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Welcome

The UK Immersive Technologies Global Expert Mission (GEM) to Japan, funded through the Audience of the Future (AotF) Challenge, invited a group of UK experts to meet with private and public sector organisations in Japan to better understand the immersive technologies landscape and help benchmark against UK capability.

This report is made available to inform UK businesses and the UK government about the extended reality (XR) market in Japan, relevant stakeholders, and insights into synergies between the two countries to determine a strategy for future collaboration.

Furthermore, the mission captures key research, innovation and market opportunities and challenges in consideration for UK companies to collaborate with Japanese partners.

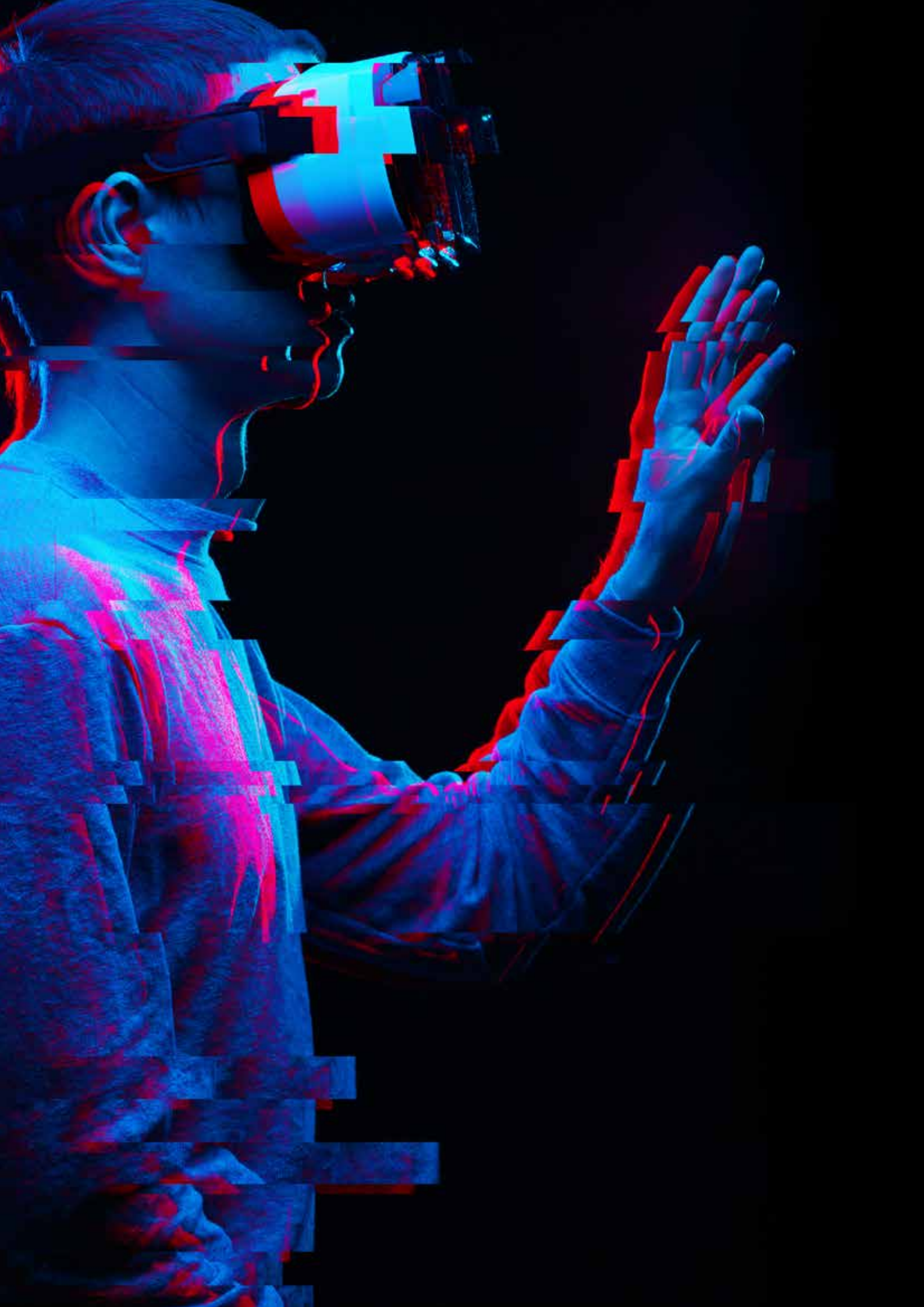
The outcome of the mission is to provide evidence to support private/public investment in the UK and explore opportunities for the UK to collaborate with the best Japanese organisations and companies.

Definitions

Augmented reality (AR):	a technology that superimposes a computer-generated image on a user's view of the real world.
Extended reality (XR):	an umbrella term that encompasses all the immersive technologies.
Haptics:	the use of technology that stimulates the senses of touch and motion, especially to reproduce in remote operation or computer simulation the sensations that would be felt by a user interacting directly with physical objects.
Immersive technologies:	ways of creating, displaying and interacting with applications, content and experiences, transforming the digital experience by bringing together the virtual with users' sight, sound, and touch.
Mixed reality (MR):	a medium consisting of immersive computer-generated environments in which elements of a physical and virtual environment are combined.
Virtual reality (VR):	the computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a virtual reality headset, gloves fitted with sensors, or a full body haptics suit.

Acronyms

3D	Three-dimensional
5G	Fifth generation
6DoF	Six degrees of freedom
AI	Artificial intelligence
AotF	Audience of the Future
API	Application programming interface
B2B	Business to business
B2C	Business to consumer
DIT	Department for International Trade
EPSRC	Engineering and Physical Sciences Research Council
GEM	Global Expert Mission
HDR	High definition range
HMD	Head-mounted display
IoT	Internet of things
IP	Intellectual property
LBE	Location based entertainment
LBVR	Location based virtual reality
LTE	Long term evolution
NFT	Non-fungible token
OLED	Organic light-emitting diode
SIN	Science and Innovation Network
UGC	User generated content
VTubers	Virtual YouTubers



1. Introduction

1.1 Innovate UK and the Global Expert Missions

Innovate UK supports business-led innovation and is part of UK Research and Innovation (UKRI)¹. UKRI convenes, catalyses and invests in close collaboration with others to build a thriving, inclusive research and innovation system. To this end, Innovate UK helps businesses to identify the commercial potential in new technologies and turn them into new products and services that will generate economic growth and increase productivity. With a strong business focus, Innovate UK drives growth by working with companies to de-risk, enable and support innovation.

As innovation is increasingly a global endeavour and the ambition of UK businesses to become truly international enterprises is at its highest, Innovate UK established its Global Expert Mission (GEM)² programme in 2017. Delivered by Innovate UK KTN, in partnership with the FCDO Science and Innovation Network (SIN)³, GEMs help further Innovate UK's global strategy by providing the evidence base for where it should invest and by providing the opportunities for UK businesses to build partnerships and collaborations with key economies.

1.2 Mission Overview and Objectives

Innovate UK's Audience of the Future (AotF)⁴ Challenge Fund brings creative businesses, researchers and technology experts together to create striking new experiences that captivate the public. Those funded through the challenge will adopt, exploit and develop immersive technologies to create new products and services. The challenge captures new global audiences and will grow the UK's leading market position in creative content, products and services by adopting, exploiting and developing immersive technologies.

The challenge has invested £39.3 million in the development of new immersive technologies such as virtual, augmented and mixed reality. It has also commissioned research to better understand audiences for immersive productions in the fields of art, culture, heritage and entertainment.

The GEM to Japan is part of a series of international activities building on the AotF Challenge activity.

1.3 Mission Scope and Objectives

The Immersive Technologies GEM to Japan in June 2022, funded through the AotF Challenge, invited a group of UK experts to meet private and public sector organisations in Japan to better understand the immersive technologies landscape and help benchmark against UK capability.

The mission predominantly explored the creative industries, and cross-sector applications of enabling technologies, such as:

- Augmented reality (AR)/virtual reality (VR)/mixed reality (MR)/extended reality (XR).
- Haptics, sonics and other sensory interfaces.
- Advanced visualisation and display technologies.
- Artificial intelligence (AI) and fifth generation (5G).
- Real time and associated production technologies.

Built around UK business, policy and research representation, the mission aimed to:

- Determine how Innovate UK can best support UK businesses more effectively and efficiently when considering partnerships with Japan.
- Provide insights into synergies between the two countries in immersive technologies and determine whether there is appetite for further collaboration.
- Identify and showcase key market opportunities in Japan for innovative products and services to UK businesses that may be interested in collaborating with Japan.
- Capture key UK research and innovation (R&I) and market opportunities/challenges for developing innovative products and services when considering collaboration with Japan.



Dinner at British Embassy in Tokyo for UK delegation and Japanese stakeholders

2. The Immersive Technology Market in Japan

The domestic market size of the XR and immersive video market in Japan was estimated at a value of approximately \$2.8 billion in 2019 and is forecast to reach close to \$11 billion by 2051⁵.

This growth will be driven by Japan's adoption of 5G wireless technology, increasingly diverse applications for VR/AR technologies and strong government support. The Japanese government is a strong advocate for new technologies; the Ministry of Economy, Trade and Industry provides grants for content creators that leverage advanced content creation technologies, including VR/AR, to promote products, services or tourism.

Japan is a world leader in technology, and gaming in particular, with a long history of pioneering and developing video game hardware and software. Japan's online games market reached JPY 1,127 billion in 2017 (\$10 billion), accounting for about 70% of the entire domestic games market. According to Electronic Entertainment Design and Research's Insights Reports, the average revenue per paid user per month on mobile games is \$24.06 for Japan, \$12.83 for South Korea, \$6.61 for North America and \$2.88 for China⁶. The growth of online game platforms is augmented by Japan's mature gaming market. Most consumers already have access to mobile gaming infrastructure, with an almost 91% penetration of smartphones in Japan.

In addition to gaming and entertainment purposes, VR/AR technologies are starting to find applications in experiential/training purposes (mainly VR) and navigation (mainly AR) across a range of industries such as healthcare, tourism, retail, education, real estate, defence and manufacturing.

Japan's adoption of 5G wireless technology, strong government support and an increased range of applications for VR/AR technologies will fuel the growth of this sector. The AR/VR-related market spending in Japan is expected to grow from \$1.29 billion (JPY 140 billion) in 2018 to \$3.42 billion (JPY 370 billion) in 2023. The compound annual growth rate from 2018 to 2023 is predicted to be 21.5%. By sectors, the consumer sector is expected to be the largest market in 2023 at \$1.16 billion (JPY 130 billion) in 2023, while the distribution and service sector is expected to follow at \$1.08 billion (JPY 118 billion)⁷.

2.1 Hardware Overview

The growing success of VR is primarily attributed to Japan's gaming culture, followed by enterprise use cases. Japanese hardware providers are limited, but include Sony PSVR, Toshiba Enterprise Smart Glasses, Canon MR HMD and Epson Smart glasses.

Japan is also a strong contender in the chip market, with Japan's ARM chips powering mobile and standalone XR devices, aiming to vastly improve visual fidelity and device performance such as power savings.

2.2 Software Overview

Japan has a vibrant market for immersive technology software providers, which include solutions around networking for massively multiplayer experiences, VR creator toolkits, and audio and video solutions for remote meetings (telepresence and productivity).

Further software innovation is needed to unlock the application of immersive technology in robotics which can be applied beyond predictable environments.

While there is a robust software ecosystem, the challenge is around a shortage of immersive technology skills and awareness in the market to adopt and drive the growth of the industry.

2.3 Ecosystem Overview

The Future Tech Hub is the sole incubation facility for VR/AR area startups. They are highly active in tracking and supporting the development of the XR ecosystem in Japan. Activities include community support, events, an accelerator programme, seed investment in startups and international networking activities.

XR Consortium is Japan's representative XR industry group and is a point of contact both within and outside Japan. Figure 1 below provides an overview of company members of the XR Consortium⁸ in the immersive technology market in hardware, business development, software, content/service development for consumers and businesses, and consulting.



Figure 1: Japan XR Consortium member companies across the ecosystem (source: XR Consortium)

2.4 Primary B2C Use Cases in Japan

2.4.1 VTubing

In Japan, the primary consumer XR use cases are VTubing and gaming. There are over 9,000 VTubers in Japan, with the top ten YouTube Super Chat World Ranking⁹ spots frequently occupied by many Japanese VTubers. Some of the strongest indie intellectual property developers include Thirdverse, MyDearest, AMATA, and Gemdrops. Major studios such as Capcom, Bandai Namco Entertainment and Sony are actively developing XR content pieces. The primary platforms for distribution include Meta, Sony and Steam. Figure 2 is from the XR Consortium's presentation on the XR ecosystem in Japan.

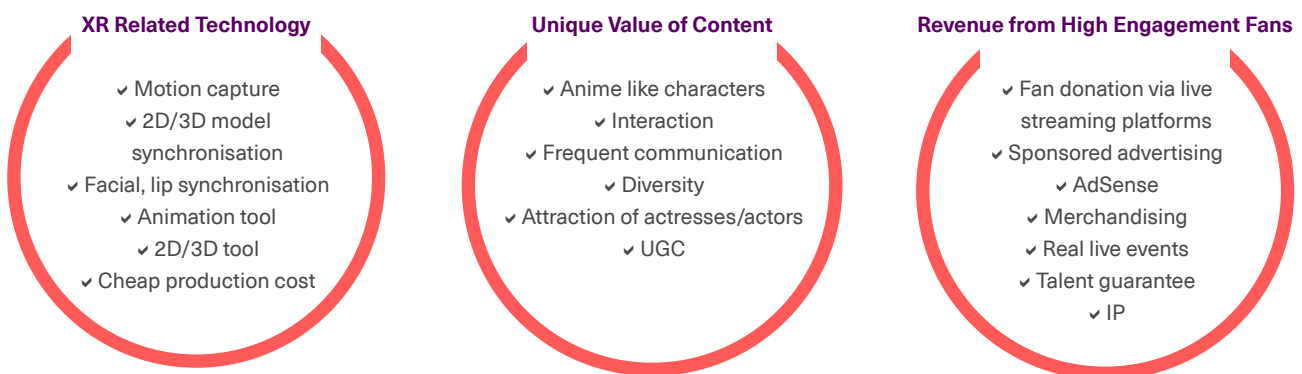


Figure 2: Key areas of XR activity in Japan (source: XR Consortium)

2.4.2 Location based entertainment

Location based entertainment (LBE) has been successfully commercialised in Japan with [teamLab](#)¹⁰ offering numerous case studies across a number of their semi-permanent digital installations. The locations include permanent installations in Osaka, Tokyo, Fukuoka, Singapore, Shanghai and Macao and single-item exhibits in New York, Shanghai, Kuala Lumpur and Singapore.

teamLab's Borderless¹¹ experience in Tokyo has, since 2018, become the most visited museum dedicated to a single group or artist, as recorded in the Guinness World Records, with just over two million visitors in 2019. The success of this model has led to teamLab opening numerous exhibitions across Japan and the world.

2.4.3 Music

The pandemic fuelled interest in music and the metaverse in Japan, accelerating the music industry's timeline to explore emerging technology to reach new audiences. This was catalysed by the artist and industry side of the market, with major companies actively investing in emerging technology solutions for their artists to reach new, digital audiences.

Highlights include interest in non-fungible tokens (NFTs) and VR content studios. Rakuten¹², a Japanese company which can be thought of as the Amazon of Japan, is working on 5G, investing in cloud tech, metaverse startups, and accelerator programmes. Line¹³ is another company with a huge digital influence as the biggest mobile app in Japan (the Japanese WhatsApp) with 90% market penetration, and a heavy focus on 5G mobile applications.

Surprisingly, music streaming and subscriptions have only been present in Japan for approximately four years. Domestic IP is under capitalised, and consumers still buy CDs. There is a significant opportunity to recreate the consumer experience in the Japanese music industry with emerging technologies and use cases. Additionally, there is no spatial audio sound studio in Japan outside of Sony's private studios, which presents an enormous opportunity for the UK to act as a supplier to the music market, and XR market for immersive spatial audio applications.

2.4.4 Digital twinning

Based on the examples discussed, digital twinning in Japan is B2C, with brands endorsing digital twin projects to enhance their relationship with consumers. Digital twins act as a way to augment physical real-world consumerism through shopping (transacting), scaling (shared experiences) and socialising (interacting), and was referred to by several Japanese stakeholders as a growth market, with the examples of Virtual Shibuya and a personalised shopping experience from Nike.

2.5 Primary B2B Use Cases in Japan

Japan has extensive B2B use cases for XR. These include physical training¹⁴, retail applications, marketing, healthcare and other applications.

2.5.1 Simulation and training

The future of work is a core focus in Japan with the goal of advancing capabilities around remote work and collaboration. In Japan, AEON¹⁵ retail stores adopted the VR training platform InstaVR for their employees. Established in December 2015, InstaVR is a VR startup that supports content production, distribution, and analysis to promote business use cases of VR¹⁶.

2.5.2 Marketing

There are a number of large-scale marketing collaborations taking shape between a creative studio and a larger company. XR Fair Tokyo¹⁷ was funded by NTT DOCOMO¹⁸, a Japanese mobile phone operator, as a part of their 5G initiatives¹⁹. Additional marketing opportunities between Japanese XR companies and telecoms include Virtual Market by HIKKY, Virtual Shibuya by Virtual City Consortium, and XR Scope by PARCO, KDDI, and Psychic VR Lab. Clients for immersive marketing initiatives in Japan are primarily established companies showing a keen interest in the metaverse.

2.5.3 Healthcare

There is a mass market opportunity linked to Japan's ageing population, focusing on the use of XR for remote training, medical services, treatment, care and therapy. Artificial intelligence, embodied avatars, and haptics are key areas of study for the medical field (through NEDO). For more details on the healthcare market in Japan, please see the section on NEDO, under stakeholder meeting summaries.

2.5.4 Smart city technologies

With all the market opportunities, some of which are listed above, there is a general drive towards creating connected, efficient and productive cities domestically and in other countries where Japan sells technologies. Some companies such as Panasonic have completely realigned their entire business to capitalise on these market opportunities by developing and selling entire vertical niches with products, platforms and solutions of internet of things (IoT) devices and the infrastructure to run them to fulfil the needs of these next-generation future cities.

2.6 Entry and Growth Barriers in XR Market

2.6.1 General challenges in the global XR ecosystem

The wider global XR market is facing a much lower rate of adoption of head-mounted displays (HMDs) than expected. Companies must establish monetisation despite widespread market adoption being several years out. New business models are being established, particularly in the metaverse, which also faces challenges around standardised best practices and evolving regulations.

Hardware and graphics quality for enterprise use cases are still at an early stage, especially for certain activities such as remote settings for work, play, and collaboration where consumers expect high-fidelity content and interactions. Controls for HMDs are nascent, with challenges around handheld device variability.

Improved hardware, miniaturisation of devices, development tools and application stores will make product development and distribution easier. However, this is still early stage, alongside projection technology and spatial audio software that augments XR experiences.

2.6.2 Specific challenges to XR market in Japan

Japan is a relatively closed market due to cultural factors such as language barriers and entertainment preferences such as anime. For example, there is a focus on catering primarily to a Japanese audience, with VTubers creating animated content for a Japanese following. Language also presents the challenge of access to information and knowledge sharing between international and domestic stakeholders. While there is Japanese expertise in the XR market, it has yet to become globalised enough to be competitive internationally, and is at a very early stage.

Feedback from the organisations we visited, was that another major challenge to market growth in Japan is the acquisition of XR skills, and exposure to the technology to grow the XR base of skilled workers and creators to make content, technology, and business cases for XR.

While Japan's gaming market is strong and the primary driver behind XR adoption and awareness, it has been challenging for companies to monetise products and find appeal for mass adoption outside the entertainment sector. As a result, XR's primary use outside of gaming is in enterprise applications, and experiential marketing campaigns.

Due to Japan's early-stage VR hardware products, they are up against a much more mature market of international VR headsets, with leading foreign names such as Meta Quest and HTC VIVE being preferred by users due to device quality, compatibility, and the availability of content. Consumer adoption of new technology is also slower, as younger audiences primarily consume 2D content on YouTube.

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3 Innovation Landscape in Japan

3.1 Main Government and Public Bodies in Japan for XR Innovation

3.1.1 National institutes

The National Institute of Advanced Industrial Science and Technology ([AIST](#)) is one of Japan's largest public research organisations. It focuses on the creation and practical realisation of technologies useful to industry and society, and on bridging the gap between innovative technological seeds and commercialisation.

The National Institute of Information and Communications Technology ([NICT](#)) is Japan's sole national research and development agency specialising in the field of information and communications technology (ICT). NICT is charged with promoting the ICT sector as well as research and development, which drives economic growth and creates an affluent, safe and secure society. To enhance the research and development (R&D) of key technologies necessary for the smooth realisation of Beyond 5G, NICT launched the [Beyond 5G R&D fund](#) to support R&D projects of research organisations and make use of core facilities to promote R&D in the public and private sectors. The 2020 budget was JPY 50 billion.

3.1.2 Funding agencies

The following four funding agencies are responsible for allocating the majority of Japan's competitive public R&D funds²⁰:

1. **Japan Society for the Promotion of Science** ([JSPS](#)) has the largest budget and provides bottom-up funding through grants-in-aid for scientific research. It also offers both inbound and outbound fellowships to encourage international collaboration. JSPS's budget for the 2022 fiscal year totalled JPY 266.1 billion. This includes JPY 139.7 billion in subsidies for grants-in-aid for scientific research, JPY 0.7 billion for the Leading Initiative for Excellent Young Researchers programme and JPY 97.5 billion for a multi-year fund for grants-in-aid financed by the government²¹.
 2. **Japan Science and Technology Agency** ([JST](#)) provides top-down funding aimed at implementing national science and innovation policies. Its budget for FY 2022 is JPY 170.6 billion.
 3. **Japan Agency for Medical Research and Development** ([AMED](#)) funds integrated R&D in medicine, from basic research to clinical trials. Its budget is JPY 124.9 billion for FY 2022.
 4. **New Energy and Industrial Technology Development Organisation** ([NEDO](#)) provides funding for innovation and immersive technology in Japan. NEDO is affiliated with the Ministry of Economy, Trade and Industry (METI) and promotes R&D and commercialisation of industrial technologies. Its budget is JPY 197 billion for FY 2022.
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3.1.3 Universities

Public sector research is conducted in dedicated research institutions and higher education institutes. There are 86 national universities, 93 public universities and 607 private universities in Japan.

Japan also has 27 national research institutions. Each institution is under the jurisdiction of a ministry and is expected to serve as a base for open innovation supporting national and societal needs²².

The two primary universities in Japan driving XR research, innovation and international collaborations are the University of Tokyo and Osaka University.

3.2 Japan Science and Innovation Priorities and Policies²³

3.2.1 6th Science, Technology and Innovation Basic Plan

Japan's 6th Science, Technology and Innovation Basic Plan, launched in March 2021²⁴, is the central, strategic science plan agreed upon by the Cabinet Office, setting out Japan's priorities for 2021-25.

The plan aims to realise Society 5.0, defined as 'a human-centred society that achieves both economic development and solutions to social issues through a system that highly integrates cyberspace and physical space'.

The key three pillars of the policy are: transformation into a sustainable and resilient society (social structural reform premised on the use of digital technologies), creation of "knowledge" (strengthening research capability), and development of human resources (strengthening of the "ability to explore ideas" and "a continuous learning mindset").

3.2.2 Moonshot Programme

In January 2020, the Government of Japan announced nine Moonshot Goals²⁵ it hopes to achieve by 2050. The projects are in the fields of cybernetics, preventative medicine, autonomous robotics, food production systems, sustainable resource circulation, quantum technologies, healthy ageing, weather control and mental health.

3.2.3 SIP Programme

The second five-year phase of the Cross-ministerial Strategic Innovation Promotion Programme (SIP)²⁶ started in 2018 and is expected to have a total budget of around JPY 150 billion. SIP covers 12 projects in fields such as cyber security, autonomous vehicles, disaster resilience, and decarbonised energy systems.

3.2.4 WPI Centres

First established in 2007, the World Premier International Research Centre Initiative²⁷ aims to establish globally competitive centres of excellence that will attract top researchers from around the world. Hosted by universities and national research institutes across the country, there are 14 centres, each receiving annual funding of JPY 700 million to JPY 1.4 billion for 10-15 years. The working language at WPI Centres is English and around 40% of researchers are from overseas.

3.3 UK and Japan Science and Innovation Cooperation

The UK is Japan's fourth biggest collaborator in scientific research, while Japan is the UK's fourteenth. The quality of UK–Japan research is 3.5 times the world average (measured by field-weighted citation impact), higher than with the US, Germany or China for both countries. In specific fields such as medicine, the quality of UK–Japan research is over 6.5 times the world average. Other fields with very high-quality collaborative research are immunology and microbiology; environmental science; social sciences; biochemistry, genetics and molecular biology; neuroscience; earth and planetary sciences; physics and astronomy; engineering; and agriculture and biological sciences²⁸.

In FY 2019, UK researchers were the fourth largest group of visiting researchers to Japan (after China, the US and South Korea), accounting for 4.6% of the total. The UK is the second most popular destination for Japanese researchers on mid to long-term overseas placements (9.7% of the total)²⁹.

Research in Japanese culture is prestigious. However, today there is a greater push for tangible IP in the market rather than pure research-oriented goals. Previous collaborative R&D programmes such as EUREKA Globalstars Japan can be referenced as a successful funding mechanism for research between Japanese and UK companies.





4 Summary of Stakeholder Meetings

4.1 Private Sector

4.1.1 Panasonic

Panasonic is the principal brand name of the Japanese electronics manufacturer Panasonic Corporation. They have five main areas of focus: smart mobility, sustainable energy, immersive experiences, integrated supply chain, and consumer lifestyle.

As of April 2022, Panasonic Group was segmented into several entities under one parent group to improve efficiency in each business vertical. Their business structure is segmented into verticals that are responsible for specific offerings such as AR/VR, entertainment, automotive (simulations), healthcare and wellbeing. The structural changes reflect the company's market push towards providing and supplying core and enabling technologies and technology stacks into smart city developments and environments. These business segments are geographically focused and include, but are not limited to: smart building and housing; smart energy infrastructures; smart domestic and entertainment technologies; smart commercial appliances and white goods; and smart heating and cooling systems and infrastructure.

Panasonic's XR endeavours are at an early stage, with initial distribution intended for the domestic market, and business development with Chinese companies. Core features of their headset include high resolution capable of displaying HDR images, ease of use, miniaturisation (lightweight and small form factor), spatial audio, 6DoF, 5G compatibility, a micro OLED display with a pancake lens, and Qualcomm chips³⁰. Commercialisation is planned for later this year in the domestic market.

To showcase Panasonic's target to achieve the ideal society within 250 years, the company opened Mirai Ward (Mirai Business Solutions) to enable its business-related customers to experience demonstrations of its related emerging technology. The showcase included mobility services, accessibility-enabling tech, autonomous vehicles, virtual production stages, projections for design and simulations (used to streamline the construction process), and holographic displays.

Panasonic is heavily invested in the digitisation of processes, and UN Sustainable Development Goals, as NEDO and Panasonic work together closely for R&D funding from the government for projects aligned with Japan's sustainability and environmental goals.

Panasonic's typical timeline to integrate technology into the market and cities is approximately five years from product ideation to deployment. They believe gaming and metaverse applications are the leading drivers of adoption of XR in the Japanese market, noting that the Japanese XR market is very nascent, and companies and industries are segmented. Overall, Panasonic is exploring XR to unlock new revenue streams.

4.1.2 Future Tech Hub

Future Tech Hub is an incubation and coworking facility for VR startups. Future Tech Hub is willing to host UK startups. Tokyo XR Startups is Japan's first VR/AR startup support programme. In partnership, they have access to a strong community of VR developers, designers and entrepreneurs, curating an environment for VR startups to thrive. Future Tech Hub facilitates seminars and meetups, accelerator programmes, and international networking. There are 98 companies in the XR Consortium connected through Future Tech Hub. A number of these companies are established XR consultancy firms that mostly serve larger private companies in the domestic market. The consultancies expressed an interest in learning about new technologies, insights and XR solutions in the UK market that they can present to their domestic clients.

4.1.3 Virtual City Consortium

The Virtual City Consortium is formed by KDDI Corporation, Tokyu Corporation, Mizuho Research & Technologies Institute, Inc., and organised by Future Design Shibuya Co., Ltd. Their primary goals are to develop a case study around a Japanese metaverse and to establish best practices and guidelines for the wider industry.

The consortium representatives view the metaverse as a space where users can embody avatars for a virtual online social experience – a digital space that is becoming more like the real world and society (commerce, culture, trade). As the real world and metaverse intersect, they predict consumers will spend more time in the metaverse. Current challenges to unlocking this vision include the standardisation of business models, interoperability, and accessibility of quality content.

The consortium observes that online games in Japan are beginning to look more like spatial social media platforms, but there are still limited virtual spaces for metaverse socialisation. Factors accelerating the adoption of metaverse-like platforms include the increasing demand for digital fashion to dress virtual avatar representations.

As a part of their collaboration, the consortium created Virtual Shibuya, a digital twin of the physical location. It attracted over one million visitors during the pandemic in 2020. Ten percent of visitors were international due to the US Embassy tweeting about Japan's virtual Shibuya Halloween event.

The consortium views digital twins as a way to augment physical, real-world consumerism through shopping (transacting), scaling (shared experiences) and socialising (interacting).

KDDI, a telecommunications giant in Japan, funded Virtual Shibuya as a case study for the metaverse and 5G. They use the virtual world for virtual concerts, special events, and recruiting. When revenue is generated from Virtual Shibuya, a portion is donated to the physical district to strengthen ties between the digital and physical spaces.

In Japan, interoperability discussions have only just begun. As Virtual Shibuya is owned by KDDI, a telecommunications company, they are exploring business models around charging users per gigabyte they consume – enabling “gig” gifting tokens where consumers can purchase gigabytes to gift to their peers – as a part of their product offering; a unique approach in this space.

The consortium’s goals:

- To increase the number of XR creators to boost the availability of user generated content (UGC).
- Create new IP opportunities with avatars and digital spaces.
- Raise awareness of the metaverse for B2B stakeholders and consumers.
- Develop case studies and guidelines around online moderation.
- Participate in the discussion around standards for interoperability and new business models for the metaverse.
- Increase skills in the XR space (3D).
- Collaborate with companies that make UGC more accessible to independent creators, such as Ready Player Me as an avatar solution.

4.1.4 Psychic VR Lab

Psychic VR Lab’s mandate is to make it easy to showcase XR content. They provide an easy-to-use no-code VR creative platform called STYLY that specialises in lifestyle content such as fashion, art, culture, business, and music. A part of their core offering alongside STYLY is their XR distribution platform. Core features include a gallery to upload existing XR works, and an XR studio tool to create and edit VR and AR content.

As of June 2022, STYLY reports 45,000 accounts and five million downloads. The software is free to creators who use it to showcase their content, whereas enterprise users are required to pay a fee for the product. Psychic VR Lab is seeking creators to use their toolkits and festivals to showcase content made using their tool. Their goal is to connect artists with AR and VR by removing the barrier to entry with an easy-to-use toolkit, train and educate XR creators to encourage XR adoption and market growth, and unlock new economic value outside of the saturated 2D streaming market.

Psychic VR Lab also runs the NEWVIEW Awards that showcase XR creators from around the world. The event includes a cash prize of JPY 3.5 million and the opportunity to showcase in a major department store in Shibuya, Tokyo. In its first year in 2018, it attracted 152 pieces of work from 15 countries, and, most recently, 666 works from 39 countries.

In order to connect the local and international XR community, Psychic VR Lab is creating an XR Lab, a physical venue in Shinjuku that offers services, devices and hardware, and coworking space for the community at the intersection of art, film and XR. Their plan is not just to connect locally in Japan but globally, providing an opportunity to bring works from the UK.

4.1.5 CinemaLeap

CinemaLeap, founded in 2019, produces and distributes VR as well as vertical format movies for smartphones. A part of their core offerings is VR animation services, hand tracking for interaction, and haptic device integration into XR narratives to add physical sensation to immersive storytelling.

Their primary areas of focus are 6DoF XR and 2D short films, created with funding support from the Culture Agency in Japan, private sector companies, the film industry, and some subsidies from the Japanese government. Their goal is to produce Japanese content for domestic and international audiences, and support the distribution of international XR content in the Japanese market.

CinemaLeap runs Beyond the Frame Festival, Japan's first international film festival focused on VR that takes place online and is available in Japanese and English. The primary XR curator contact in the UK is Liz Rosenthal, who can assist UK XR content creators interested in being featured in Beyond the Frame Festival. The festival already collaborates with foreign nations, such as France, where a competition is held for French projects, and winners are featured in the final showcase.

4.1.6 Mogura VR

Mogura VR is a media company that publishes news and information about virtual reality. Approximately 1.2 million visitors are reported to visit their publication every month. Mogura VR is the biggest XR publication in Japan, covering business and entertainment. They have a consulting business unit that primarily works with large businesses, advising them on the approach and development of their XR strategy. The media company identifies VTubers and gamers as the primary news source for the broader public in Japan, with the majority of international XR news in Japan coming from the US.

Mogura VR's goals are to act as an XR and metaverse hub that consists of information, a physical venue, and an industry network. They conduct research to inform the XR ecosystem and the wider market on key trends and insights in the XR market. While language barriers present a challenge for knowledge transfer and exchange, Mogura VR captures information on the Japanese market that can be relevant to informing UK companies. Mogura VR hosts XR conferences and exhibitions in Japan, which can act as an opportunity for UK companies to connect with the XR market.

4.1.7 Odakyu Electric Railway Company

The Odakyu Electric Railway Company is a major railway company based in Tokyo. The Odakyu Group, of which the railway is a subsidiary, comprises 100 companies in the areas of transportation, merchandising, real estate and other businesses.

The Odakyu Electric Railway Company sees XR as an opportunity to promote local and international tourism in Japan. The company owns numerous physical properties, including hotels, buses, real estate, railways, a merchandising business, and the XR Lab.

The XR Lab is an art and film experience centre where creators can produce content and present their work. The venue features international XR works, hardware, coworking, seminars, and hackathons, playing a key role in identifying use cases locally, before budgets are approved to expand the adoption of XR in the wider market for specific use cases.

As a private entity, the railway is focused on the application of XR in public spaces. Based on real experimentation and case studies, they have established a timeframe of two to three years of commitment to XR R&D to create content and develop best practices for location based virtual reality (LBVR), before exporting it to the wider market.

The Odakyu Electric Railway Company's XR goals are to enhance, expand and market their offerings by using XR for community building, the promotion of tourism, upgrading physical locations with XR experiences, and ameliorating the commuter experience.

Primary case studies include showcasing AR in public spaces to transform them into tourist attractions. Content is developed to educate younger audiences about Japanese cultural heritage by extending AR experiences from the XR Lab to Japanese cities, much like the UK's AotF [Wallace and Gromit AR experience](#).

The market opportunity identified by the Odakyu Electric Railway Company is leveraging XR as a sales mechanism for physical merchandise, one of their primary business endeavours, and as a promotional tool to capture and grow the tourism market in Japan.

4.1.8 Aroma Bit

Aroma Bit's primary business domains are in developing, producing and selling equipment and systems including compact odour imaging sensors, and producing, developing, and selling innovative services using sensory products. For example, they offer an ultra-compact scent imaging device that captures data on scent using proprietary receptors. While Sony invested in Aroma Bit early on, 30% of Aroma Bit's customers are international.

Aroma Bit views digital olfaction as comprising three main product areas: data, sensory systems, and sensory devices. Their goals are to visualise the world of aroma through imaging technology as a part of the health and wellbeing market, become the Google for scent, and bring objectivity to scent through data.

Market opportunities include quality control, R&D around olfactory use cases, supply chain management, agriculture, ambient scent monitoring for mobility and transportation, security, smart factories, multisensory ecommerce (scent prior to purchase) and scent visualisation. Academic partnerships around allergy and product research play an important role in developing their products and identifying new market opportunities.

4.1.9 Music Ally

[Music Ally](#) is a knowledge and skills company aiming to help the music industry understand the power of digital trends and tools to build sustainable careers across the globe. The company publishes reports in English, Japanese and Chinese, organises conferences, and works with global artists. It provides insights into best practices and effective strategies to grow and monetise successfully in the global music industry.

4.2 Public Sector

4.2.1 National Institute of Information and Communications Technology (NICT)

The National Institute of Information and Communications Technology (NICT)³¹ is Japan's primary national research institute for information and communications.

5G testbeds in Japan are undergoing feasibility studies for evaluation. The primary use cases for 5G have been identified as data and cloud services, network radio testbed applications, simulator and emulator applications, middleware test beds for digital twins (simulations), communications, data collection with sensors (IoT), big data (predictive analytics), and artificial intelligence.

The testbeds are allocated as a public infrastructure, meaning the NICT has created an application programming interface (API) for third parties to create applications on top of the existing infrastructure. Their goals are to unlock new commercial opportunities based on advances in 5G, AI, data, and cloud computing. Japan's 5G bodies already collaborate with the EU, US, and ASEAN on research, and there is an opportunity to replicate these collaboration models with UK stakeholders. IP is created on an individual project level as a part of the NICT, and contracts are created on a case-by-case basis (in the case of collaborative research projects).

NICT has Memoranda of Understanding (MoU) with four UK universities and is open to establishing further agreements.

4.2.2 New Energy and Industrial Technology Development Organisation (NEDO)

New Energy and Industrial Technology Development Organisation (NEDO) is a national research and development agency that promotes the technological development necessary for the realisation of a sustainable society. NEDO acts as an innovation accelerator to contribute to the resolution of social issues by developing and demonstrating high-risk innovative technologies with practical applications.

NEDO is Innovate UK's primary innovation partner in Japan. Three UK–Japan collaborative projects were funded through the Eureka GlobalStars Japan R&D Call in 2020. The call was co-funded by Innovate UK and NEDO.

NEDO's projects range from mid to long term. They begin with information gathering and roadmapping, followed by strategy and planning in years one and two, technology development and demonstrations in years two to six, and a review in year ten. All technological development is coordinated around standardisation which means that all stakeholders must adhere to specifications prescribed by NEDO.

NEDO is prioritising solutions for automation and remote capabilities due to the labour shortage in Japan, and an ageing population. Members of the workforce are leaving their jobs to care for the elderly, creating an urgent demand for innovation in the areas of remote controls, autonomous systems, wholesale, retail, nursing/healthcare, and the service industry. In these use cases, technology is directly interfacing with a vulnerable population, and therefore, NEDO is interested in using AI to identify and even exaggerate human emotions to ensure clear communication between individuals and remote service providers.

NEDO's goal is to create business opportunities based on innovations in their primary areas of focus. While interested in entertainment, it is not a priority or their primary mandate. NEDO's funding scheme is centred on supporting Japanese businesses, the maintenance and enhancement of industrial competitiveness, cross-industrial cooperation, technological integration, international cooperation, creating scalable solutions using AI, developing multimodal XR AI platforms for telerehabilitation and health care provision, and furthering haptic integrations for rehabilitation and healthcare.

For example, one of NEDO's projects aims to create a bidirectional remote haptic conveyance system using ultra-thin haptics where a remote doctor can palpate using a remote interface. The same motion is performed by a robot arm, with emotional reactions monitored using AI systems. The same devices can be used for remote communications, signalling and training which they call "social signal haptisation".

NEDO's use of AI aims at updating care through emotional analytics, basing intervention on estimations of mental and physical states via constant measuring and a detailed evaluation of physical functions by a Mode Register 3 device. Embodied avatars are also a key area of R&D for novel remote communication. They aim to propose a method for automatically generating the emotional movements of avatars using what they call "Motion Unit AI" to apply real-time character animations.

NEDO is also developing LTE/5G drones mounted with sensors for remote control use cases, digital twin environments based on multimodal information from drones, AI to detect abnormalities and predictive behaviours, and XR for remote training and collaboration.

In 2021, NEDO selected five projects for funding. By 2024, they hope to achieve the development of the foundational technology and, by 2035, to have their solutions for automation and remote collaboration integrated across various applications in society.



Annex 1 – List of UK Participants

Edify

FCDO SIN Tokyo

Goldsmiths, University of London

Innovate UK

Innovate UK KTN

Prox & Reverie

VividQ Ltd

Wysa/XRHA

XR Stories

Annex 2 – List of Japanese Participants

Aroma Bit

CinemaLeap

Future Tech Hub

Mogura VR

Music Ally

National Institute of Information and Communications Technology

New Energy and Industrial Technology Development Organisation

Odakyu Electric Railway Company

Panasonic

Psychic VR Lab

Virtual City Consortium

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