish Strategic Investment Fund. It is intended to promote startup investment and is administered by the European Investment Fund.

EIIS

The Employment Investment Incentive Scheme (EIIS) offers tax relief to individuals who invest in companies approved by the Revenue Commissioners. Companies can apply for approval individually or can participate in a fund run by a financial institution that offers a portfolio to its investor clients.

Angel investors are often entrepreneurs who have had success with companies and have benefitted from their companies being acquired. They are sometimes referred to as "smart money" where they have expertise and networks in the investee company's sector and can add value to the company in growing the business as well as by investing.

Public Funding for innovative immersive technology companies

There are multiple avenues for public-funded support in Ireland for start-ups and companies that are scaling. The role of these agencies is critical.

The Local Enterprise Offices (LEOs) that are attached to Local Authorities and other local agencies offer feasibility and other grant assistance to suitable projects.

Enterprise Ireland (EI) offers two main types of assistance, grant assistance and equity investment to companies that meet their criteria and are taken as EI clients. Companies are at a minimum to be seen as being able to achieve €1 million revenues and have 10 employees within three years. EI's equity investment supports companies that have secured private investment (e.g. Angel Investment) or professional (e.g. EIIS Funds, AIB Seed Capital Fund or Venture Capital) with EI co-investing as part of an investment round.

Venture Capital/Follow On Investment

Based on interviews with many sector participants, companies that are considered to have business models capable of being rapidly scaled are able to attract larger investment rounds including venture capital participation and co-investment by Enterprise Ireland. Investors and organisations that support companies indicate that there is a need for companies to be **supported to improve their commercial capabilities**, so that they can engage effectively with prospective customers, gain references, revenues and pipeline and build strong investment proposals.

The level of venture capital activity in Ireland in immersive technologies is proportionally less than in the UK. There were an estimated 20 such investments in Irish companies between 2017 and 2020 compared to the UK where analysis by Arden Partners plc reveals that £154m worth of capital flowed into the private virtual reality sector alone in 2021 up from less than £90m in 2020.[53] Globally, immersive technologies are attracting higher levels of funding and, for example, businesses that emerged from VR-focused global accelerator Vive X have raised $60 million within the last year with the largest rounds of funding in the healthcare and enterprise training areas.[54]

While the level of investment had slowed in Ireland over the past few years, announcements by global companies such as Meta (Facebook) and Microsoft have led to optimism among investors and support agencies that there will be an increase in the level of activity and a greater number of companies coming through with the fundamentals to attract larger investments. This was also reflected in the 2021 Immerse UK VC Investment Report:[55]

> ...the mood music has notably changed. The founders interviewed for this report all reported an overall positive environment with 35% of investors surveyed expecting investment levels to increase over the next 12 months.

Atlantic Bridge, **Kernal Capital** and **Sure Valley Venture** are three venture capital firms that have made immersive technology investments in Ireland in the past. Sure Valley being perhaps the most active investor in Ireland in immersive technologies, with investments in companies including Immersive VR Education, Warducks and Volograms. Atlantic Bridge is active both in Ireland and internationally, with investments including Volograms and Metaio, the Munich based AR company that was subsequently acquired by Apple.

Engage VR (VR education and training) and **Volograms** (smart volumetric video capture of people) are examples of companies that have attracted venture investment.

Similar to other stakeholders, investors believe **there is a strong need to improve awareness of immersive technologies across sectors**, so that businesses can envisage the significant value they can achieve from implementing these technologies and a need for much more early implementation activity to prove such value, supporting the growth of the sector and the competitiveness of the Irish economy.

Enterprise Ireland comment on Immersive Technologies

Immersive technologies such as augmented and virtual reality (AR/VR) experiences have for a long time been viewed more as a nice to have than something that becomes an integral part of our social and working lives but this is changing rapidly with many Irish companies leading the way in producing innovative VR / AR solutions within several industry sectors. The promises of a Metaverse-filled future is exciting and a huge plus for this sector when you look at the endless opportunities for predicted social collaboration and interaction via VR, 3D and AR. The recent rise in popularity of immersive technologies is due not just to increased availability of lower cost hardware but also the convergence and maturing of other adjacent technologies such as maturing game engines, big data, compute power, AI and increasingly the deployment of 5G.

There is no doubt that the original use case of AR / VR was the immersive gaming and entertainment industry but there are huge opportunities for Automotive design and Manufacturing using VR and AR. There are vast opportunities using VR in education and training by using this technology to simulate workplace environments to teach employees or trainees how to do their job in a safe and controlled and often remote environment. We believe immersive technology will democratise simulation training - simulators which were once restricted to high value jobs such as fighter pilots and surgeons, will be open to all industries which will benefit from them due to the availability of immersive technology options. AR has every chance of increasing its presence in the education market in the coming years where all the student requires is a smart phone / tablet and internet connection. In Healthcare, augmented reality solutions are becoming increasingly important to address issues such as the complexity of remote patient support and the increased burden on hospitals. Opportunities in Immersive entertainment experiences at home, Volumetric filmmaking, Augmented Reality shopping experiences, Immersive sporting and events.

We see VR being used for training and AR for operations. People will learn in VR, get used to wearing a headset to do their jobs then when they deploy into the field they'll be using AR headsets and with the expected rise in VR and smart glasses in 2022 with Meta's next generation headset, Sony's Playstation VR2 and Apples expected VR / AR device all arriving to compete with possibly the most popular VR Headset on the market, The Oculus Quest 2, the opportunities for companies operating in this emerging sector are exciting, with the VR/AR and Mixed Reality sector having the potential to become one of the most disruptive technologies of the next 10 years with the combined markets forecast to reach $300 Billion U.S dollars by 2024.

Enterprise Ireland is leading in a changing world and remains committed to supporting startups within this emerging sector in an effort to accelerate the development of world-class Irish companies to achieve strong positions in global markets resulting in increased national and regional prosperity by offering a wide range of financial and non-financial supports to eligible companies.

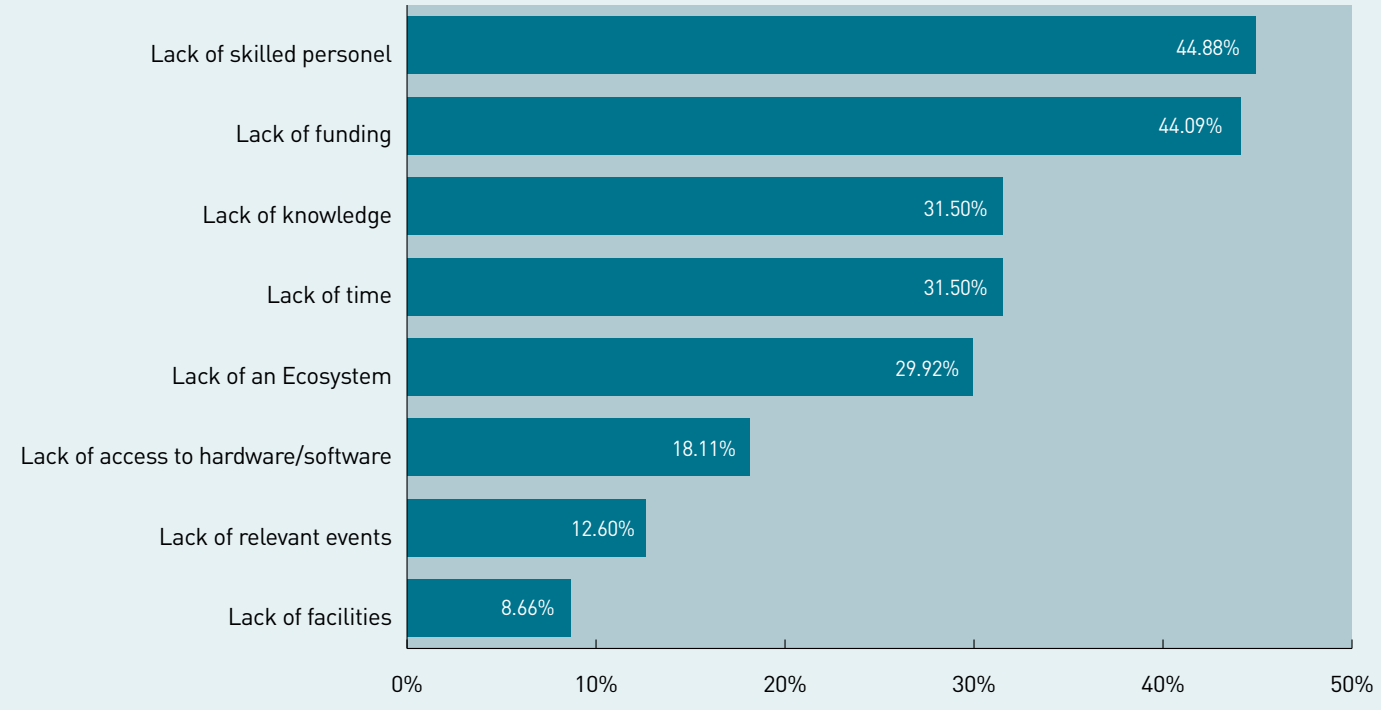
chapter **SEVEN**

Barriers to Growth

When asked about what was the greatest barriers to the growth of the Immersive Technologies sector in Ireland, five issues stood out (with percentage of respondents who mentioned each barrier in brackets):

- Lack of skilled people (44.9%)
- Lack of funding (44.1%)
- Lack of knowledge (31.5%)
- Lack of time (31.5%)
- Lack of an Ecosystem (29.9%)

FIGURE 13 ▸ Percentage of respondents who mentioned each barrier



Source: Survey data

Lack of skilled people

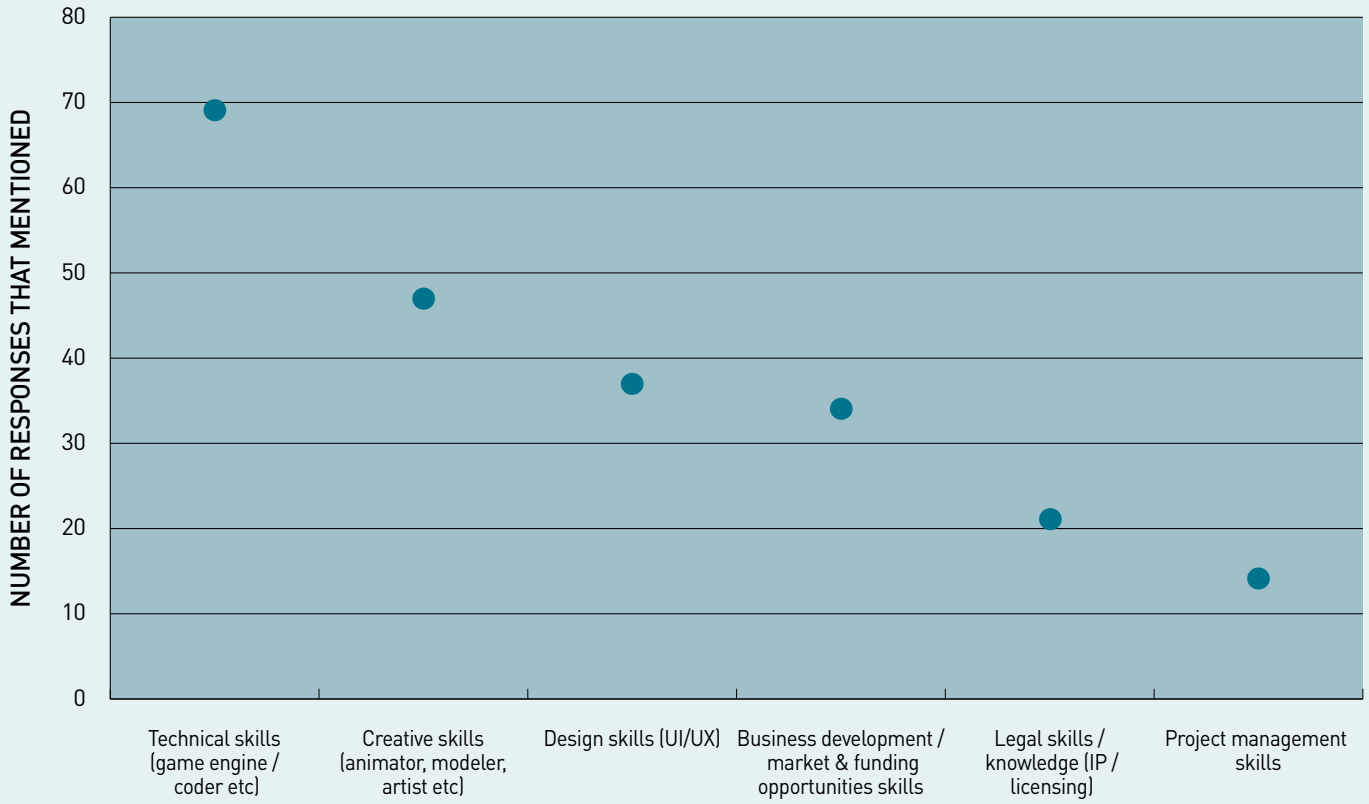
Lack of skilled people is seen as the largest barrier to the growth of the sector. The Immersive Technology skills gap is a significant barrier to growth. A dynamic, highly trained, world leading immersive workforce is central to building a thriving and successful immersive sector in Ireland. The three areas of skill with the greatest shortages according to the survey are:

- Technical skills (game engine /coder etc)
- Creative skills (animator, modeller, artist, interactive designer who understands spatial etc) and Design skills (UI/UX)
- Business skills (Business development / market & funding opportunities skills)

Key insights learned:

- New cross-functional skillsets are required, as functions traditionally associated with enterprise software and gaming silos intertwine.
- Commercialisation skills within the immersive technology community are needed to grow commercial competency of domestic companies (better engage with customers, build value propositions and compelling investment proposals as companies move from start-ups to scale-ups).
- Overall, Irish Immersive companies need to have access to the right skills when they need them to accelerate R&D and drive company growth.

FIGURE 14 ▸ Skills shortages mentioned by respondents



Source: Survey data

Lack of funding

Lack of funding is seen as a key barrier to the growth of the sector, ranging from available customer budgets, external investment and dedicated research. Lack of dedicated funds to capitalise on market opportunities are a barrier for a sector dominated by early stage businesses.

Key insights learned:

- The domestic sector comprises of early stage businesses. These companies do not necessarily have the resources or bandwidth required to invest in dedicated R&D while developing their businesses.

- Interviewees from support agencies, research centres and companies offering immersive technology services indicated that there is a strong need for early stage R&D funding for prototyping and commercialisation support to engage with early adopters, build pipeline and revenues and to bring forward strong investment proposals.
- The need for greater dedicated innovation supports for working with immersive technology were referenced widely, with the need for support for Proof of Concepts, in addition to existing general supports, to provide proof of anticipated value and accelerate adoption.[56]

Lack of an Ecosystem

The domestic ecosystem is not mature enough. More opportunities to share knowledge on industry developments, creating new connections and collaborations across all parts of the Irish tech and immersive tech sectors are needed for a thriving, sustainable immersive ecosystem. Sectors and innovators are operating in silos and not connecting to share or build new ideas and learn from cross innovation or find new market opportunities.

Key insights learned:

- Industry representatives feel that greater collaboration is needed across all aspects of the sector, between large tech multinationals and SMEs, start-ups, researchers and universities.
- In particular the need for greater collaboration between industry and academia is needed to help inform and develop industry relevant provision, provide work placements, build collaborative relationships and tailor research to meet domain specific needs.

Lack of Government and institutional knowledge/awareness of immersive technology puts Ireland at a disadvantage

Low awareness of the potential for Immersive Technologies within leadership is holding back the sector. A common theme arising from the research was that if Ireland does not develop a strategy to build capabilities in the sector, we will fall behind in competitiveness, including in our ability to attract Foreign Direct Investment, as we will not be able to service their transformation to immersive technology training and operations. It was clear from interview candidates that there needs to be a clear, Government-led strategy and direction set for the development of the sector to prosper. Government departments and agencies need to build up awareness of immersive technologies as a priority, to better understand the scope of the immersive technologies opportunity for Ireland, and communicate this across the business community in Ireland.

Key insights learned:

- Some reported that governments (including Scandinavia, the UK and the Middle East) are investing more in the use of the technology, giving their innovators home experience and setting a high quality standard in its procurement processes, etc.[57]
- Many reported senior levels of management need to understand the transformative power of immersive technologies, to encourage them in informed initial adoption and to progress transformation in a sector often using older siloed technologies and embedded systems.
- Without relevant stakeholder experience of using the technologies on projects in their home market, exporting companies in the sector risk falling behind competitors from elsewhere in providing services, as they will not have the same level of experience.
- Many not currently using immersive technologies are aware that they need to increase their own knowledge about the possibilities, opportunities and use cases.
- Many interviewees mentioned the need for facilities to enable the companies in the sector to carry out the Proof of Concepts. Ireland is seen as being at a considerable disadvantage in this area, as facilities that exist tend to be in the context of research groups and not accessible to companies. e.g. there is currently no high level immersive technologies production studio in Ireland, with work requiring such a studio going to the UK or Paris or to one of the other approximately 40 studios of this level worldwide.

chapter **EIGHT**

Opportunities

Build upon Ireland's export strengths

Immersive technology represents a global marketplace with tremendous potential for domestic businesses to exploit new and global opportunities. Even at this early stage, the survey data confirmed that the sector is outward looking and export-oriented.

Ireland has the reputation for being at the heart of ICT in Europe. Our strong technology exporting credentials that can be replicated in immersive technology.[58] Supporting this relatively young sector with existing domestic commercialisation talent and skills development support can significantly improve growth capability. This will enable domestic business leaders to be more effective in finding, engaging and succeeding with the right customers, funders and prospects in new markets.

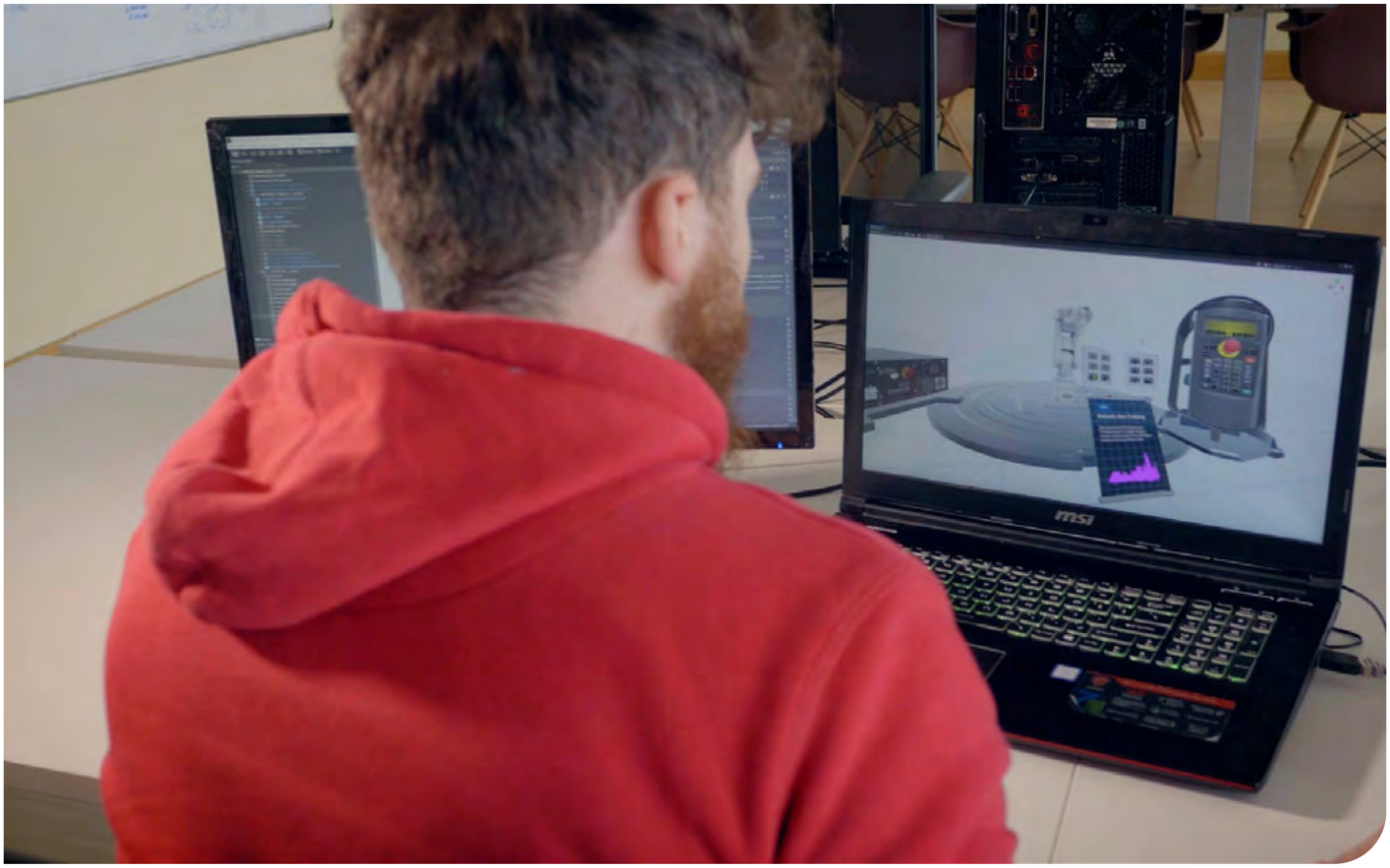
The more mature European and international markets present a significant opportunity for Irish businesses. As found in the data, many firms plan to increase their investment and expect their immersive technologies business to expand over the next 12 months, with key business occurring in international markets. This sector would be ideally suited to being promoted, as part of the Irish Advantage programme, for example.

Building Ireland's Immersive Talent Pool

Many of the barriers outlined in this report point to some key challenges that, if not addressed, will fundamentally hinder any potential for this sector. Central to this is the importance of a robust skills and talent pipeline, ensuring a workforce that is fit for purpose, a world class and a research and development framework that allows for greater innovation and business support to start-ups and scale-ups.

Immersive Technologies Skillnet can play a pivotal role in addressing these immediate and future skills gaps through their subsidised and supported industry led talent development initiatives across the immersive technology skills pipeline including technical, creative and business skills. Screen Ireland, Animation Skillnet and Screen Skillnet can continue to act as key drivers through upskilling the screen sector workforce in immersive technology content creation, development and production.

Apprenticeships are one example of where valuable on the job support can make a real difference in building a skilled talent pool. An ongoing domestic initiative that will help to upskill the enterprise workforce is the plan to



develop a new Apprenticeship in Immersive Technologies by an Eirmersive led industry consortium, which includes the Immersive Technologies Skillnet, together with Mayo-Sligo-Leitrim Education & Training Board as the co-ordinating provider.

Many countries are competing to attract creative thinkers and content creators and have been incredibly active in engaging and attracting immersive businesses and talent. It is vital that Ireland continues to not only build, but work to retain, a dynamic immersive technology workforce now and into the future.

The emerging immersive technologies ecosystem in Ireland.

Irish businesses that are engaged with new and emerging technologies such as AR and VR see the global advances and impact being made in other countries and are hungry to compete. Those interviewed saw significant opportunity. Given Ireland's reputation as a global tech hub, many believe Ireland can leverage its strength to drive a stronger immersive sector.

The foundations of a stronger immersive tech ecosystem in Ireland can be relatively easily built, at little cost, through better connecting innovators, companies, funders, regional support agencies, funders, investors, researchers, and universities. This enables the type of organic collaboration that drives innovation, R&D and sector growth.

This report has highlighted that although the immersive sector is concentrated in the capital city, 50% of respondents are operating elsewhere. Given the small size of Ireland, an opportunity exists to connect and amplify various activities, which could leverage opportunities for the Irish immersive sector as a whole. Many regions around the country have strengths that can support the emergence of innovative immersive technologies companies outside Dublin, including a network of immersive technologies research centres, new strategic government funded initiatives for digital businesses and a focus on community building in regional hubs.

An example of government innovation supporting the emergence of immersive technologies is how Smart Dublin, Dublin City Council's Smart City initiative, is trialling the use of new and emerging technologies in events and culture departments.

Support greater collaboration, networking and knowledge sharing of use cases to build greater awareness

The survey and industry interviews in this report overwhelmingly point to a lack of awareness of value, impact and use cases in AR and VR as being a major barrier to growth.

Many highlighted the need for a much greater level of collaboration and openness between participants in the sector. One such successful collaboration has been the recent Biopharmachem Skillnet collaboration with TU Dublin to realise a 'Powder Handling for Pharma Manufacturing' programme in VR.

Eirmersive is mentioned a number of times as playing an important role in bringing the players together and there was an appreciation of the growing number of events such as the ARVR Innovate conference aimed at bringing people together to network, share ideas, connect, and collaborate, before the Covid 19 pandemic brought events to a halt.

Opportunity exists at both the immersive sector level and the domain level to realise value from savings afforded by immersive technologies and their transformative potential.

"Developing an AR/VR ecosystem will be incredibly important over the next decade. This is not the future, it's the now and we need to be on the ground floor rather than playing catch up years from now. "

Content Creator

chapter **NINE**

Key Messages/Findings

Irish immersive businesses are exporting to Europe and internationally.

The Irish Immersive tech market is both inward and outward facing, with a strong international market and growing home market. Almost two thirds of customers are located outside of Ireland with Europe being the most important export market (29% of customers), followed by the USA(19.5%). 78% of companies are exporting, with almost 40% saying export sales account for more than 50% of sales.

A shortage of skilled people, difficulty accessing funding, low market awareness and a low level of investment in accessible facilities are barriers to growth in this nascent market.

Immersive technology businesses rank lack of skilled people and lack of funding as the most significant barriers to growth, followed by lack of knowledge, time and underdeveloped ecosystem. There is a shortage of skills across the board, but especially for technical skills. Hybridisation of roles will be the new norm, requiring some knowledge of immersive tech - from engineering to marketing. Access to funding is a particularly high barrier in this sector because of the high costs involved in bringing a Minimum Viable Product (MVP) to the market and difficulty start-ups and scale-ups experience accessing funding, which is in turn hampering innovation. Lack of widespread awareness across the economy of the transformative power of immersive technologies was mentioned by a large number of companies and researchers interviewed as something that was holding back the sector in Ireland which in turn hinders the companies from experimenting in their home market. Investment in infrastructure accessible beyond research environments would fuel innovation in immersive technologies in the arts and in industry.

There is opportunity for Irish immersive tech businesses to excel on a global scale.

The impact of the Covid 19 pandemic has seen a rapid maturing of the market for immersive technologies as technology innovation and investment by leading technology firms opens up opportunities across a wider range of uses and markets. Irish immersive businesses are aware that international markets are seizing these new opportunities and do not want to be left behind the curve.

Irish businesses are already driving value from immersive technologies.

Irish businesses are using immersive technology and innovating in process improvements, developing new products, changing culture and expanding markets. The survey showed that Irish immersive businesses are creating value across a wide range of sectors. Benefits include reducing costs and improving efficiencies, the development of new products, faster prototyping and increased visibility.

There is an emerging immersive ecosystem with a focus on Dublin and hot spots growing regional activity.

Clusters of excellence and innovation are emerging across Ireland in established and new tech and research hubs. These clusters have the potential to unlock much needed support for this nascent immersive tech sector, driving greater connectivity between businesses and sectors and in turn fuelling new innovation and R&D.

The sector consists of multinational companies investing heavily in immersive technologies and start ups and scale ups with an ambition to escalate their R&D and investment.

Some large multinationals are active in immersive technologies in Ireland but the responses to this research are predominantly made up of small early stage firms. 46.9% of immersive businesses have turnover of less than €100,000 and 50% have four employees or less, 63% expect to grow in the next year.

Irish Immersive technology businesses expect to invest more in immersive technologies in the next 12 months.

Investment from companies working in or new to immersive is on the up: 80% of respondents are considering investment in the next 12 months and 22% are planning 'major investments'. Ireland will see a significant increase from businesses themselves in immersive technology, demonstrating the high levels of commitment to and ambition in utilising immersive technology to drive business growth.

Businesses new to the market are exploring new applications and considering investment.

Businesses are exploring and evaluating how they can use immersive technology, looking for suitable use cases. 40.5% of companies surveyed are actively exploring new investment for over the next year, suggesting a significant ramp up in use of Immersive Technologies.

Ireland has a vibrant immersive technologies research and development landscape with regional hotspots.

In addition to in-house research in large technology firms, there are a number of research groups specialising in immersive technologies in third level institutions, particularly in Dublin, Waterford, Cork and Limerick. Many of the interviewees believe there is a role for this research community to guide on how immersive technologies can comply with regulatory needs in areas such as Data Protection and Privacy, Standards and Human Factor.

Low levels of Venture Capital investment reflecting nascent market but number of high profile success stories.

While there have been some notable successful fundraising involving Venture Capital by companies considered by professional investors to have scalable business propositions, the deal flow is at an early stage. Immersive technology companies are relying on accessing public funds, often with co-investment from Enterprise Ireland and grants and other support from other agencies such as regional incubators and Local Enterprise Offices, indicating the high dependency of these scale up companies on these support agencies.

Executives from major technology companies believe that Ireland is at a relative disadvantage in the immersive technology space.

A number of interviewees expressed concern that Ireland lags behind other countries' promotion and investment of immersive technologies. It was claimed by a number of them that greater supports are available for immersive technologies and associated innovations in competing countries.

"The government agencies need to upskill in this area to better support it."

Software and Content Creation company

chapter **TEN**

Recommendations

Ireland's thriving global technology hub and creative industries are ripe for disruption and the transformational opportunities created by immersive tech. The potential is here now, however given the barriers to growth outlined in this report, the immersive market will require significant strategic support to make the most of these new opportunities today and to be in a stronger position to innovate on a global scale in the future. This can be addressed by these recommended actions:

Create an Immersive Technology Strategic Roadmap for Growth

Create a 'Roadmap for Growth' Immersive Tech Working Group, composed of government agencies, support bodies, researchers and industry with a strategic intent to align policy and work programmes to address the barriers and challenges facing the immersive tech sector outlined in this report. This Working Group would:

- Promote an aligned approach and targeting of new and existing support mechanisms to drive greater R&D and innovation in immersive tech across sectors.
- Tailor public sector procurement practices. A priority for the construction sector, for example, would be to adjust procurement and project practices progressively to promote immersive technologies inclusion in consultation, design, procurement, construction and maintenance.
- Focus existing interventions to address the business development needs of startups and scale ups, including commercialisation skills development and support with reaching new markets and audiences.
- Inform workforce development priorities and existing support agencies to ensure the Irish immersive tech workforce is fit for purpose, including more short professional development courses and apprenticeships to further develop workforce skills and enable new and cross skills development. Additionally, focus on supporting individuals to add new relevant skills to their existing technical skills for immersive technology roles that require a new combination and on building collaborative skills to support multidisciplinary teams made up of creative, technical and other workers.
- Invest in additional research, intelligence and market data to inform future funding and policy development.
- Ensure fiscal incentives, such as the gaming tax credit, meet the needs of companies using immersive technology

Build greater awareness of the enabling and transformative potential of immersive technology through a campaign that provides hands on opportunities to try out immersive content, applications and experiences, showcases companies and their products, builds use-cases and sign posts to intelligence, advice, guidance, support and investment.

This can include individual reports on opportunities for immersive technologies in specific sectors, similar to the one recently prepared by Enterprise Ireland on Opportunities in Immersive Media Entertainment. There will be a role for training on how to use immersive technologies tailored to individual sectors where the Return on Investment case is strong, for example, construction and retail.

Direct targeted funding for new programmes that support applied research and prototype development to help innovators and companies experiment with and apply immersive tech within businesses, products, services, and entertainment.

Funding within existing funding structures can pump prime innovation through new interventions such as prototype experimentation labs, hackathons, workshops, events to bring in immersive companies, researchers, and innovators together to learn, cross skill and innovate across industry.

Provide business and development support to scale up these ideas and take them to market.

Create a new fund to provide access to equipment and hardware to showcase and demonstrate the use of immersive tech in a wide range of sectors, enabling businesses to explore what immersive technology is and how they can utilise it in their businesses today and in the future.

Empower regional organisations.

Provide bespoke support for regional businesses, to hot desk, network, pitch to clients and avail of wider support targeted at high growth tech sector

Broker introductions, collaborations and greater engagement between industries working in or looking to work in immersive tech on the ground locally.

Support greater cross sector collaboration, enable the fertilisation of new ideas and incentivise leading edge R&D to help drive innovation. This can be achieved by empowering support networks on the ground to:

- Connect the wider Irish ecosystem and bring industry together to network, collaborate, share knowledge and best practice.
- Incentivise greater collaboration between industry and academia.
- Build awareness of and showcase the opportunities in the application of immersive technologies.
- Gather industry intelligence and broker national and international connections.
- This network would support, in partnership with the Roadmap for Growth Working Group, the development and implementation of the recommendations set out in this report and work with other technology representative bodies and local networks to build an immersive tech ecosystem built for and by industry.

Prioritise promotion of immersive technologies sector in international markets through the following actions:

- Conduct feasibility studies of the market opportunities in international markets of potential high value to Irish immersive tech companies.
- Work with the Irish government's trade strategy 'Ireland Connected: Trading and Investing in a Dynamic World' to ensure that Irish immersive tech businesses are embedded within Team Ireland approach to markets, where the Embassy and State Agency overseas network work together to promote trade, tourism and investment.
- Support Enterprise Ireland to take up the range of international collaboration opportunities such as digital Missions and Trade Shows and Government or European funded collaborative R&D programmes between universities.

"If we are to move into this space we need to engage in deep research and in acquiring funding and personnel to pilot some new approaches."

Education Consultants

"The barriers to entry for us so far has been the lack of funding. In order to get to a certain stage in which a company can bring an MVP to seed funders/ larger Irish funding bodies like Enterprise Ireland requires more funding and investment. Although we very much welcome the fund from Screen Ireland and long may that last, we believe more funding opportunities could help Irish Immersive companies get to where they need to be in a shorter space of time."

Early Stage Content Creator

APPENDICES

Appendix A

List of Survey Respondents

Organisation	Person
Accenture	Aravind K Thoomu
Adaptas	Celine Mullins
Agritech centre of excellence	Niall Trant
Airbus	Shane Carroll
Algorithm Productions Ltd	Nick Linders
Altum Analytics	Dmitry Korzhik
Ar/Vr/Xr practitioner	Stephen Dignam
Arup	Enda Kirwan
Arup	Michael Galbraith
Avanade	Luke Bourke
Axonista	Claire McHugh
Bauer media	Sophie LaTouche
BBDO DUBLIN	Barry O'Sullivan
Bentley Systems International	Daniel Debtuch
Best Practice	Asumpta Gallagher
Beta Digital	Louise O'Conor
Boolmoot	Paco
C+W O'Brien Architects	Davitt Lamon
Ciara Tamay	Ciara Tamay
CIS Force	Dmitry Lazarev
Connect Academy	John Peavoy
Cook Medical	Pat O'Hora
Davra	Theo Giannopoulos
Dell Technologies	Joseph Correia
Digisoft.tv	Darragh O'Brien
Dropbox	Alexandra Etienne
Dublin West Education Centre	Daithí Ó Murchú
Dún Laoghaire Institute of Art, Design and Technology (IADT)	Robert Griffin
eCerge	Ken Condon
Edge Behaviour	Aidan McCullen
Emagine	Craig O Keeffe
ENGAGE XR Ltd	Sandra Whelan
Fab Lab Maker Hub	Stuart Lawn
Fourth Reality	Gary Pearson
Future Focus21c	Anita McKeown
Glanbia	Padraig Mitchell
H2 Learning	Michael Hallissy
Honeycomb Solutions & Concurrent Engineering	Owen Kirby
Imvizar	Michael Guerin
Innovision Media Ltd	John Flanagan
Intel	Patrick Morrissey
IOT-WORX	Mark Sheridan
Irish Manufacturing Research	Sam Del-Greco
Kehlan Kirwan Videographer & Photographer	Kehlan Kirwan
Kirby group	Mark Danaher
LCIXR Ltd	Eoin Long
Leaptree	Barry Connellan
Learnovate	David Farrelly
Logitech	Aidan Kehoe
Logitech Ireland Services	Denis O'Keeffe
Lookinside	David McAuley
Mastercard	Keith Jordan
Mayo Sligo and Leitrim Education and Training Board	Sean Burke
Mayo, Sligo, Leitrim Education and Training Board	Siobhan Magner
meetingRoom Software Ltd.	Jonny Cosgrove
Mersus Technologies Ltd	Geoffrey Allen
Meta	William Henry
Millennia Aviation	Lye Ogunsanya
Mixed Reality Therapy	JF Leader
Morphosis Studio	Christian Boshell
Munster Technological University	Andrew de Juan
Nimbus Research Centre, MTU	Kevin O'Mahony
Nova Realities	Emmet Burke
Nüwa Digital Media Content Production Studios Limited	Guillaume Auvray
Obscurity	Dónal Troddyn
Octagon Simulations Limited	Damien Meade
Orb Media	Ciara Sheahan
Outmin	David Kelleher

List of Survey Respondents (continued)

Organisation	Person
Patentnav	Edward O'Gorman
Perfici Intelligence	William Johnstone
Pfizer	Ronan Kelly
Pink Kong Studios	Niamh Herrity
PLACEengage.com and Proptech Ireland	Carol Tallon
Planet Hologram Studios Ltd.	Aisling Hurley MSc.
Plop	Allen Wixted
Precision Sports Technology	Emma Meehan
Publicis	Ronan Kenny
Radio Systems PetSafe Europe Ltd	Cormac White
RDI Hub	Niall Larkin
S3 Connected Health	Raymond Crosbie
School	Conor Gerard Kerrigan
SchooVR	Mark Baldwin
Screen Wexford	Linda Curtin
Sentireal	David Trainor
Simvirtua Ltd.	James Corbett
SKIDATA Ireland Ltd	Michael Dale
SKMMP	Aileen Carville
SOL Learning	Siobhán O'Leary
SolasVR	Stephen Pitcher
StoryToys	Devon Wolfgang
StoryToys	Emmet O'Neill
Stryker	Eimar
Sunny Numbers	Cleidi Hearn
Teagasc	Emily Crofton
Technological University Dublin	Alex Gibson
Technological University Dublin	Avril Behan
Technological University Dublin	Brian Vaughan
Technological University of the Shannon	John Jennings
Technological University of the Shannon	Niall Murray
TEKenable	Paul Richmond
The International College for Personal and Professional Development	Tom Moran
The Learning Rooms	Ryan McInnes
The National Institute for Bioprocessing Research and Training (NIBRT)	Eric Dumas
The Play Platform	Martin Fitzgerald
TUS - Clonmel Digital Campus	Adrian Fielding
Unity	Claire Cunningham
University College Cork	David Murphy
University College Dublin	Abey Campbell
University of Limerick	Eoin O'Connell
UtilityAR	Séadna Smallwood
UTS - Underground Technical Services Ltd	Mike Sheehy
Verve	John Kilcullen
Virtual Reality Gaming Ltd	Ronan Cunningham
Virtual Teic	Paul McMahon
Vologrames	Rafael Pagés
VRAI	Niall Campion
W5	Russell Gillespie
Walton Institute	Jim Prendergast
Walton Institute (formally TSSG)	Carol Faughnan
Wanderful	Lena Angland
WarDucks	Nikki Lannen
Waterford and Wexford Education and Training Board	Mary Walsh O'Shea
White Pyramid Ltd	Leo Cullen
WordsWorth Learning Ltd	David Ross
Writers Game Ltd	Camille Donegan
WuXi Biologics Ireland	Marie Kirk
XR Concepts	Jerry Foley
Zero Latency Dublin	Evan Gallagher

Appendix B

Research Interview Contributors

Organisation	Person
Agritech Centre of Excellence	Niall Trant
ARUP	Michael Galbraith
Atlantic Bridge	Chris Horn
Bentley Systems	Deniel Debtuch
Clout.art	Paula Kilgarriff
Crew Digital	Niamh Costello
DBS	David Williams
Digisoft / Cyber Twin	Brian Rattray
Dundalk Institute of Technology	Peter Morris
Emagine	Craig O'Keefe
Engage VR	Chris Madsen
Enterprise Ireland	Keith Brock
Enterprise Ireland	Michael O'Dea
FBD (2016/20)	John Mulreid
Folk Wunderman Thompson	Keith Lawler
HSE CAMHS	Niamh Morrin
IDA	Shane Nolan
Imvizar	Michael Guerin
Independent consultant to energy sector	Kevin O'Donovan
Kosmos / Fifth Dimension	Ross Griffin

Organisation	Person
Logitech	Dennis O'Keefe
Mastercard	Keith Jordan
MCVR Designs	Kevin McNamara
Meetingroom	Jonny Cosgrove
Mersus	Geoff Allen
National Rehabilitation Hospital	Jibraan Esoof
Nimbus	Kevin O'Mahoney
Plop	Allen Wixted
RDI Hub	Niall Larkin
RTE	Grace Dinan
SchooVR	Mark Baldwin
Smart Dublin	Jamie Cudden
Sure Valley Ventures	Isabelle O'Keeffe
Tourism Ireland	James Kenny
TUD	Alex Gibson
TUD	Avril Behan
UtlityAR	Patrick Liddy
Vologrames	Rafa Pagés
VRAI	Niall Campion
Vsense	Gareth Young

Bibliography

1 Source: A Taxonomy of Mixed Reality Visual Displays, Milgram et al

2 Source: Deloitte, From virtual to reality: Digital reality headsets in enterprise and education, December 2020

3 Source: Virtual reality (VR) headset unit sales worldwide from 2019 to 2024

4 Source: IDC Report, Spend on Emerging Device Categories, October 2021

5 Source: Finances Online, 12 Virtual Team Trends for 2022/2023: Top Forecasts To Watch Out For, 2021

6 Source: Gartner, Inc. Digital Worker Experience Survey, August 2021

7 Source: IDC: Worldwide Augmented and Virtual Reality Hardware Forecast Update, 2021–2025: CY 4Q21, January 2021

8 Source: Unity, 2021 Immersive Technology Trends Report, 2021

9 Source: The Guardian, Facebook to create 10,000 jobs in EU to help build 'metaverse', 18th October 2021

10 Source: The Fashion Law, Nike is Eyeing the Metaverse with New Hires & Trademark Filings, 2nd November 2021

11 Source: Consultancy.co.uk, Accenture buys 60,000 Oculus headsets for VR training, 5th November 2021

12 Source: Sunday Times, Virtual reality: pandemic leads to rise in headset sales to escape lockdown, 17th January 2021

13 Source: Export Orientation of Startups, Entrepreneurship in Ireland 2019

14 Source: Enterprise Ireland, Powering the Regions, 2019

15 Source: Department of Enterprise, Trade and Employment, Innovation 2020, 2015

16 Source: EY_DKM CIF Construction EIA FINAL Report_08072020.pdf

17 Source: Department of Housing, Local Government and Heritage, Housing for All - a New Housing Plan for Ireland, September 2021

18 Source: Unity, Immersive tech takes off for enterprises: Seven takeaways from a new study, 13th December 2021

19 Source: Construction IT Alliance (CitA), CitA Tech Trend: Virtual Reality / Augmented Reality, October 2021

20 Source: Higher Education Authority website

21 Source: Edweek Market Brief, Global Spending on Virtual Reality, AI in Education Poised to Skyrocket, Report Says, 17th February 2021

22 Source: Business & Finance, IDA Ireland reports highest increase in FDI employment in a single year, 21st December 2021

23 Source: IDC, Pandemic Tempers Growth in AR/VR Spending, but the Long-Term Outlook is Positive, 20 July 2020

24 Source: The Arts Council, Employment and Economic Impact Assessment of Covid-19 on the Arts Sector in Ireland, October 2020

25 Source: Analytics and Insights, AR and VR in entertainment is expected to reach US$45.20 billion by 2027

26 Source: Find Your Sounds, Jean-Michel Jarre Welcomed 2021 to 75 Million Viewers with Multi-Media VR Concert Spectacular from Notre-Dame de Paris 'Welcome To The Other Side', 8th January 2021

27 Source: Traction Project Website

28 Source: https://www.elainehoey.com/imaginary-state-s

29 Source: RTE Website, Ar Ais Arís - Brú Theatre's immersive experience as Gaeilge, 18th June 2021

30 Source: RTE Website, Video on Demand

31 Source: Animation Innovation and Immersive Development Fund 2022

32 Source: CSO, System of Health Accounts 2019

33 Source: IBEC, Ireland: Where Digital Health Thrives, 2020

34 Source: Cision PR Newswire, Augmented and Virtual Reality in Healthcare Market Size to Reach USD 4367 Million by 2027 at CAGR 23.6%, 29th October 2021

35 Source: CNBC, Virtual reality is booming in the workplace amid the pandemic, 4th July 2020

36 Source: IDA Ireland Website, 2022

37 Source: Department of Enterprise, Trade and Employment, Annual Employment Survey 2020, April 2021

38 Source: PWC Blogs, Seeing is believing: Why Germany is set to lead the European VR / AR revolution, 9th December 2019

39 Source: Deloitte, An Outlook on the Retail Sector - Domestic Market Review, 2020

40 Source: Retail Touch Points, AR's Retail Value to Hit $7 Billion by 2023, 2018

41 Source: Engadget, Pinterest adds augmented reality furniture shopping to its app, 31st January 2022

42 Source: Nasdaq, Dyson delivers virtual reality in new twist to home shopping, 18th November 2021

43 Source: Introducing Meta: A Social Technology Company, October 2021

44 Source: CSO, Statistical Yearbook of Ireland 2021: Part 2 Business and Economy, 2021

45 Source: IDA Ireland Website, 2022

46 Source: CCS Insight, Things Are Finally Going Well for Extended Reality: Solid growth in 2021 in both consumer and enterprise spaces, 2nd July 2021

47 Source: Failte Ireland Website, 2022

48 Source: Lee,W.-j.;Kim,Y.H.Does VR Tourism Enhance Users' Experience? Sustainability 2021, 13, 806. Sustainability-13-00806.pdf

49 Source: Early Metrics, Can virtual tourism save the travel industry?, 18th November 2021

50 Source: Confirm Smart Manufacturing, Confirm launches Smart Manufacturing Future Wireless Innovation Test-Bed, 12th April 2021

51 Source: https://www.nimbus.cit.ie/extendedrealitylab

52 Source: https://imr.ie/pages/xr-adopt

53 Source: Technology, 2021 a record year for virtual reality investment, 12th January 2022

54 Source: CNBC, Virtual reality is booming in the workplace amid the pandemic, 4th July 2020

55 Source: Immerse UK, UK Immersive Tech: VC Investment Report, June 2021

56 Reference was made in multiple interviews to Israel and the United States potentially accelerating away from Ireland with this approach.

57 Source: Catapult - The UK authority on advanced digital technology website, 2022

58 Source: More than half of Irish exports in December 2021 (55 per cent or €134 billion) were what the CSO classified as computer services, which covers hardware and software-related services as well as data-processing services. Irish Times, December 2021

Immersive Technologies Skillnet

IMMERSIVE TECHNOLOGIES SKILLNET

1st Floor, The Tower, Trinity Technology and Enterprise Centre
Grand Canal Quay Dublin 2

E manager@immersivetechnologiesskillnet.ie
W www.immersivetechnologiesskillnet.ie

Immersive Technologies Skillnet is co-funded by Skillnet Ireland and network companies. Skillnet Ireland is funded from the National Training Fund through the Department of Further and Higher Education, Research, Innovation and Science.

An Roinn Oideachais agus Scileanna
Department of Education and Skills

Skillnet IRELAND