CoSTAR
THE UK R&D NETWORK FOR CREATIVE TECHNOLOGY

UKRI Arts and Humanities Research Council

ForesightLAB

UK Innovation in Immersive XR Technologies for screen, performance and digital entertainment: UKRI funding trends and insights (2006–2024)

A Foresight Lab Report

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The CoSTAR Foresight Lab

Driven by the UK's leading Creative Industries experts, the CoSTAR Foresight Lab is researching the adoption, use and impact of new, emergent and convergent technologies in gaming, TV, film, performance and digital entertainment.

Our findings will inform research, development and innovation across the Creative Industries, including the R&D taking place through the convergent screen technologies and performance in real time (CoSTAR) programme, the UK R&D network for creative technology.

CoSTAR is a £75.6 million national R&D network of laboratories that are developing new technology to maintain the UK's world-leading position in gaming, TV, film, performance, and digital entertainment. Delivered by the UKRI Arts and Humanities Research Council, the programme is supporting new innovations and experiences that will enrich the UK's creative industries, economy, and culture. The network comprises the National Lab, the Realtime Lab, the Live Lab, the Screen Lab and the Foresight Lab. CoSTAR is funded through UK Research and Innovation's Infrastructure Fund, which supports the facilities, equipment and resources that are essential for researchers, businesses, and innovators to do groundbreaking work. You can find out more by visiting www.costarnetwork.co.uk.

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ABOUT THIS REPORT

This report provides a benchmark for the state of play of UK Research and Innovation (UKRI) investment into XR technologies for screen, performance and digital entertainment at the close of 2024, against which the future effects of the Convergent Screen Technologies and Performance in Realtime (CoSTAR) Network activities can be compared. In providing an overview of the funding context of UK-based XR activity before the intervention of the CoSTAR Network, in similar and adjacent spaces to CoSTAR, the report functions as a baseline view of the funding context to track key trends in funding allocations and funded XR activity, to quantify investment in the space as a first step to demonstrating results of the investment, and to identify knowledge gaps in the investment history of UK-based XR activity.

EXECUTIVE SUMMARY

- UK Research and Innovation (UKRI) funded 529 projects involving immersive technologies for screen, performance and digital entertainment between 2006 (when their digital records began) and 2024.

Funding

- The 529 projects received £231,159,278. From the beginning of 2017, when the number of XR projects funded by UKRI increased, 473 projects received £208,786,270. Since 2017, XR projects have received approx. 0.33% of UKRI's budget each year.
- The funding of extended reality (XR) projects for screen, performance and digital entertainment increased significantly from 2017 onwards.
- Innovate UK was the largest funder by value within UKRI providing 40.76% of the total funding for XR projects (based on UKRI data).
- There were 35 XR projects awarded over £1m and these took the form of large, collaborative R&D projects and resourcing for training, infrastructure and the development of new technologies to support XR work.

Organisations involved in XR activity

- There were 302 lead organisations of the 529 XR projects.
- The top 11 locations for lead organisations of UKRI-funded activity were London, Bristol, York, Manchester, Birmingham, Brighton, Glasgow, Nottingham, Newcastle, Belfast, and Guildford.
- London was home to the highest number of lead organisations of UKRI-funded XR activity, and Bristol home to the second highest.
- 152 projects (29%) had lead organisations based in London, which is fewer than expected given previous reporting and expectations of London being central to the Creative Industries.

- 860 organisations collaborated on the 529 projects (686 based in the UK, 119 outside of the UK, and 55 with locations unknown).
- China and Hong Kong were the most frequent international collaborators (41 organisations) but this trend seems to be in decline.
- Policy drivers concerned with the Creative Industries have played a significant role in the distribution of funding across the UK.

Networks of collaboration

- The development of ecosystems is important in providing the necessary conditions for successful creative work.
- The most frequent lead organisations in UKRI-funded XR projects were Higher Education Institutions (HEIs).
- Most collaborating organisations were drawn from a mix of HEIs, media production and software companies, and cultural and heritage infrastructure.
- Networks of organisations were important, often led by HEIs but connected by anchor institutions like the BBC and BFI.
- The BBC was an important actor in collaboration networks for UKRI-funded XR activity.
- Cross-sector collaboration is an important factor in the success of XR activity.
- HEIs play an important role in leading cross-sectoral innovation.

Spotlight on UKRI-funded virtual production

- 38 of the 529 projects focused on virtual production (VP), with those projects starting between 2014 and 2024.
- The 38 VP projects were awarded £99,628,402 in funding, which is 43% of the total XR funding for this period.
- There has been cumulative investment by UKRI in VP technologies, wider XR technologies and the place-based ecosystems required to utilise them.

Trends in XR activity

- Predictions are that the value of the XR sector will only increase in the next five years and investment will therefore need to be maintained to ensure innovation support.
- There was a notable focus on heritage use cases.
- There was an emerging focus on artificial intelligence from 2017 onwards.

Conclusions

- Investment in all areas of creative R&D in the UK created the conditions for the CoSTAR Network and its labs.

Next steps

- Further work is needed to establish the economic and social impact of these projects.
- Future work by the CoSTAR Foresight Lab will include a mapping of university and industrial investment to complement this reporting.

CONTENTS

INTRODUCTION

This report expands upon existing mapping of Extended Reality (XR) activity in the UK to provide a benchmark for the state of play of UKRI investment in XR technologies at the close of 2024, against which the future effects of CoSTAR Network activities can be compared. XR technologies (see below for definition) bring together real and virtual spaces for a range of uses, one of which is across screen, performance and digital entertainment.

CoSTAR (Convergent Screen Technologies and Performance in Realtime) is the UK research and development (R&D) network for creative technology, a five-year project with five Labs around the UK, delivered by UKRI. The CoSTAR Network is designed to innovate across the UK's gaming, TV, film, performance, and digital entertainment sectors, with an initial focus on virtual production (VP) and, more widely, on XR. XR and VP technologies stand at a pivotal point (Willment et al. 2024, 2) and, therefore, an understanding of the conditions and activities that led to the creation of the CoSTAR Network is beneficial.

The 2023 'Virtual Production Ecosystem Mapping' report suggested that "[a] more exhaustive study into the VP ecosystem in the UK that builds on these findings, especially including more large commercial studios, will be beneficial" (Hitchen et al. 2023, 25). This work aims to go some way to addressing that by mapping UK-based XR activity, including VP, funded by UKRI between 2006 (when their digital records began) and 2024. The aim of this project is to ascertain what kinds of projects are being delivered and undertaken with VP and XR technologies in the UK in the areas of screen, performance and digital entertainment, who is doing that work, and emerging trends and priorities that will be of relevance over the next five to ten years and beyond.

The remit of the CoSTAR Network is gaming, TV, film, performance and digital entertainment sectors. XR and VP technologies are not unique to these sectors and have applications across, for example, healthcare, education, manufacturing and retail. This report focuses on XR and VP technologies implemented in similar contexts to those of the CoSTAR Network, which includes projects for the development of XR and VP technologies, projects that use these technologies for gaming, TV, film, performance, and digital entertainment purposes, across traditional media and performance spaces as well as in heritage and tourist spaces.

Extended Reality, or XR, is a term that describes the use of technologies to create integrative digital and physical environments. Extended Reality technologies encompass Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) and have implications across a wide array of sectors, including in media and performance, healthcare, education, manufacturing and retail.

Virtual Production, or VP, can be defined as "harness[ing] the power of virtualising technologies to create digital environments in, and through which film and television can be made" using "live action green/blue screen, entirely virtual worlds and LED volume[s]" (Willment and Swords 2023, 4). It employs the capabilities of recent advances in real-time computer game engine technology for use in the creation of games, film and television, such as the live-action series The Mandalorian (Thomas 2025) and the live show ABBA Voyage, in which digital avatars of the band's members performed on stage (Elliot 2023).

Research questions

This report asks, in a pre-CoSTAR UK landscape:

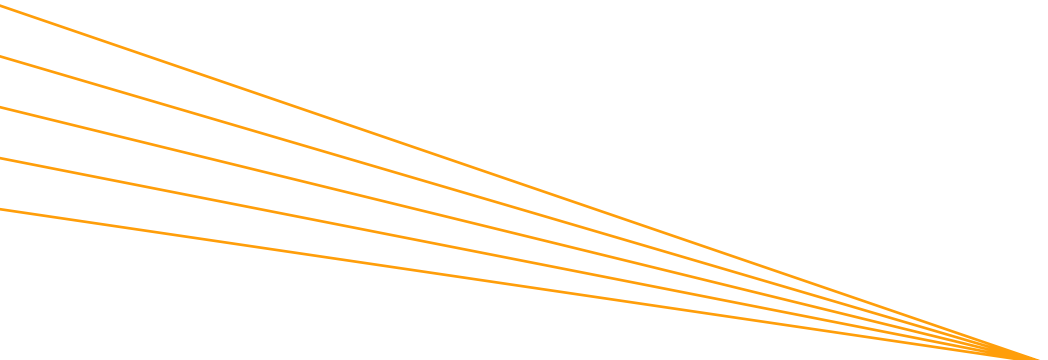
1. What did UKRI investment into XR innovation look like?
2. What was the timeline of UKRI-funded XR activity?
3. How much UKRI funding was allocated to XR activity?
4. What did the UKRI-funded projects look like?
5. Which organisations were leading and collaborating on those projects?
6. Where were those organisations located?
7. How much XR activity was specifically focused on Virtual Production?
8. What are the benchmarks of success for XR projects?
9. What trends can we identify that might shape the future of XR and VP?

Scope

Other reports on the immersive and XR sectors define their objects of study differently and use different methods to obtain data. Innovate UK reported that by 2018 there were 253 immersive technology projects funded by UK Research Councils (Kennedy and Stockley-Patel 2020). In 2019, Immerse UK and Digital Catapult used UKRI's Gateway to Research database to find over 500 immersive technology projects (Immerse UK and Digital Catapult 2019, 5). In 2021, work on 'createch' – a sector that overlaps with the immersive sector and is defined as "technological research and development activities by creative firms" – used machine learning methods on the same database and found 2542 createch projects by 4000 organisations (Mateos-Garcia 2021a, 3). These different focuses – on immersive technology versus createch – make direct comparisons difficult. Further, reports on specific technologies and uses of those technologies that fall under the immersive umbrella, as XR does, are even more specific, such as Hitchen et al.'s mapping of the emerging ecosystem of Virtual Production in the Creative Industries in a Virtual Production Capabilities Framework that captured 62 assets (Hitchen et al. 2023, 2). These previous mapping efforts will be used as points of comparison in this report, while being mindful of their different scopes and definitions.

This report focuses on UKRI-funded projects comparable to the types of projects that the CoSTAR programme will undertake and support. We therefore looked at all projects funded by UKRI that use immersive technologies (including VR, AR, XR, VP, MR and other technologies and media products described as immersive) for the purposes of gaming, TV, film, performance, and digital entertainment. Applications of these technologies for other purposes, for example, as educational tools or health and wellbeing aids, are therefore outside the scope of this report, but this work represents a blueprint for similar reports to be conducted in the future with additional focus areas.

The XR activity covered in this report extends from 2006, the year UKRI made their data digitally available, to projects that started in 2024. Projects with start dates of 2025 or later were not included as the aim of this report is to capture an understanding of the UKRI-funded XR landscape in the UK prior to the funding and development of the CoSTAR Network.



METHODS

With the scope of the project in mind – UKRI-funded projects involving XR technologies in the context of screen, performance and digital entertainment – this report was compiled using data from the UKRI database of all its funded projects since 2006: Gateway to Research (GtR).

The difficulty of quantifying the Creative Industries by sourcing and comparing accurate data is a known problem. Existing work aiming to "map UKRI's current portfolio of Creative Industries projects and to put a shape and, tentatively, a size on it for the first time" encountered challenges with matching research disciplines and Creative Industries sectors in the context of innovation funding (Smith et al. 2023, 6). To address these challenges, this report takes a hands-on approach to the data available via GtR, manually determining which projects align with our scope. There are further challenges around determining how much the UK invests in publicly supported R&D in the Creative Industries (Chitty 2023), which mean that comparing how much UKRI invests in XR versus other forms of innovation are outside of the scope of this report.

Key search terms were used to identify potentially relevant projects: 'virtual reality', 'virtual production' OR VP, 'extended reality' OR XR, immersive, 'game engine' and 'augmented reality'. For all of the projects returned using these key word searches the description of each project was checked by the research team to verify its relevance. We defined a project as being in scope if it mentioned the use of developing immersive technologies for the purposes of screen, performance or digital entertainment or a direct application of immersive technologies for those purposes. Some of the projects extended to infrastructure, such as labs, facilities and research programmes, and some involved applications of XR technologies for a specific use case, such as the creation of a site-specific museum exhibit.

These types of activity could be referred to more broadly as 'immersive'. However, in this report we opt for the term Extended Reality and, where relevant, Virtual Production since the term 'immersive' has multiple meanings. For example, immersive theatre refers to a reconfiguring of the interactions between audience and performers rather than the use of any specific technologies. In compiling our dataset, we found that the search term 'immersive' yielded relevant projects but also many out of the scope of this report.

For each relevant project we identified, data on 19 metrics was collected (project title, lead organisation, funded value, description, etc.). We augmented the dataset with annotations on four further criteria: whether each project description mentioned sustainability, equality, diversity and inclusion (ED&I), artificial intelligence (AI) or heritage. We also enriched the dataset by, for example, adding the associated location (city) and type (using UK Government Standard Industrial Classification codes) for each organisation mentioned as a lead or collaborator in the XR projects.

Limitations of the data

Although the Gateway to Research database is a convenient source of funding data, it should be emphasised that it only contains data about UKRI-funded projects, and that other organisations in the UK also fund XR activity, such as Arts Council England, Arts Council Wales, Creative Scotland, Digital Catapult, National Lottery Heritage Fund, Research England and Wellcome Trust, as well as the higher education sector, and industry. XR activity funded by other bodies will be addressed in a forthcoming report.

Limitations also arise from how funding schemes within UKRI are presented in the GtR database. Each project is listed as being funded by only one scheme despite there being crossover between them. For instance, the Industrial Strategy Challenge Fund (ISCF) was a scheme that included funds from both Arts and Humanities Research Council (AHRC) and Innovate UK but projects are listed on GtR as being funded by only one of the three schemes. This makes it difficult to assess and compare the role that each funding scheme within UKRI had in supporting XR activity. (A full list of individual funding schemes can be found in the Appendix.) The data presented in this report reflects the data available through Gateway to Research and we acknowledge that it may not convey the complexity of the funding situation. This makes comparisons between funding schemes within UKRI difficult, for example, using just the GtR figures, we cannot categorically say which funding schemes awarded the most amount of money to XR projects between 2006 and 2024, and so findings in this report should be read as indicative of the available data while we acknowledge that the funding situation may be more complex.

Software and packages used

The resulting dataset was visualised and analysed using a variety of tools:

- Gephi (Bastian et al. 2009) for network visualisation
- The NetworkX package for Python (Hagberg et al. 2008) for network analysis
- The GeoPy package for Python for extracting latitude and longitude from city names
- AntConc (Anthony 2018) for word frequencies
- Flourish for the generation of geographical maps
- OpenRefine for data cleaning
- Microsoft Excel for all other data analysis and visualisations.

Research ethics approval

Research ethics approval was obtained from Edinburgh College of Art, University of Edinburgh. This research is part of the CoSTAR Foresight Lab's activities, funded by the Arts and Humanities Research Council (AH/Y007433/1).

INTRODUCTION TO UKRI-FUNDED XR ACTIVITY

UK Research and Innovation (UKRI) funded 529 XR projects related to screen, performance and digital entertainment between 2006 and 2024. These projects were funded by 16 different schemes within UKRI. They received a total of £231,159,278 funding with individual projects receiving between £4,964 and £29,908,139.

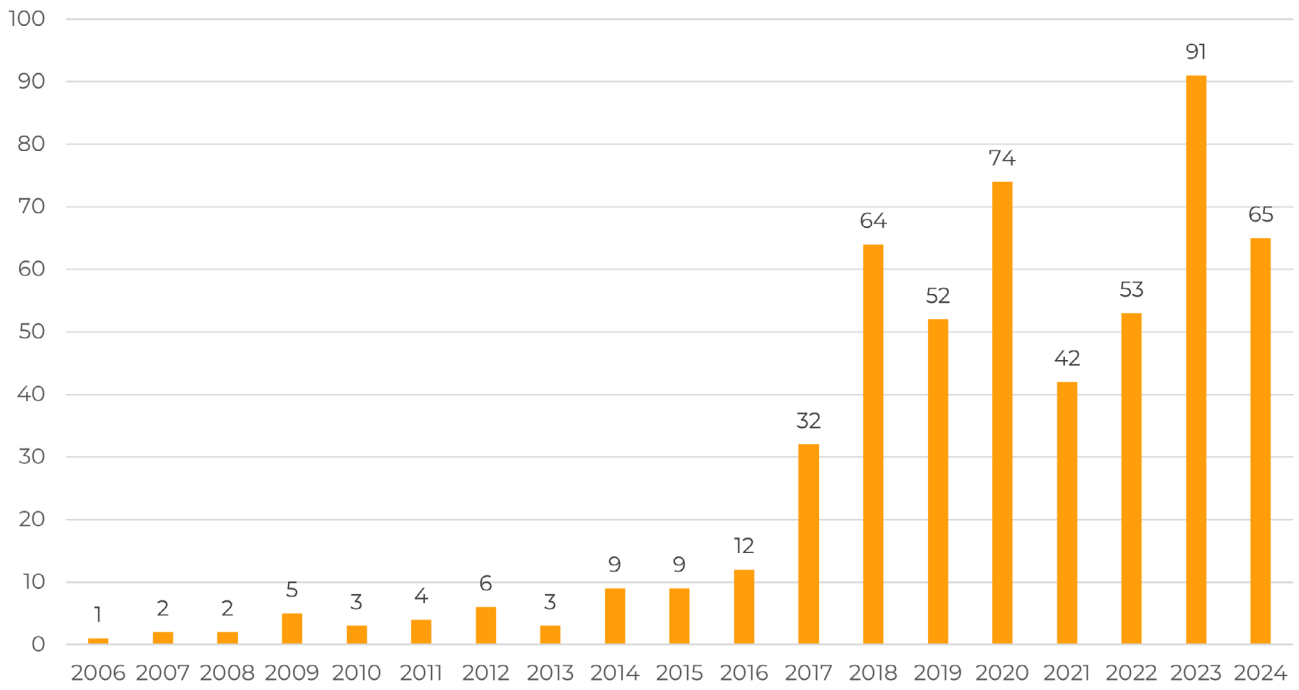
UKRI made some large investments into creative R&D around XR technologies in 2009, 2013, 2014 and then consistently since 2017. The first of these invested in the technologies and skills needed to undertake creative R&D and creative production using immersive technologies. These were: a doctoral training centre for visual engineering (Industrial Doctorate Centre: Virtual Environments, Imaging and Visualisation in 2009), improving technology for immersive audio at home (S3A: Future Spatial Audio for an Immersive Listener Experience at Home in 2013), developing tools and processes for CGI and video-based media in real-time (ASAP - A Scalable 2D/3D Architecture for Cross Media Virtual Production in 2014), advancing real-time computer graphics for cinema (Real-time Interactive Cinematic Content Creation in 2014), and progressing audio-visual signal processing and machine perception (Audio-Visual Media Research Platform in 2017). These initial projects were funded by the Engineering and Physical Sciences Research Council (EPSRC) and Innovate UK; later Innovate UK became the largest funding scheme within UKRI of this type of work. These projects laid the groundwork for the UK's preparedness for developing a Virtual Production and XR technologies R&D ecosystem, which was then developed through successive investments as detailed in this report.

After these initial investments into technology and skills for XR, the funded projects consisted of large, collaborative R&D projects and lots of smaller projects led by commercial organisations. Within the GtR dataset, large awards were made for multi-year creative R&D projects on XR technologies and wider creative technologies, such as Storyfutures in 2017, Future Screens NI in 2018, MyWorld in 2021 and media.cymru in 2022. This pattern of investment tells a story of consistent support for the conditions necessary for the UK to excel at harnessing immersive technologies, putting the UK in the position to benefit financially from the immersive sector. PricewaterhouseCoopers (PwC) predict that £1.39 trillion will be added to the global economy through immersive technologies with the UK's share in this increasing to £62.5 billion by 2030 (Bennett and Murphy 2020, 6).

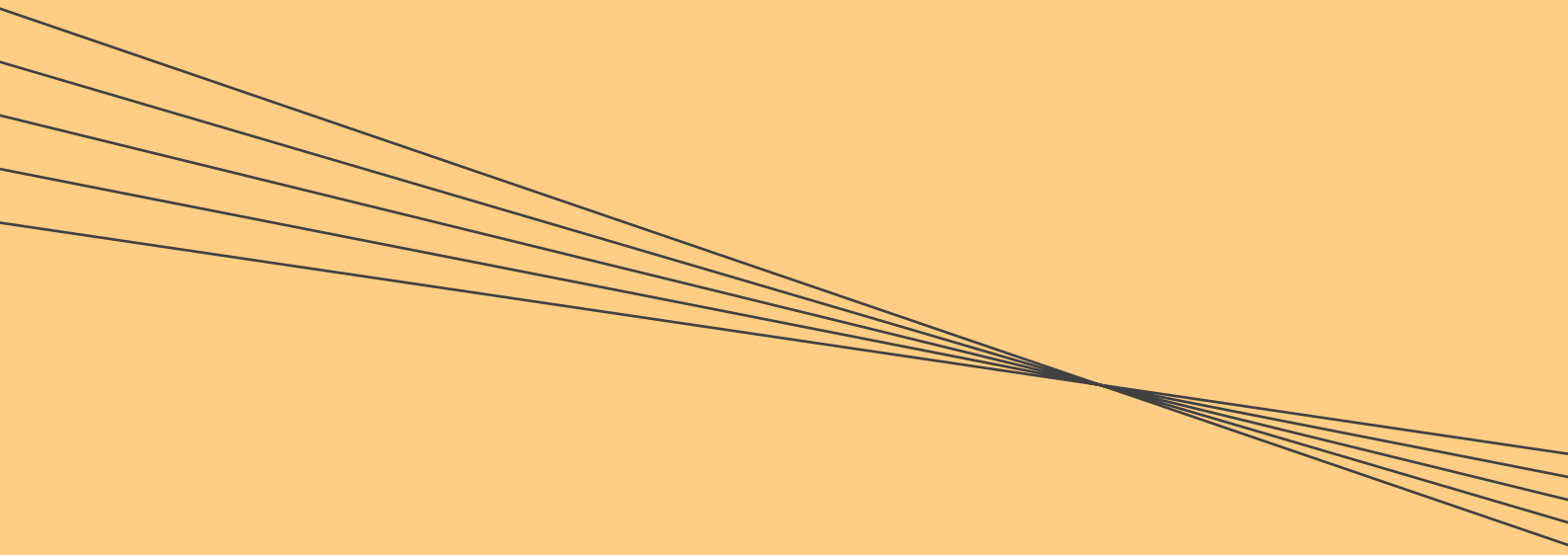
Number of projects per year

UKRI has funded 529 XR projects related to screen and performance with a marked upswing in the number of projects from 2017 onwards (see Figure 1).

Figure 1. Number of XR projects for screen, performance and digital entertainment funded by UKRI per year, 2006-2024.



FUNDING OF XR ACTIVITY



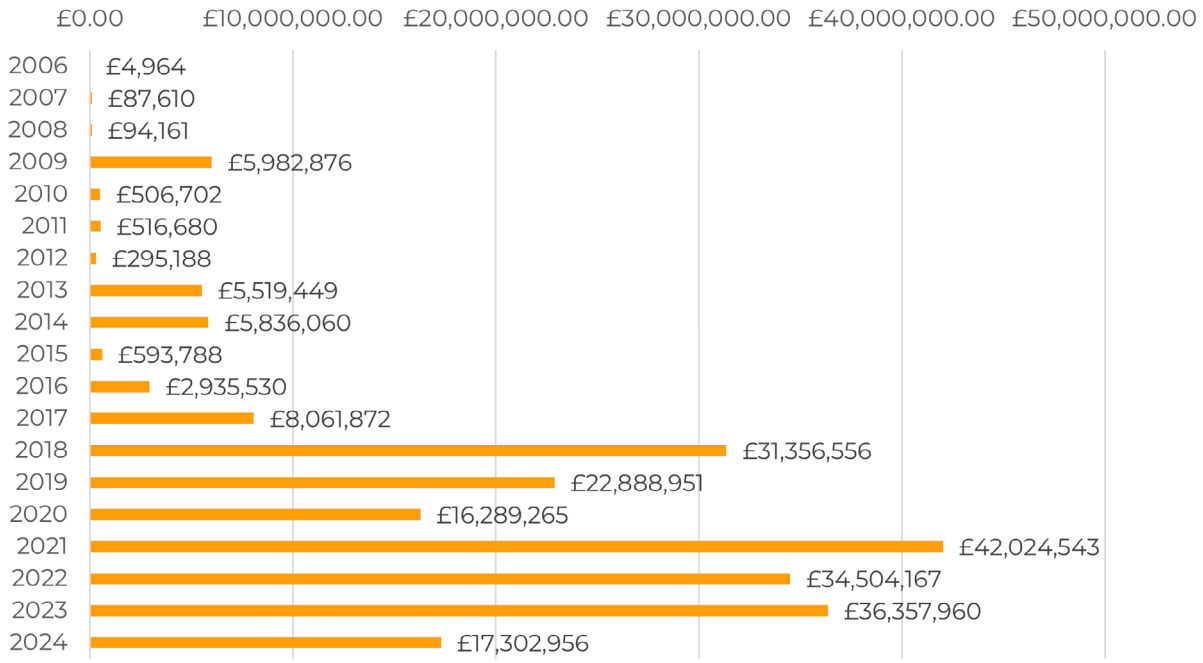
Summary

UKRI awarded £231,159,278 to XR projects related to screen, performance and digital entertainment from 2006-2024.

The UKRI annual budgets between 2017-2018 and 2024-2025 have ranged from £6,768m to £8,874m. On average, since 2017, the amount of money given to XR projects for screen, performance and digital entertainment each year is approximately 0.33% of the entire UKRI budget (UK Research and Innovation 2022, 3).

The amount of funding awarded to XR projects each year has varied, with spikes in investment in 2009, 2013, 2014 and from 2017 onwards (see Figure 2). The upturn in the number and value of funded XR projects from 2017 mirrors wider investment in the immersive sector in 2016-17 (Immerse UK and HTC VIVE X 2021, 4; Beauhurst and Huckletree 2022, 7), with the funding devoted to immersive technology projects in 2016–2017 nine times higher than in 2009–2010 (Innovate UK 2018, 7). Possible contextual reasons include the popularity of the augmented reality mobile game Pokémon Go by Niantic, which was released in 2016 and brought mainstream adoption and attention to AR technologies on a large scale as well as demonstrating and expanding an audience for them (Paavilainen et al. 2017). The Oculus Rift VR headset had its first consumer release in 2016 (Stapleton 2016). These cultural and market occurrences were accompanied by an increase in investment through targeted measures such as CreativeXR, funding from Arts Council England and Digital Catapult for arts organisations experimenting with immersive technologies (Romer 2017), and an initial investment of £33m from the UK Government as part of the Industrial Strategy Challenge Fund for new immersive technologies in 2018 (Innovate UK 2018).

Figure 2. UKRI funding for XR projects for screen, performance and digital entertainment per year, 2006-2024.



Largest UKRI awards for XR projects

The earlier spikes in investment (2009, 2013 and 2014) correlate to significant single investments (awards over £1m). There were 35 awards of over £1m between 2006 and 2024 (see Table 1).

These 35 projects were undertaken by 25 different organisations with 1 organisation featuring 3 times (University of the West of England) and 8 organisations featuring twice (ESL Gaming UK Limited, Royal Shakespeare Company, University of Birmingham, University of Bristol, University of Glasgow, University of Surrey, University of Ulster, and University of York).

The projects were: large, collaborative R&D projects[1] with some immersive components, such as the two largest awards (£29,908,139 for MyWorld and £22,241,047 for media.cymru, both funded by the Strength in Places Fund, identified as Innovate UK in GtR, as well as Storyfutures, Bristol + Bath Creative R&D and Future Screens NI, all funded by UUI (ISCF & AHRC), and XRtists / Immersive Arts, funded by AHRC); a doctoral training centre (Industrial Doctorate Centre: Virtual Environments, Imaging and Visualisation, funded by EPSRC); new studios, labs and other research facilities (Studio UK - Open Networks 5G Enhanced Virtual Production Studio, funded by Innovate UK), the development of specific technologies to support XR work (Real-time Interactive Cinematic Content Creation, funded by Innovate UK); and the development of a specific media product such as a multiplayer adventure based on Wallace & Gromit (Moving Image Demonstrators, funded by ISCF).

An analysis of the most frequent and most central organisations undertaking this XR work can be seen in the section Networks of Collaboration.

1 These are distinct from the Creative Industries Clusters Programme 2018-2024, which created nine large-scale creative R&D projects that brought together academia and industry with the aim of significantly contributing to the UK economy.

Table 1. Details of 35 largest XR projects for screen and performance funded by UKRI 2006-2024 by funding value (over £1m).

Start date	End date	Project title	Project overview	Project Type	Lead reesarch organisation	Funded value	Funder
Sep-09	Mar-18	Industrial Doctorate Centre: Virtual Environments, Imaging and Visualisation	Doctoral centre for visual engineering	training centre	University College London	£5,649,575	EPSRC
Dec-13	Jun-19	S3A: Future Spatial Audio for an Immersive Listener Experience at Home	Immersive audio experiences from home	technology	University of Surrey	£5,415,204	EPSRC
May-14	May-16	ASAP - A Scalable 2D/3D Architecture for Cross Media Virtual Production	New pipeline, tools and processes for rendering and reviewing CGI and video-based media	technology	Double Negative Limited	£1,929,948	Innovate UK
Jun-14	Mar-15	Real-time Interactive Cinematic Content Creation	Real-time computer graphics for cinema	technology	Industrial Light And Magic (UK) Ltd	£2,648,884	Innovate UK
Jun-17	Dec-20	Virtual Realities - Immersive Documentary Encounters	Applying Virtual Reality technology to documentary content	media product	University of Bristol	£1,051,606	EPSRC
Jul-17	Jan-23	Audio-Visual Media Research Platform	Research in audio-visual signal processing and machine perception	technology	University of Surrey	£1,577,222	EPSRC
Aug-18	Aug-23	StoryFutures Academy: Industry Centre of Excellence in Immersive Narrative	Upskilling UK creative talent in immersive storytelling	collaborative R&D project	National Film And Television School	£7,554,427	ISCF
Sep-18	Mar-24	StoryFutures: Gateway Cluster Partnership for Audiovisual Digital Creativity	Technologies for immersive storytelling	R&D cluster	Royal Holloway University of London	£6,508,228	UUI (ISCF & AHRC)
Sep-18	Mar-24	Creative Industries Clusters Programme	Part of CICP (Bristol + Bath Creative R + D) with focus on emerging technologies	R&D cluster	University of The West of England	£6,165,645	UUI (ISCF & AHRC)
Oct-18	Dec-23	Future Screens NI	Part of CICP partly focused on emerging animation, games and immersive technologies	R&D cluster	University of Ulster	£6,155,381	UUI (ISCF & AHRC)
Jan-19	Dec-21	Dinosaurs & Robots	Using immersive technologies in visitor experiences, in-home edutainment and retail destinations	media product	Factory 42 Limited	£4,796,170	ISCF

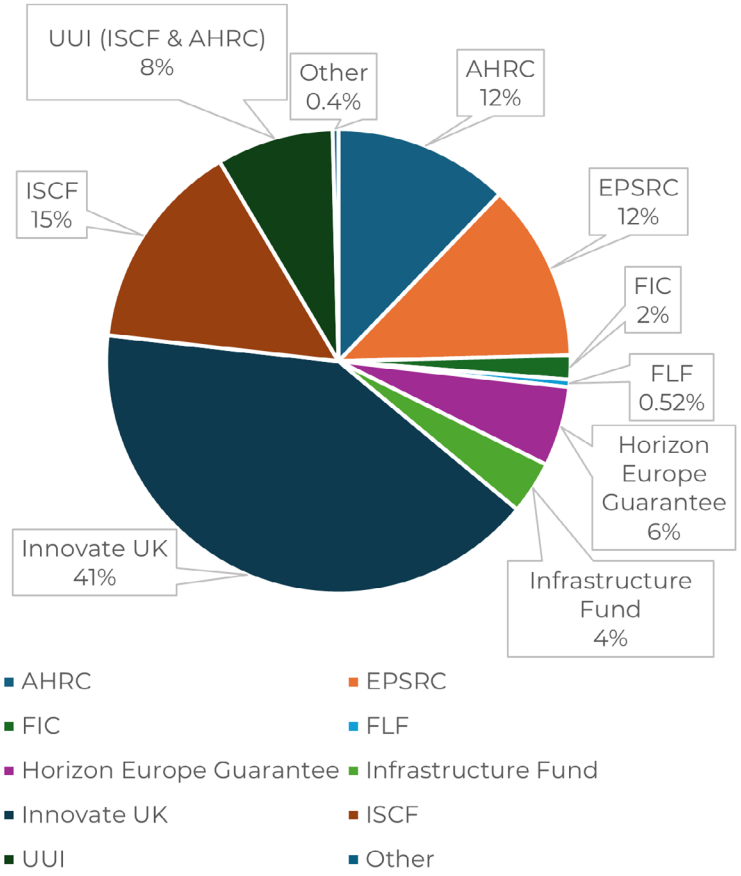
Start date	End date	Project title	Project overview	Project Type	Lead reesarch organisation	Funded value	Funder
Jan-19	Dec-21	Immersive performances of the future	Adding XR to live performance	media product	Royal Shakespeare Company	£4,008,833	ISCF
Jan-19	Jun-21	WEAVR: Immersive Cross-Reality Experiences in Esports	Platform for remote audiences to experience esports and physical sports	media product	ESL Gaming UK Limited	£3,953,587	ISCF
Jan-19	Dec-20	Moving Image Demonstrators	Immersive multiplayer adventure based on Wallace & Gromit	media product	Tiny Rebel Games Limited	£2,483,645	ISCF
Nov-20	Oct-25	CAMERA 2.0	Research into visual technology	technology	University of Bath	£3,401,653	EPSRC
Dec-20	Dec-21	WEAVR: Immersive Cross-Reality Experiences in Esports	Platform for remote audiences to experience esports and physical sports	media product	ESL Gaming UK Limited	£1,178,251	ISCF
Dec-20	Dec-21	Immersive performances of the future	Adding XR to live performance	media product	Royal Shakespeare Company	£1,043,343	ISCF
Mar-21	Mar-27	MyWorld	Content creation, delivery and consumption with emerging immersive media formats and technologies	collaborative R&D project	University of Bristol	£29,908,139	Innovate UK
Aug-21	Mar-23	Studio UK - Open Networks 5G Enhanced Virtual Production Studio	No description available	research / lab / studio facilities	Digital Catapult	£5,539,620	Innovate UK
Aug-21	Apr-25	Augmented Reality Musical Ensemble (ARME)	Virtual musicians for use in an ensemble	media product	University of Birmingham	£1,183,465	EPSRC
Jan-22	Dec-26	media.cymru	Global hub for media innovation with a focus on green and fair economic growth	collaborative R&D project	Cardiff University	£22,241,047	Innovate UK
Sep-22	Sep-27	XR Network+ : Virtual Production in the Digital Economy	Academic research and industry R&D in VP	collaborative R&D project	University of York	£2,659,782	EPSRC
Jan-23	Jun-24	UAL VP/XR for textiles and dress: Infrastructural development	Specialist VP/XR Lab facility for fashion and textiles	research / lab / studio facilities	University of the Arts London	£3,576,000	Infrastructure Fund
Feb-23	Mar-24	The Bridge: A Creative Lab For Physical-Meta Production	New lab with new and upgraded equipment and items refurbished from industry	research / lab / studio facilities	University of the West of England	£2,292,912	Infrastructure Fund

Start date	End date	Project title	Project overview	Project Type	Lead reesarch organisation	Funded value	Funder
Feb-23	Oct-23	Performance Lab: Innovating Practice-led Research and Development in Immersive and Digital Technologies in Theatre and Performance	New and upgraded facilities with immersive sound and XR capabilities	research / lab / studio facilities	Royal Central School of Speech And Drama	£1,372,979	AHRC
Mar-23	Mar-25	Centre for Digital Innovation (CDI)	Innovation accelerator for digital technologies	collaborative R&D project	Manchester Metropolitan University	£4,093,009	Innovate UK
Mar-23	Mar-25	MediaCity Immersive Technologies Innovation Hub	People-centred immersive technologies innovation hub in MediaCity	cluster or cluster-like	The Landing At MediacityUK Limited	£3,196,061	Innovate UK
Mar-23	Mar-25	Museums in the Metaverse	Platform for online visitors to explore cultural assets	media product	University of Glasgow	£2,090,879	Innovate UK
Aug-23	Aug-27	Augmented Social Play (ASP): smart-phone-enabled group psychotherapeutic interventions that boost adolescent mental health by supporting real-world connection and sense of belonging	Using smartphones to deliver real-world group experiences	media product	University of Birmingham	£1,357,879	Horizon Europe Guarantee
Aug-23	Aug-27	ASP Belong	Using smartphones to deliver real-world group experiences	media product	Make Real Ltd	£1,163,778	Horizon Europe Guarantee
Sep-23	Sep-25	Future Island-Island	Sustainable immersive digital heritage and culture	media product	University of Ulster	£4,112,377	AHRC
Feb-24	Jan-27	XRtists: Artists Extending Realities	Commissioning new artists to make and share immersive work	collaborative R&D project	University of the West of England	£5,908,640	AHRC
Apr-24	Apr-29	FUSION - Future Social Interaction in XR	Immersive technologies to create hybrid experiences continuously in everyday life	technology	University of Glasgow	£1,727,789	Horizon Europe Guarantee
Jun-24	Jun-28	Immersive Opera: Accelerating Operatic Innovation through Industry Co-operation	Immersive performance practices and technologies to inspire interest in opera	media product	Guildhall School of Music and Drama	£1,194,284	FLF
Aug-24	Aug-28	Co-Producing EDI Interventions for Virtual Production	Making film and tv industries more inclusive while VP is being adopted	ED&I project	University of York	£1,275,804	AHRC

UKRI investment into XR by funding scheme

UKRI investment in XR activity for screen, performance and digital entertainment was delivered through 16 different funding schemes (see Figure 3).[2,3]

Figure 3. Percentage of UKRI funding for XR projects for screen, performance and digital entertainment by funding scheme, 2006-2024.[4]



The funding was mostly delivered via Innovate UK, which contributed 40.1% (£94,227,462) of all the funding for XR projects (See Table 2). AHRC, EPSRC and ISCF also contributed 12-15% each (AHRC: £28,225,922, EPSRC: £28,611,991, ISCF: £33,905,810). Innovate UK has a higher budget than AHRC, EPSRC or ISCF, with a budget of £2,438m for 2022-2025, compared to £207m for AHRC and £1,929m for EPSRC for the same period (UK Research and Innovation 2022, 4).

2 The funding schemes as listed on the UKRI Gateway to Research database differ from the core nine funding schemes (e.g. Arts and Humanities Research Council, Medical Research Council). The schemes listed include more targeted schemes, such as Horizon Europe Guarantee and the Fund for International Collaboration (FIC). A list of the funding schemes mentioned in this report is given in the Appendix.

3 As noted above, some project funding came from multiple funding schemes but Gateway to Research only lists one scheme for each project, so these figures are not fully representative of the situation.

4 Funding schemes each contributing 0.15% or less of the total funding for XR projects, according to GtR, have been aggregated under the label 'Other'. These seven funding schemes are: COVID, ESRC (Economic and Social Research Council), NERC (Natural Environment Research Council), Newton Fund, SiPF (Strength in Places Fund), SPF (Strategic Priorities Fund), STFC (Science and Technology Facilities Council).

Table 2. Percentage of UKRI funding for XR projects for screen, performance and digital entertainment awarded by each funding scheme, 2006-2024.

Funding scheme	% of UKRI's funding for XR
Innovate UK	40.76
ISCF (Industrial Strategy Challenge Fund)	14.67
EPSRC (Engineering and Physical Sciences Research Council)	12.38
AHRC (Arts and Humanities Research Council)	12.21
UUI (ISCF & AHRC)	8.15
Horizon Europe Guarantee	5.57
Infrastructure Fund	3.67
FIC (Fund for International Collaboration)	1.68
FLF (Future Leaders Fund)	0.52
Other	0.4

Of the projects looked at in this report, by 2014 Innovate UK was a significant funder of work on XR, peaking in 2021 and 2022 and, it should be noted, that across all creative technology funding in 2020, not just the media production that is the focus of this report, Innovate UK was in the top ten investors (Creative Industries Council 2021).

Forecasts for XR growth

XR activity and the immersive tech sector has been experiencing growth, especially since 2017. In 2020, it was estimated that the 'createch' sector in the UK raised nearly £1bn in venture capital investment, with £68.21m going to augmented reality and £64.53m to virtual reality companies (Creative Industries Council 2021). This growth is forecast to continue with PricewaterhouseCoopers (PwC) predicting that £1.39 trillion will be added to the global economy through immersive technologies with the UK's share in this increasing to £62.5 billion by 2030 (Bennett and Murphy 2020, 6).

ORGANISATIONS INVOLVED IN UKRI-FUNDED XR ACTIVITY

Summary

In this section we look at the organisations that contributed to the 529 XR projects, both the lead organisations and collaborating organisations, inside the UK and internationally. We found that UKRI-funded XR activity was less concentrated in London than other reports of creative R&D suggest, although London was still the most popular city for lead organisations with Bristol in second place. There are areas of the UK where there seems to be less UKRI funding for XR projects but, when looking at all the collaborating organisations participating in the 529 XR projects for screen, performance and digital entertainment, as well as the leads, the funding is more evenly distributed. Universities take a lead on many of the projects but there are also many industry firms, local authorities and charities represented. International collaborators play a large role in the 529 projects with many organisations based in China and Hong Kong, and the USA.

The data we share in this section, which shows the importance of collaboration across academic, private and public sectors, across regions in the UK and with international involvement, highlights the important roles of policy and funding in fostering such collaborative ecosystems in the success of the UK's Creative Industries.

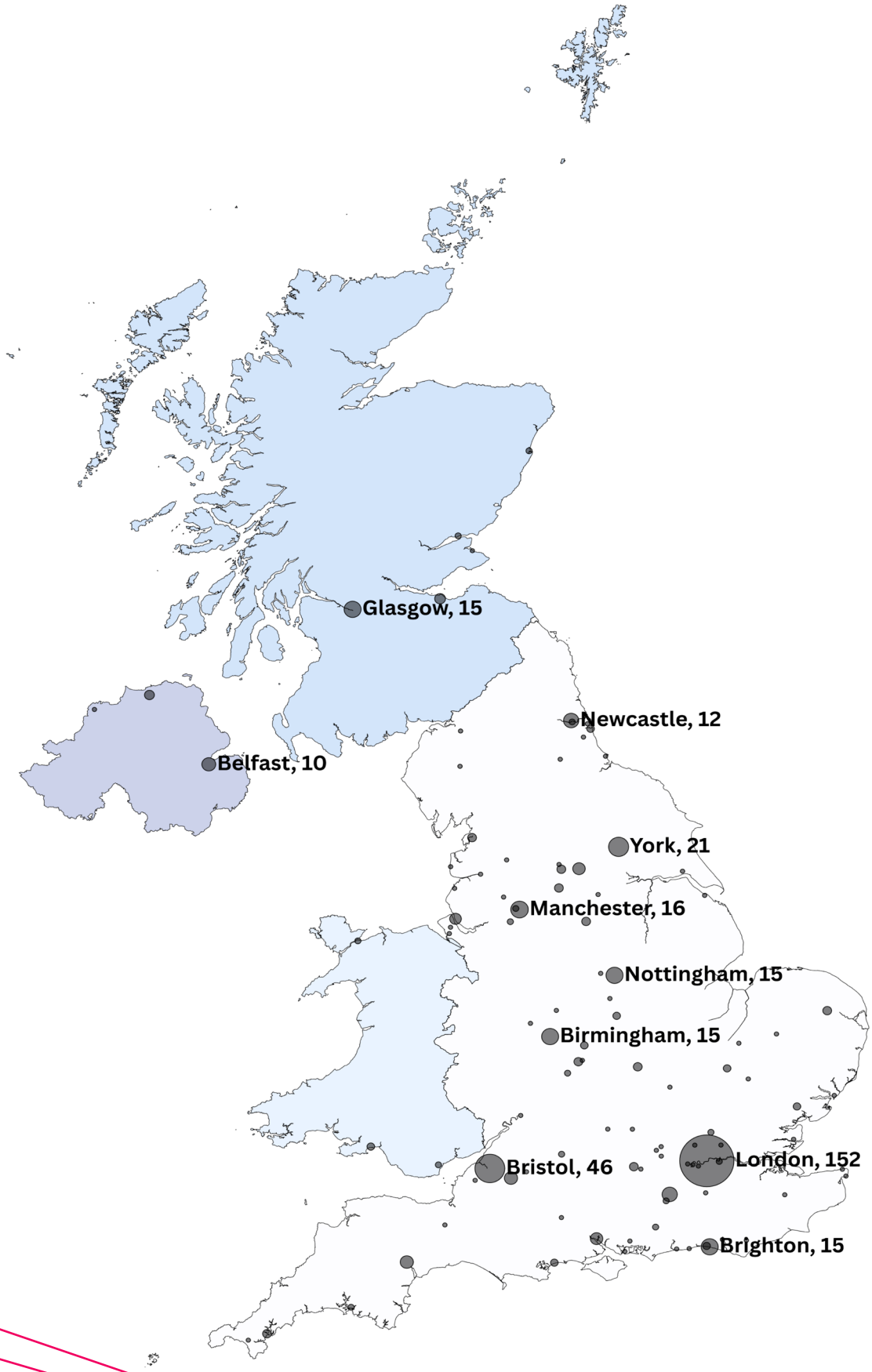
Geographical distribution of UKRI-funded XR projects

As the focus of this report is UKRI-funded XR activity for screen, performance and digital entertainment, this is not an account of all XR organisations and projects in the UK but, rather, funding allocated by the various schemes within UKRI.

London is often positioned as the hub of creative production in the UK (Foord 2013; Montgomery 2007; O'Hara and Naik 2021) and so it would be expected for XR production to follow a similar trend. Although reports of the concentration of organisations and projects in London vary (Beauhurst and Huckletree 2022; Hitchen et al. 2023; Immerse UK and Digital Catapult 2019; Mateos-Garcia 2021a), the UKRI-funded XR activity exhibits a greater geographical spread than in those previous reports, locating centres of activity around the UK where higher education institutions, established media companies, technology companies and smaller media producers come together with UKRI investment. Of the 529 XR projects identified, 152 (29%) had a lead organisation based in London and 374 (71%) in another UK location.

The following map (see Figure 4) indicates the geographical spread of lead organisations of UKRI-funded projects for screen, performance and digital entertainment. Locations with 10 or more lead organisations are labelled.

Figure 4. Locations of lead organisations of UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024. Base map sourced from Office for National Statistics. Marker size indicates number of organisations in each location.



London

Reports differ about how much of a concentration of UK XR activity occurs in London, although having a lead organisation in a region need not imply that all the activity is there as, for example, many non-London projects will involve London-based companies. A 2019 report of immersive technology activity found that 47% occurred in London (Immerse UK and Digital Catapult 2019, 4). In 2021 a survey of 'createch' companies found 57% of them to be London-based (Mateos-Garcia 2021a, 4). An account of the entire new media and immersive tech sector in 2021 also found a concentration of businesses in London (Beauhurst and Huckletree 2022, 1) and, in 2023, there was found to be a concentration of VP facilities in London and the South East (Hitchen et al. 2023, 3). The fact that in this dataset only 29% (152) of the lead organisations of the UKRI-funded XR activity were London-based indicates that the projects funded by UKRI have a wider geographical spread than previous activity in similar sectors.

It should be noted that funding restrictions will play a role in the location of funded organisations. For example, funding routed through a non-business institution will not necessarily reflect where businesses are located.

Hubs

Table 3 lists the 11 locations with the largest number of lead organisations. The remaining 96 locations had 9 or fewer lead organisations with 57 locations only home to 1 lead organisation.

Table 3. Top 11 most frequent UK locations for lead organisations, number of projects per location and number of lead organisations in location of UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.

Location	Number of projects	Number of lead organisations in location
London	152	96
Bristol	46	28
York	21	2
Manchester	16	9
Birmingham	15	5
Brighton	15	6
Glasgow	15	5
Nottingham	15	2
Guildford	12	1
Newcastle	12	5
Belfast	10	7

The number of organisations in each location leading UKRI-funded XR projects varied. While in most of these most-frequently represented locations each organisation led between approximately 1 and 3 projects, in York, Nottingham and Guildford this concentration of funded projects was much higher. The 2 organisations based in York (University of York, Viridian Fx Ltd) led, between them, 21 projects, 2 organisations in Nottingham (University of Nottingham, Legendary Games Ltd) led 15 projects, and 1 organisation in Guildford (University of Surrey) led 10 projects. Note that while universities are the most prevalent lead organisations here, not all of the projects are centred on academic research as some are more business-oriented with funding distributed across a wider geographical area, for example XRtists: Artists Extending Realities, which is a national programme delivered by the University of the West of England in Bristol.

The largest hub outside of London is Bristol. Bristol-based organisations were the leads for 5 large and high value UKRI-funded projects (above £1m) from 2006-2024:

- MyWorld
- Bristol + Bath Creative R&D, which was part of the Creative Industries Cluster Programme
- XRtists: Artists Extending Realities
- The Bridge: A Creative Lab For Physical-Meta Production
- Virtual Realities – Immersive Documentary Encounters

Immerse UK and Digital Catapult, in a report from 2019, also identified hubs, in descending order of size, in Manchester and the North West, Northern Ireland, Brighton and East Sussex, the North East and Tees Valley, Leeds City Region, Nottingham and the East Midlands, and Edinburgh (4). This somewhat correlates with our research. However, our research finds more projects led by Glasgow organisations (led by Glasgow School of Art, University of Glasgow and several private media studios) than those based in Edinburgh, Birmingham in the West Midlands (with the University of Birmingham and Foundry Visionmongers the most frequent leads) and Guildford (mostly led by the University of Surrey). It also surfaces York rather than Leeds as a hub of XR activity (almost all led by the University of York).[5]

Bristol

There were 28 lead organisations based in Bristol, the most active city outside of London. The organisations with the most projects were HEIs: University of Bristol and University of the West of England (with 9 projects each) and industry: Condense Reality Ltd and Crack Industries Limited (with 2 projects each). The other organisations were private companies involved in technology, media, heritage and culture, such as Bristol Old Vic And Theatre Royal Trust, and Clifton Observatory.

Bristol has previously been recognised as a hub for immersive technology activity. A report by Immersive UK and Digital Catapult characterises "[t]he immersive ecosystem in the region" as "well-established" with the presence of "four major universities, and several cultural and arts venues, such as the Watershed, Bristol", and the location for BBC and Channel 4 offices, Aardman Animations and Bristol Games Hub, as well as strong cultural heritage and tourism and 5G infrastructure (Immerse UK and Digital Catapult 2019, 71-72). These multiple types of organisations in close proximity allow for collaboration.

5 It should be noted that in locating hubs of XR activity we have looked at the number of organisations in each city / town rather than the surrounding areas.

Innovation deserts

We note some areas of the UK where there is an absence of UKRI-funded XR activity: north of Swansea in Wales, the west and south of Northern Ireland, and the Highlands and Islands of Scotland. Population density will play a factor in this unevenness and comparing the geographical spread of projects with populations and each nation's index of multiple deprivation would be a useful piece of future work to evidence the links between investment in creative R&D and standards of living.

Successful innovation, which can be conceptualised in the Creative Industries as "activities which rely on continuous supply of creativity, knowledge, skills and human capital for competitive advantage" (Wang et al. 2024, 89), it has been argued is systemic, requiring information flow between organisations so that "firms no longer innovate in isolation but through a complex set of interactions with external actors" (Huggins and Johnston 2009, 230).

Gitman et al. define innovation deserts as communities "where the population is cut off from educational, technical, and other resources connected to small business and entrepreneurial success" (2018), emphasising that it is not just a lack of resources in a particular region but also a lack of the connections deemed so necessary to knowledge and innovation.

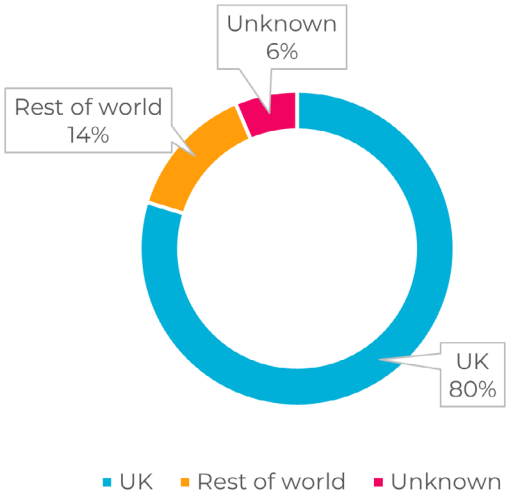
The connections require "formal and informal networking with other knowledge actors such as universities, R&D labs, and other firms" (Huggins and Johnston 2009, 228), with the role of universities seen as important in enabling innovation networks (Comunian et al. 2014; Wang et al. 2024). This emphasis on collaboration, especially with universities taking the lead, can be seen in the UKRI-funded XR projects if we consider all of the collaborators listed for each project and not just the lead organisations. There may be future opportunities to link to Further Education colleges in the areas we have identified as XR innovation deserts to ensure that collaboration and training across the whole of the UK is viable.

All collaborating organisations in UKRI-funded XR projects

Looking at all of the collaborating organisations for the 529 XR projects as well as their lead organisations, there were 860 organisations in total.[6] These organisations were not all UK-based. 119 (14%) of the organisations were based outside of the UK and 686 (80%) in the UK (see Figure 5). The remaining 55 (6%) organisations' locations were unclear from the data provided in the Gateway to Research database.

6 Some projects listed their funders (Innovate UK, EPSRC and AHRC) as collaborators. These have been omitted from our list of collaborating organisations as we have already counted them under the Funder category.

Figure 5. Percentage of organisations from UK and rest of world collaborating in UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.



All UK organisations collaborating on UKRI-funded XR projects

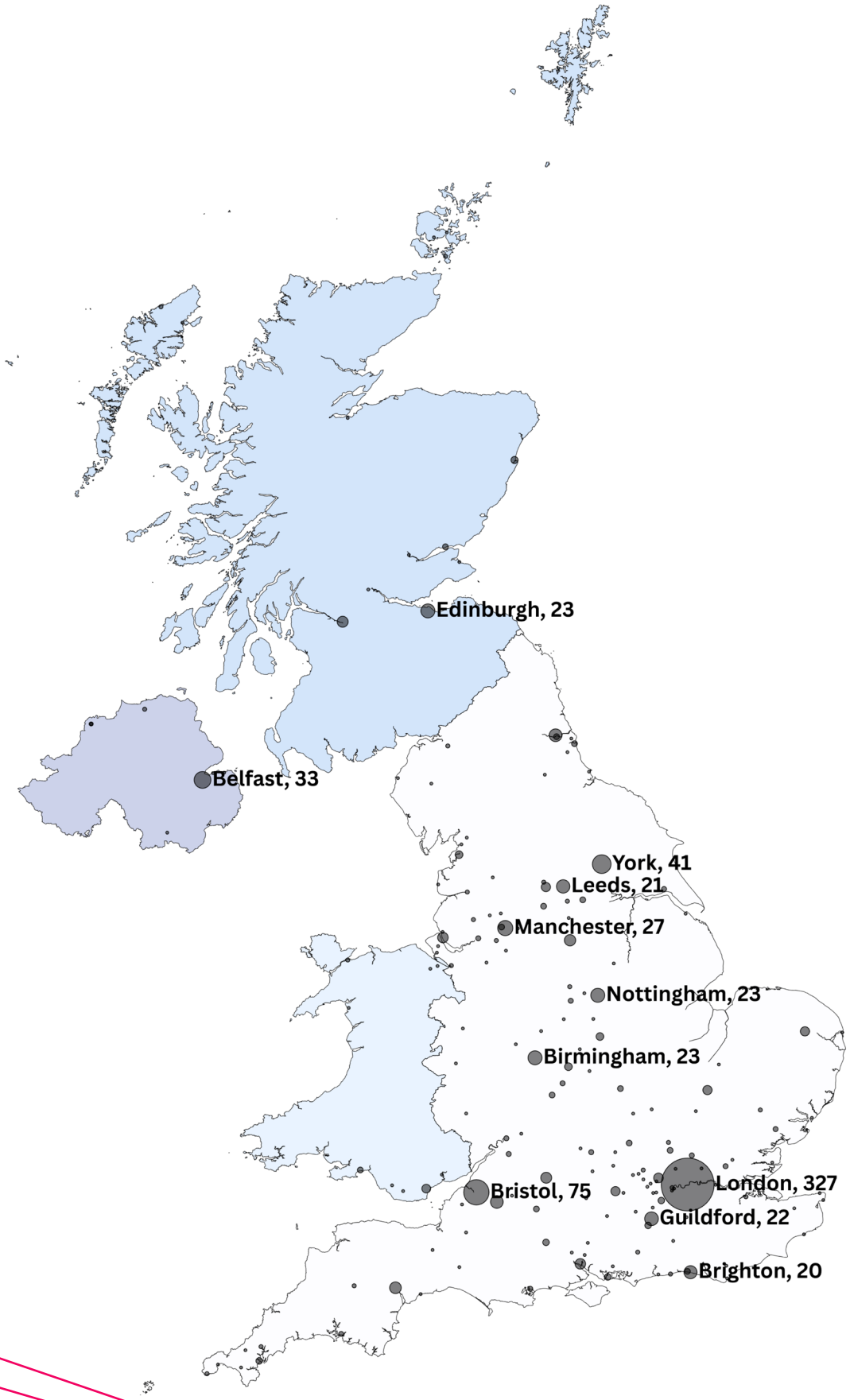
There were 1206 instances of participation by 688 organisations from 184 different UK locations. The organisations that collaborated on the most projects were HEIs and the BBC (see Table 4).

Table 4. Top 9 organisations collaborating on the most XR projects for screen, performance and digital entertainment funded by UKRI, 2006-2024.

Organisation	Number of projects
University of York	25
University of Nottingham	16
BBC	15
University of Surrey	15
University of Bristol	12
Brunel University London	11
University of the West of England	11
Goldsmiths University of London	10
University of Southampton	10

A map (Figure 6) indicates the number of times organisations from each location participated in one of the projects. Locations with 20 or more collaborating organisations are labelled.

Figure 6. Locations of all collaborating organisations on UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024. Base map sourced from Office for National Statistics. Marker size indicates number of organisations in each location.



Organisations collaborating on UKRI-funded XR projects from outside of UK

Of the 118 organisations based in countries other than the UK, there were organisations from 24 countries. The most represented countries were China and Hong Kong (41 organisations), then USA (21) then Germany (8) (See Table 5).

Table 5. Number of collaborating organisations from countries outside the UK in UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.

Country	Number of organisations
China and Hong Kong	41
USA	21
Germany	8
Egypt	5
Italy	5
India	4
Netherlands	4
Belgium	3
Canada	3
Japan	3
Other countries (with 2 or fewer organisations)	21

Global perspective of UKRI funding for XR projects

UKRI has offices in China, India, North America and mainland Europe. Since 2007, the China office in Beijing has been involved in negotiating and facilitating the delivery of joint funding programmes and worked with more than 300 partner research organisations and businesses across all sectors. Overall, China is the UK's second biggest single-country partner for collaborative research after the USA (UK Research and Innovation 2025). Third party reporting has found that UKRI funding for British-Chinese research and innovation projects reached a peak in 2016 and had, by 2022, greatly declined (Hogan 2024).

18 projects in our dataset had collaborators from China or Hong Kong between 2018 and 2022. Of these 18 projects, 1 focused on virtual production: UK-China Research and Innovation Collaboration in Cloud based Virtual Film Production led by Bournemouth University. Given this project, which looked at the status of cloud-based virtual film production in the UK and China with a view to developing future collaborations, further work looking at XR and VP activity undertaken as collaborative UK / China ventures would be beneficial, and especially looking at the international organisations mentioned in the dataset and their role in supporting UK innovation.

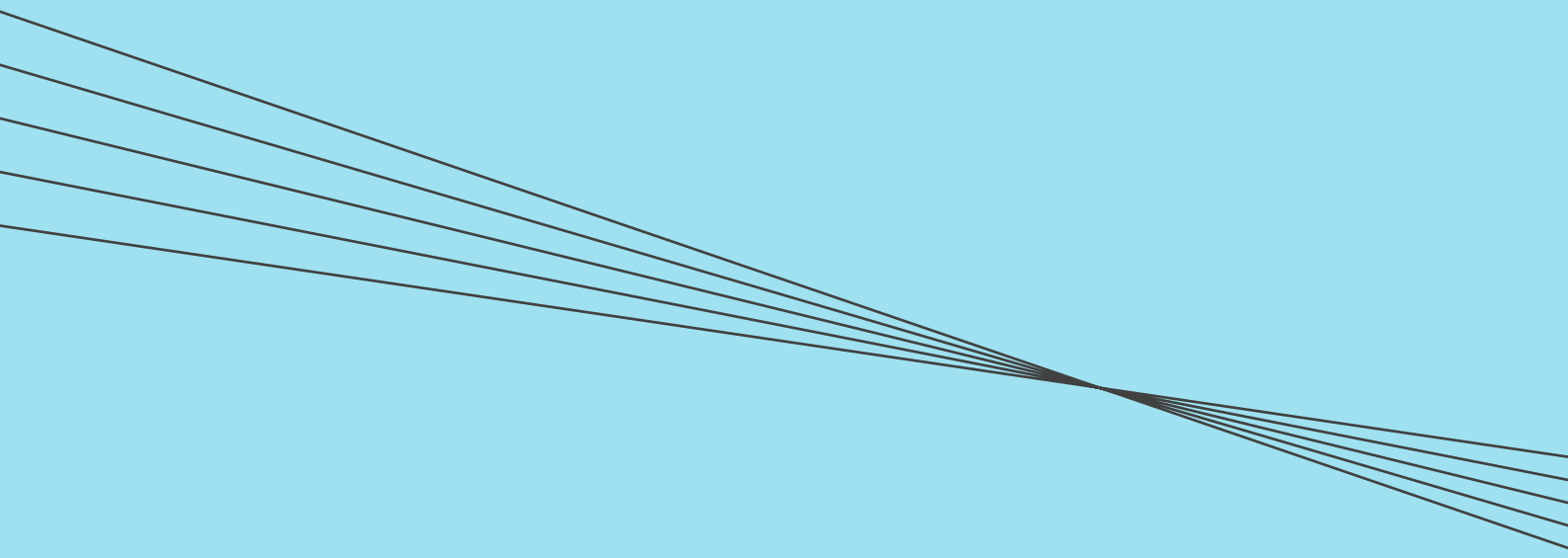
The role of policy in geographical distribution of UKRI funding

Funding schemes within UKRI may have different aims around the geographical spread of their funding. For example, the largest award of the 529 projects (over £29m to MyWorld in Bristol) is part of the Strength in Places Fund, which has the aim of supporting innovation-led regional growth by enhancing local collaborations involving research and innovation. This type of funding is aimed at strengthening regional capabilities outside existing high-activity areas, and not just in the area of the Creative Industries. The second-largest award of the 529 projects (over £22m to media.cymru in Cardiff) was also made from this fund.

Most of the UKRI-funded XR projects are collaborations between HEIs, industry and longstanding heritage, arts and creative organisations. In their overview of 'createch' (an area that overlaps with XR), the Creative Industries Policy and Evidence Centre and Nesta found that while "[c]reatech businesses are more geographically concentrated than the wider Creative Industries... publicly-funded createch R&D activities are less geographically concentrated" and attribute this to areas with diverse Creative Industries and research activities (Mateos-Garcia 2021b, 4). This points to the importance of a combination of academic, creative and tech companies for XR activity to flourish.

Although the statistics shared in previous reports, based on an analysis of wider creative technology or narrower virtual production activity, are not directly comparable with our analyses, the change between around 50% of activity taking place in London to, in this dataset, only 29% of activity being led by London-based organisations marks a significant investment by UKRI in regional Creative Industries.

NETWORKS OF COLLABORATION



Summary

Various types of organisations are involved in UKRI-funded XR projects for screen, performance and digital entertainment. While the most frequent lead organisations are HEIs, there are many collaborators drawn from the private and public sectors in the UK, including media production and software companies, and cultural and heritage organisations, as well as international organisations. This section shows the complex network of different types of organisation that are each integral to the Creative Industries, and also the effects of funding stipulations about which type of organisation can lead CI such projects.

UKRI XR network

Across the 529 UKRI-funded XR projects there were 302 different lead and 860 organisations when all collaborators are taken into account. Some organisations entered into collaborations with many other organisations, that is, they are highly connected. Those organisations act as important points of contact between other organisations or clusters of organisations. We used network analysis to measure how connected the organisations were to each other and which were the most important – or central – organisations in the network.

Most frequent lead organisations

The 529 projects were led by 304 different organisations (see Table 6). The top 10 organisations that led the most projects were all universities, which shows the leading role that universities are playing in the UK industrial strategy. It should be noted that some UKRI funding requires a HEI as lead organisation. The role of other types of organisations in collaborating in XR projects is explored further in this section.

Table 6. Top 10 lead organisations with the highest number of UKRI-funded projects for screen, performance and digital entertainment (as a lead organisation), 2006-2024

Organisation	No. of projects
University of York	20
University of Nottingham	14
University of Surrey	10
University of Bristol	9
University of The West of England	9
Brunel University London	8
Goldsmiths University of London	8
University of Southampton	8
Newcastle University	7
University of Birmingham	7

Most connected organisations

These lead organisations worked with a large number of collaborators. In total, there were 860 organisations involved in R&D activities. (See map of all collaborating organisations, Figure 6).

The organisations with the highest number of connections to other organisations (or edges), and therefore with the most power and influence in the network, include some universities (Brunel University London, University of York), representatives of the media production and software industries (DNEG, Humain, Imaginarium, Numerion Software and Sony), heritage organisations (National Trust), and infrastructure for film and television production and preservation (BBC, British Film Institute). (See Table 7).

Table 7. Top 10 most connected organisations in network of all collaborating organisations on UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024

Organisation	Number of connections
BBC	100
Sony	88
BFI	62
University of York	61
DNEG	59
Brunel University London	55
National Trust	55
Numerion Software	55
Humain	54
Imaginarium	54

When moving from looking at the lead organisations to all of the collaborators, the networks involved in XR activity become apparent: HEIs, media production and software companies, and the UK's cultural and heritage infrastructure – as seen in the British Broadcasting Corporation (BBC), British Film Institute (BFI) and National Trust – all have a strong presence.

UK collaborating organisations

For the 688 collaborating organisations based in the UK, we looked at their Standard Industrial Classification (SIC) codes, which categorise their business activities. The organisations for which SIC codes were available reported 117 unique SIC codes and there were 835 instances of these. Organisations can report up to four SIC codes each. We condensed these into the 21 SIC code descriptions listed by Companies House (see Table 8).

Table 8. Number of instances of each SIC code description reported by all UK-based collaborating organisations in UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.

SIC code description	Number of instances
Information and communication	306
Arts, entertainment and recreation	170
Education	144
Professional, scientific and technical activities	78
Accommodation and food service activities	50
Manufacturing	20
Wholesale and retail trade; repair of motor vehicles and motorcycles	20
Other SIC code descriptions	32

Despite this report's focus on projects related to screen, performance and digital entertainment, the breadth of different sectors involved in these projects shows the collaborative nature of the Creative Industries. It has been recognised that SIC codes do not necessarily capture creative activities well (McDonald et al. 2024, 52). This can be seen in the number of classifications used to categorise the organisations collaborating on these XR projects.

The most populated SIC code was 'Information and communication', which includes making media products like television shows and games as well as software, IT and broadcasting technologies. The second most populated was 'Arts, entertainment and recreation', which includes artistic creation, supporting artistic creation and operating arts venues. The third most populated category, 'Education', includes universities, colleges and schools. The 'Other SIC code descriptions' category here includes 'Human health and social work activities', 'Real estate activities', 'Financial and insurance activities', and 'Dormant companies'.[7]

The top three SIC code descriptions describe academic organisations, media organisations, creative practitioners and organisations responsible for related technologies, which shows the importance of all of these sectors to creative research and output in the UK. It should also be noted that different UKRI funding schemes may have different rules around which type of organisation can act as a lead. The type of organisation eligible to be lead partner is often determined by the funding route. For example, while research council funding is routed through HEIs, Innovate UK funding is routed through businesses.

The strong links between HEIs and industry in the development and implementation of VP have been noted (Hitchen et al. 2023, 3). Research into collaboration networks in the Creative Industries looking at research publications in 2018 found that "[o]nly a small proportion of papers had a corporate collaborator" and "on average, 2.7% of all the

7 Not all UK organisations are required to provide SIC codes, such as charities, and so they are not included in this analysis.

publications identified in the Creative Industries had one corporate collaborator" (Doeser and Hitchen 2021). Our new evidence of UKRI-funded activity shows that corporate collaborators play a significant role in the UK's XR activity, but this is not necessarily captured in research publications.

Most central collaborating organisations '

'Betweenness centrality', rather than counting the number of edges a node has, calculates the shortest paths that pass through each node and can identify organisations that make important connections between disparate parts of a network and therefore influence the flow around the network.

The top 10 organisations with the highest betweenness centrality are universities (Brunel University London, Queen Mary University of London, Queens University Belfast, University of Nottingham, University of Portsmouth, University of Surrey, University of the West of England, University of York), a digital visualisation studio (Soluis) and infrastructure for film and television production and preservation (BBC).

The BBC emerges as the organisation that acts as a connector to the most other organisations. For example, it has worked with 100 other organisations and participated in 15 XR projects between 2013 and 2024, making it an early collaborator in XR work and consistent in continuing its involvement. It was the lead organisation for 3 projects and a collaborator on the remaining 12. 2 of these XR projects also addressed virtual production:

- StoryFutures: Gateway Cluster Partnership for Audiovisual Digital Creativity, led by Royal Holloway University of London
- Mixed Augmented and eXtended Reality media pipeline (MAX-R), a pan-European project led by BBC.

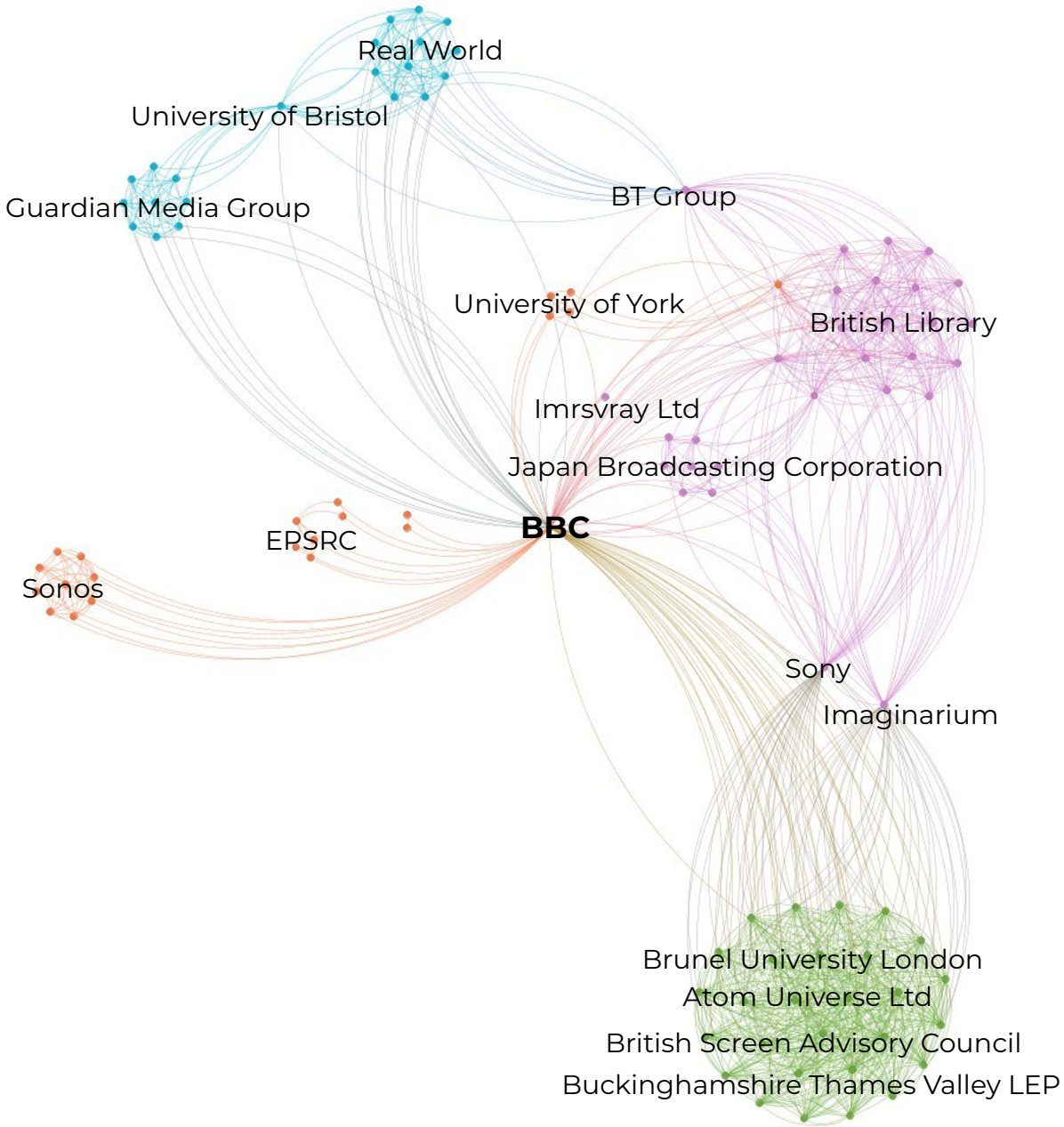
Previous research has found that "the BBC is a leading participant in createch projects across most segments, highlighting its importance as an anchor institution in the UK's creative R&D ecosystem" and that "other large cultural institutions such as the British Library, the Science Museum and the Victoria and Albert Museum also appear to be significantly involved in createch projects" (Mateos-Garcia 2021b, 5).

Looking at just XR activity, as a segment of creative technology, our data corroborates the importance of the BBC. We found that the other cultural institutions mentioned above did participate in XR projects but to a lesser degree: the British Library (2 projects), the Science Museum (2) and the Victoria and Albert Museum (4). Cultural institutions that participated as much or more in our dataset than those named are: National Trust (9 projects), Historic Environment Scotland (5), York Museums Trust (4) and the Royal Shakespeare Company (4).

Network of BBC and collaborators

The BBC participated in 15 projects with 100 other organisations. Some of those organisations entered into collaborations with many other organisations, that is, they are highly connected. Those organisations act as important points of contact between organisations and between groups or clusters of organisations. The network map below (Figure 7) shows the BBC at the centre of clusters of the other organisations with which it collaborated. The nodes represent the organisations that collaborated with the BBC; the edges represent which organisations worked together within the BBC network. The top ten organisations the BBC collaborated with are labelled, as are those that collaborated the most with other organisations that also collaborated with the BBC.

Figure 7. Network map of organisations that collaborated with the BBC in UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.



Most frequent organisations in BBC network

The organisations that most frequently collaborated with the BBC are other hub organisations rather than HEIs (see Table 9): industry (DNEG, Imaginarium, Sony), infrastructure for film and television production and preservation (British Film Institute, British Screen Advisory Council[8]), business networking organisations (Buckinghamshire Thames Valley Local Enterprise Partnership, Business South), infrastructure for telecommunications (BT Group), a virtual meeting platform (Atom Universe) and only 1 university (Brunel University London). This shows that, although the most frequent lead organisations that are awarded UKRI funding are HEIs, these non-academic institutions play a crucial role in participating in XR activity and connecting other organisations.

Table 9. Top 10 most-connected organisations also connected to the BBC in UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.

Organisation	No. of connections
Sony	57
Imaginarium	50
BT Group	34
Atom Universe Ltd	30
British Film Institute	30
British Screen Advisory Council	30
Brunel University London	30
Buckinghamshire Thames Valley LEP	30
Business South	30
DNEG	30

8 Now British Screen Forum

Networks of collaboration

Arguably, UKRI-funded XR activity from 2006-2024 relies upon a complex infrastructure. The reliance on collaboration has been recognised, with "a rich ecosystem of support and innovation underpinning the sector, from organisations such as Immerse UK, Innovate UK, Digital Catapult and the country's leading universities and research institutes" (Immerse UK and Digital Catapult 2019, 95) as well as the importance of these networks of connection between industry and research institutions (Cremona and Kevakli 2022).

While previous research into 'createch' activity identified the BBC as "an anchor institution and research partner for createch collaborations in the UK" (Mateos-Garcia 2021b, 13), our research shows that multiple organisations fulfilled that anchor role. Along with the BBC, the organisations that collaborated with the most other organisations include Sony, British Film Institute, University of York, DNEG, Brunel University London, National Trust, Numerion Software, Humain and Imaginarium. Organisations that are central in connecting other organisations include University of York, University of Surrey, Soluis, University of Nottingham, Brunel University London, Queens University Belfast, Queen Mary University of London, University of the West of England and University of Portsmouth.

Networks and their effects are important to Creative Industries and future investment needs to invest in networks of collaborators as well as individual facilities, including the communications support that is needed to build up such collaborations (Panneels et al. 2024).

SPOTLIGHT ON VIRTUAL PRODUCTION PROJECTS

Summary

Of the 529 XR projects for screen, performance and digital entertainment covered in this report, some of them focus on Virtual Production (VP). As the CoSTAR Network is initially taking an interest in VP as one of several examples of convergent technologies, this section addresses just those projects in order to make some claims about UKRI-funded VP in the UK prior to the inception of CoSTAR. Before CoSTAR, UKRI funded 38 VP projects, that is, 7.2% of all XR projects from 2006. These projects were awarded £99,628,402 in funding, which is 43% of the total XR funding for this period. The majority of the funding went to large-scale, multi-year, infrastructure projects (around 93%). These projects show the groundwork that was laid for the CoSTAR Network, which at £75.6m is the largest investment into the creative R&D in the UK to date. UKRI investment into VP, outlined below, tells a story of how sustained funding into projects incorporating studios, buildings, expertise and technology enables the conditions for continued creative R&D infrastructure.

This section tells a story of cumulative investment by UKRI in VP technologies and infrastructure and place-based ecosystems required to utilise them resulting in the CoSTAR Network. The expertise and facilities needed for the institutions who bid in a competitive process to host a CoSTAR Network Lab would not have been possible without the prior two decades of investment. Moreover, the lines between those projects focusing on VP and those on XR activities more widely is not always clear. We found that investment in all areas of creative R&D created the conditions for certain institutions to successfully bid for funding to host the CoSTAR Network Labs.

Method

Virtual production has been defined as “harness[ing] the power of virtualising technologies to create digital environments in, and through which film and television can be made” using “live action green/blue screen, entirely virtual worlds and LED volume” (Willment and Swords 2023, 4). For this report, we focused on virtual production as the use of convergent technologies (LED volumes, game engines and film and tv production technologies) for use in the film, television, game or live performance sectors. This focus is distinct from the use of similar technologies for other purposes (such as educational exhibits and training materials).

To isolate a subset of the VP projects in the larger UKRI-funded XR projects dataset we identified projects from the dataset that include the terms ‘virtual production’ or ‘VP’ and manually checked their abstracts for relevance. There were several large-scale, multi-year, capital-oriented projects that did not mention these terms in their abstracts (due to limited space) but do work in this area and so these were included as well. As this report covers activity pre-CoSTAR, the five CoSTAR labs are not included in the VP data subset.

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Types of VP projects

38 of the XR projects funded by UKRI between 2006 and 2024 were focused on virtual production.

Seven of the VP projects were R&D clusters of the type also seen in the Creative Industries Clusters Programme, that is, projects that bring together academia and industry with the aim of significantly contributing to the UK economy. These were:

- MyWorld (funded through Innovate UK)
- media.cymru (Innovate UK)
- StoryFutures Academy: Industry Centre of Excellence in Immersive Narrative (ISCF)
- StoryFutures: Gateway Cluster Partnership for Audiovisual Digital Creativity (UUI (ISCF & AHRC))
- UAL VP/XR for textiles and dress: Infrastructural development (Infrastructure Fund)
- XR Network+: Virtual Production in the Digital Economy (EPSRC)

Many of the other projects were focused on developing new processes (10 projects), or infrastructure (7), technologies (4) or assets (3) for VP (see Table 10). 3 projects were designed to provide training around VP, 2 were focused on creating a specific media performance, 1 on extending the impact of previous research, and 1 on understanding and guiding ED&I practices in VP (Co-Producing EDI Interventions for Virtual Production).

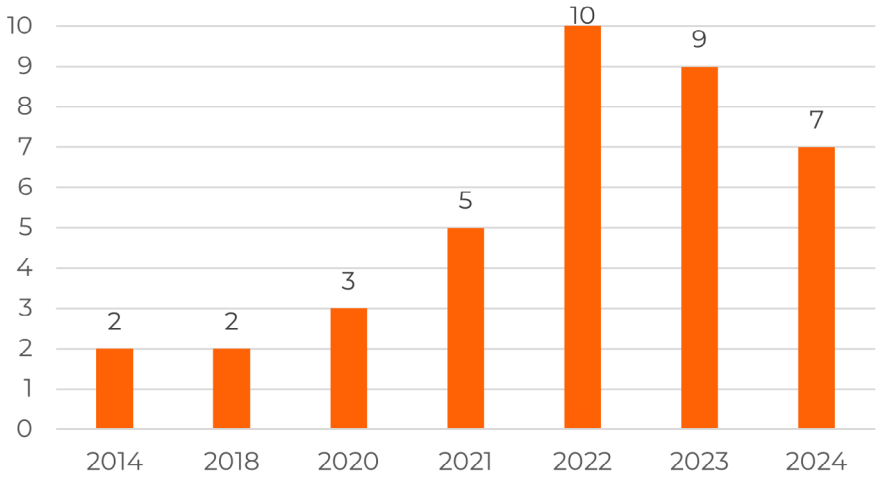
Table 10. Types of UKRI-funded VP projects, 2014-2024.

Type of VP project	Number of occurrences
Process	10
Infrastructure	7
R&D cluster	7
Technology	4
Assets	3
Training	3
Media product	2
ED&I	1
Impact	1

Timeline of UKRI-funded VP projects

The first VP projects were funded in 2014. There were no projects funded starting in 2015, 2016, 2017 or 2019, and there was a peak in 2023 (see Figure 8). Note that the CoSTAR Network is not included in this figure.

Figure 8. Number of VP projects funded by UKRI per year, 2014-2024.



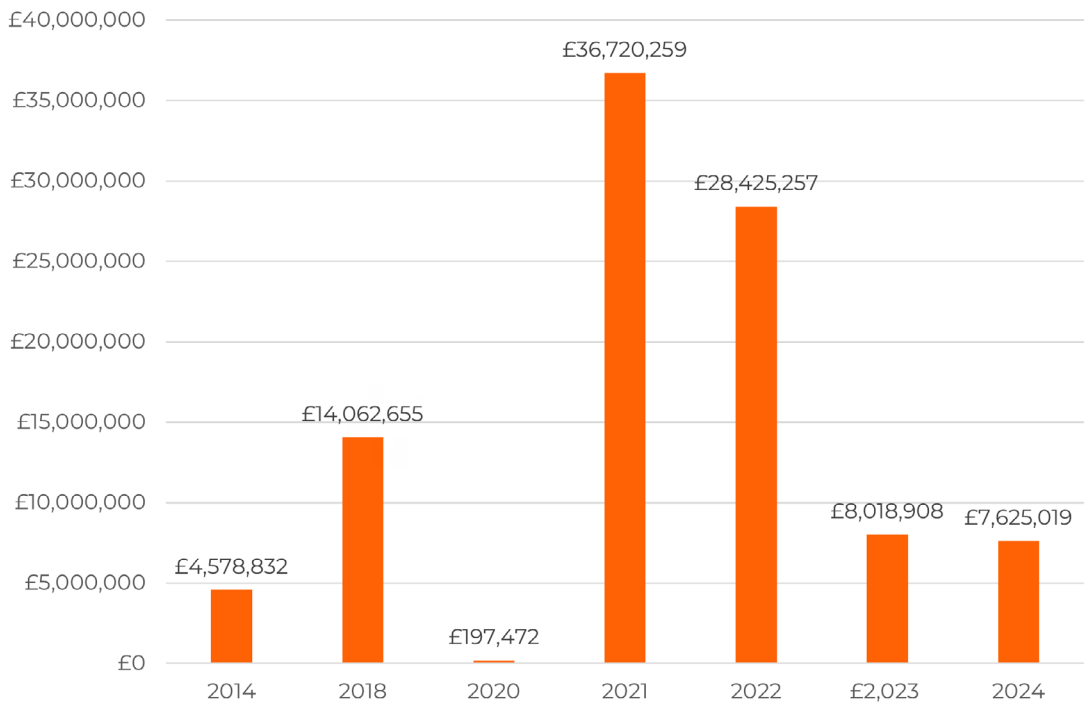
The first VP projects funded by UKRI were significant investments into projects led by commercial companies. The first was ASAP - A Scalable 2D/3D Architecture for Cross Media Virtual Production (funded through Innovate UK), a two-year project to develop new VP technologies and pipelines, led by visual effects studio Double Negative Limited (now DNEG) with a value of £1,929,948. The second was Real-time Interactive Cinematic Content Creation (funded through Innovate UK), a 1-year project to develop game engine technology, led by Industrial Light And Magic (UK) Ltd with a value of £2,648,884. While these first awards were made to projects led by industry, later this changed and the largest awards were made to VP projects led by academic institutions. This reflects the fact that AHRC have taken on this more infrastructure-oriented funding role.

Funding sources for VP projects

The 38 projects were awarded £99,628,402.[9] The funding awarded to VP projects each year was as follows in Figure 9, with a peak in 2021. In 2020 there was a dip in VP investment, likely due to the disturbance of normal working practices during the pandemic. In 2021 there was a huge surge in funding awarded to VP projects, this time likely due to an accelerated interest in VP due to the restrictions and uncertainties exposed by the pandemic (Swords and Willment 2024). In 2021 and 2022, Innovate UK provided most of the VP funding, reflecting its higher budget. Many of these projects were large-scale investments. 12 of the 38 VP projects were awarded over £1m.

9 It should be noted that financial data for studentships, of which there was one VP project, was not available.

Figure 9. Value of funding for VP projects from UKRI per year, 2014-2024.



This funding was delivered via multiple different funding schemes within UKRI: AHRC, EPSRC, FIC, Horizon Europe Guarantee, Infrastructure Fund, Innovate UK, ISCF, UUI (ISCF & AHRC) (see Table 11).

Table 11. Number of VP projects funded by each funding scheme within UKRI, 2014-2024.

Funding scheme	Number of projects
Innovate UK	22
AHRC	5
ISCF	3
Horizon Europe Guarantee	3
EPSRC	2
UUI (ISCF & AHRC)	1
FIC	1
Infrastructure Fund	1

Innovate UK funded the highest number of VP projects (22 out of 38) and gave the highest amount of funding to VP projects (£67,662,355) (See Table 12). As noted above, Gateway to Research only lists one funder per project and in some cases this does not reflect the reality of the situation. For example, a project may be funded by more than one scheme. The data presented in this report reflects the data available through Gateway to Research and we acknowledge that it may not convey the complexity of the funding situation.

Table 12. Value of funding for VP projects from each funding scheme within UKRI, 2014-2024.

Funding scheme	Total awarded
Innovate UK	£67,662,355
AHRC	£8,889,542
ISCF	£7,853,368
UUI (ISCF & AHRC)	£6,508,228
Infrastructure Fund	£3,576,000
EPSRC	£2,659,782
Horizon Europe Guarantee	£2,398,890
FIC	£80,237

Organisations and people involved in VP projects

The 38 VP projects were led by 35 different organisations with 3 organisations appearing twice on the list: Digital Catapult, University of Bristol and University of York. The 35 lead organisations are predominantly drawn from industry (22 organisations), with some from academia (11) and government (BBC and Digital Catapult led 1 project each), with the largest awards going to academic / industry collaborations led by academic institutions (listed above in section 'Types of VP projects'.

When all of the collaborating organisations are counted, 117 organisations participated in the 38 projects. Most of the projects list 1 organisation and only 5 of the VP projects list multiple collaborators: StoryFutures Academy: Industry Centre of Excellence in Immersive Narrative, StoryFutures: Gateway Cluster Partnership for Audiovisual Digital Creativity, XR Network+: Virtual Production in the Digital Economy, XRtists: Artists Extending Realities and MediaCity Immersive Technologies Innovation Hub.

87 individuals are named as organising these projects. 16 of these people worked on more than one of these projects but this is mostly accounted for by the similar team working on StoryFutures Academy: Industry Centre of Excellence in Immersive Narrative and StoryFutures: Gateway Cluster Partnership for Audiovisual Digital Creativity. The only other individual listed as working on more than one project is Professor Jane Harris, Director of Research & Innovation (Stratford) at London College of Fashion, University of the Arts London (UAL VP/XR for textiles and dress: Infrastructural development and XR Network+: Virtual Production in the Digital Economy).

There is not very much crossover in the organisations working on these VP projects, from which we can conclude that the UKRI-funded VP ecosystem in the UK prior to 2024 is comprised of many separate actors. However, when considered along with the non-VP projects, there is a lot more collaboration between organisations and individuals, which shows the integration of VP projects into the larger UKRI-funded creative R&D landscape.

Locations of VP projects

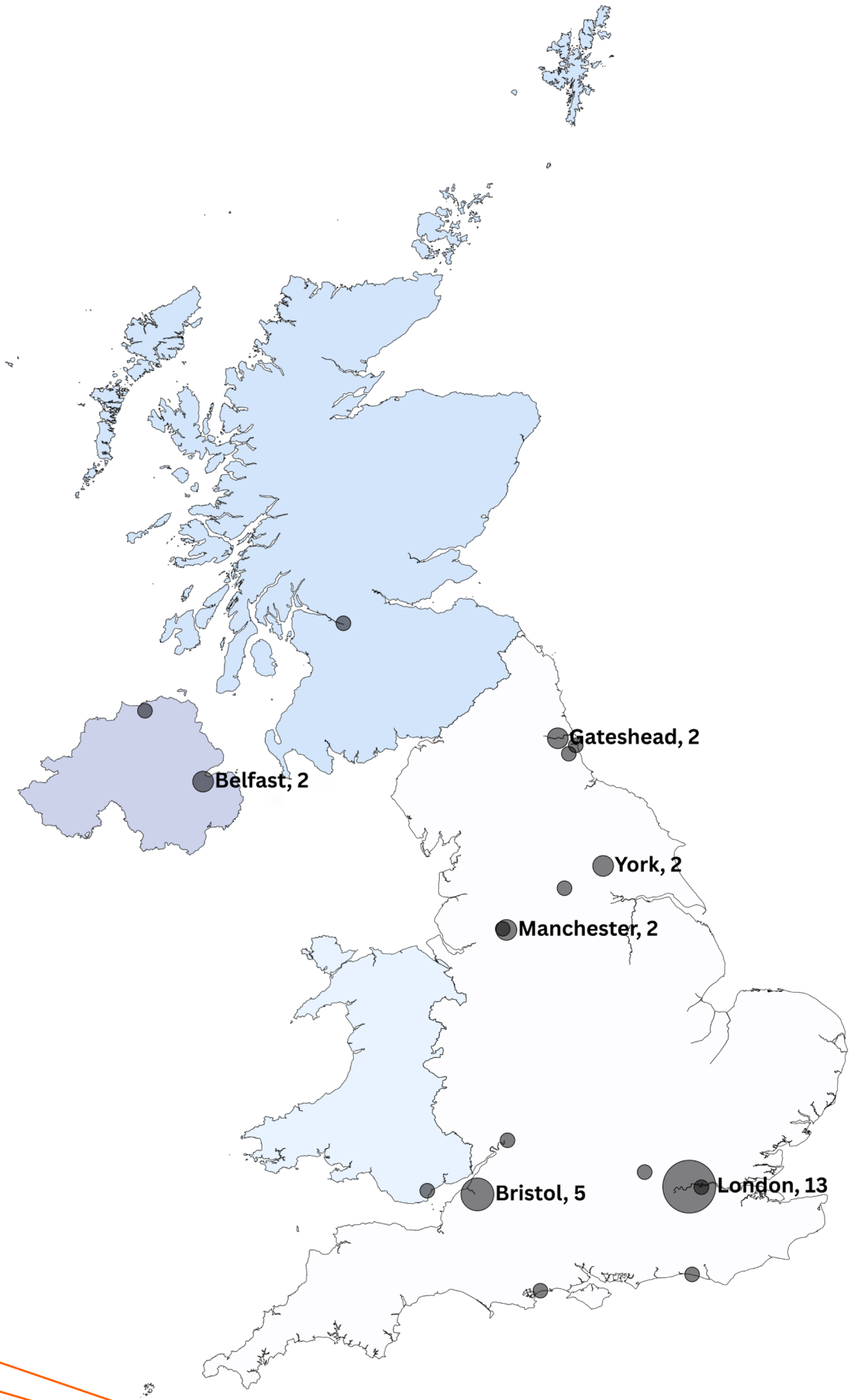
The 38 projects' lead organisations were based in 18 locations. London had the highest number of lead organisations (13 projects, 34% of all VP projects) then Bristol (5, 13%) (see Table 13).

Table 13. Number of UKRI-funded VP projects per location, 2014-2024

Location	Frequency
London	13
Bristol	5
Belfast	2
Gateshead	2
Manchester	2
York	2
Beaconsfield	1
Bournemouth	1
Brighton	1
Cardiff	1
Coleraine	1
Glasgow	1
Gloucester	1
Greenwich	1
Houghton Le Spring	1
Leeds	1
Salford	1
Sunderland	1

The map below indicates the locations of these VP projects' lead organisations with the size of the circles indicating how many organisations were based in a specific location (see Figure 10). Between 2014 and 2024 the lead organisations of UKRI-funded VP projects were predominantly located around London and Bristol, Yorkshire, Manchester, Belfast and in the Northeast of England. Locations with 2 or more lead organisations are labelled.

Figure 10. Locations of lead organisations for UKRI-funded VP projects, 2014-2024. Base map sourced from Office for National Statistics. Marker size indicates number of organisations in each location.



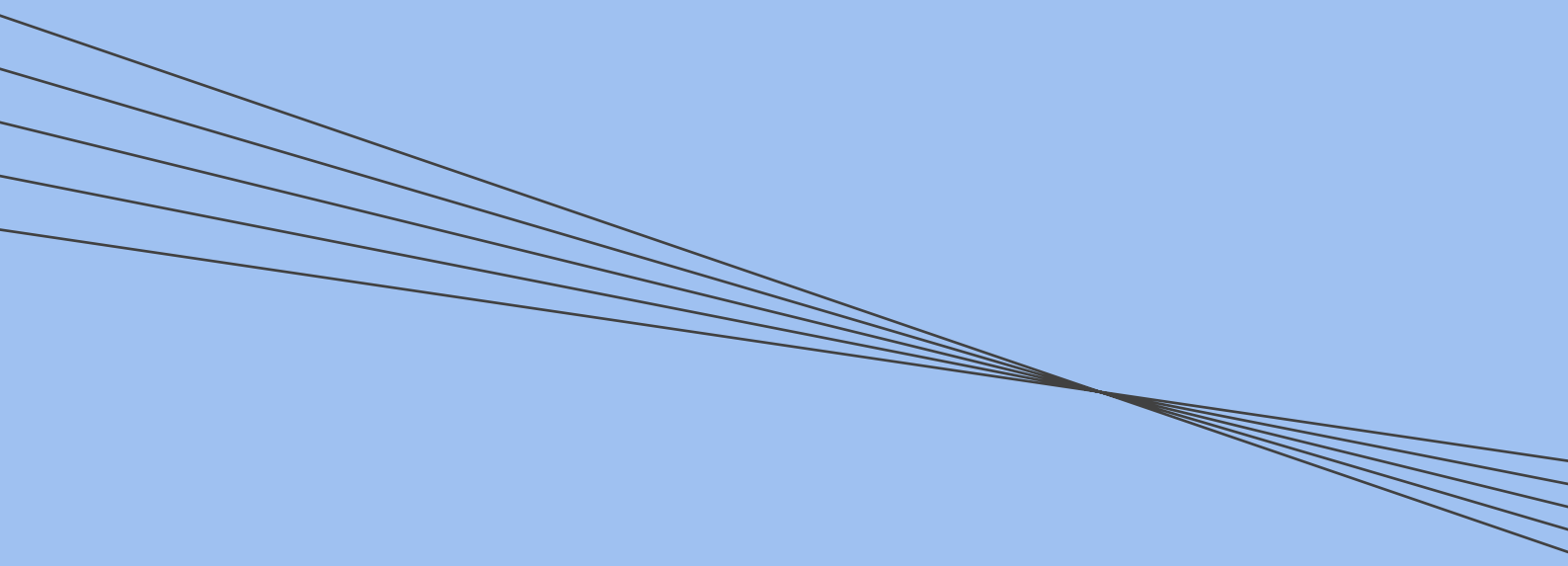
Benefits of place-based investment in creative R&D around VP: Belfast and Studio Ulster

Belfast and several of its neighbouring locations show a trajectory of UKRI-funded VP projects from 2006 to 2024. This started with the creative cluster Future Screens NI (FSNI) in 2018, two smaller projects (in 2021 and 2023), and then the area being selected as the site for the CoSTAR Screen Lab.

In the CICP bidding process, Future Screens NI was awarded £5.7m for a programme with the intention to "transform innovation and job creation and with creative industries hubs in Belfast, Newry, Coleraine and Derry/Londonderry" (FitzGibbon et al. 2023, 2). The UKRI investments into VP infrastructure and expertise in and around Belfast, benefitting academic institutions and businesses, led to further investment from both UKRI and the Northern Ireland Government. This included a £72m collaborative capital investment project supported by a £25.2m Belfast Region City Deal to create Studio Ulster (FitzGibbon et al. 2023, 27). This enabled Studio Ulster, at the Belfast Harbour Studios complex, to become the home of the CoSTAR Screen Lab, a state-of-the-art virtual production facility that is production-ready.

Belfast and the surrounding cities demonstrate what sustained funding into creative R&D can lead to, attracting funding from other sources and developing capacity for world-leading creative work, as well as economic regeneration for a region (Cuny 2022).

TRENDS IN XR ACTIVITY



Summary

Most of the 529 XR projects funded by UKRI between 2006 and 2024 have accompanying project descriptions on Gateway to Research. These show how the organisations describe their work and reveal their preoccupations and priorities as well as the priorities of UKRI.

The projects stayed consistent to the theme of immersive technologies with a focus on providing new audience experiences. The themes of artificial intelligence, ED&I, heritage, and sustainability were somewhat consistently present in the projects from 2017 onwards with a notable rise in mentions of artificial intelligence more recently.

Priorities of UKRI-funded XR projects

Taking all of the project descriptions and just looking at the content words (nouns, verbs, adjectives, adverbs) rather than the function words (conjunctions, prepositions, pronouns, etc.), there are 95,753 words in the dataset comprised of 6182 word types (unique words). The top 10 most frequent words across all of the descriptions can be seen in Table 14, which gives us an indication of the priorities of the organisations doing work on XR and the types of project that were successful in winning UKRI funding.

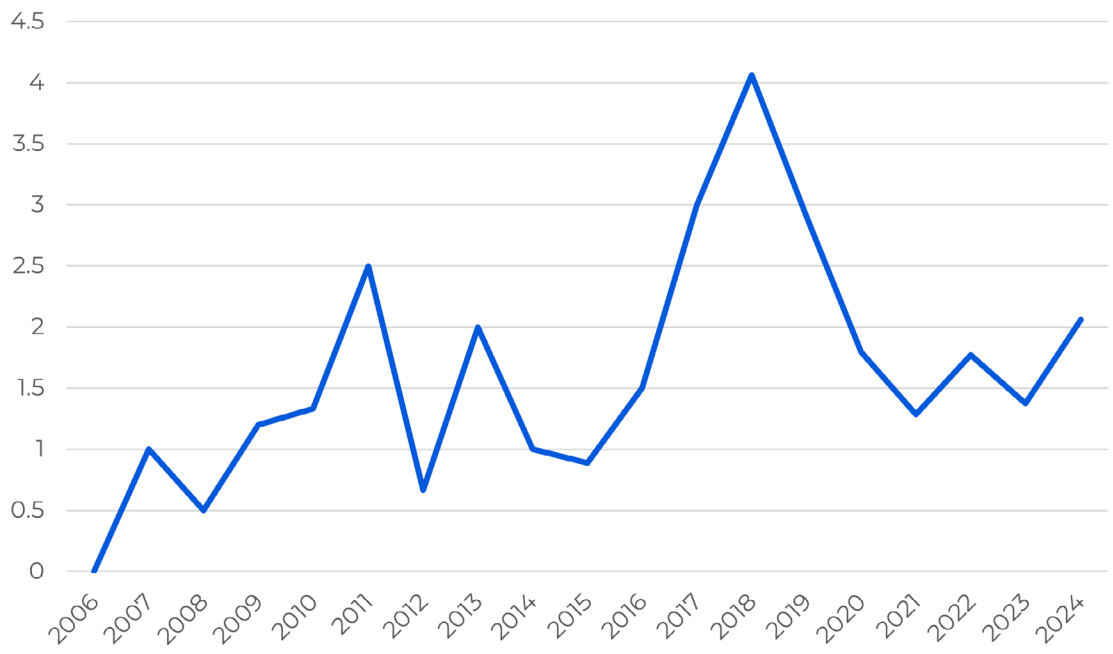
Table 14. Top 10 most frequent words in descriptions and forms they appeared in in UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.

Frequency	Word	Lemma Word Forms
3645	be	am 3 are 695 be 1076 been 201 being 108 is 1363 was 104 were 95
1094	experience	experience 579 experienced 42 experiences 454 experiencing 19
1039	project	project 921 projected 13 projects 105
891	immersive	immersive 891
856	have	had 26 has 383 have 431 having 16
825	use	use 315 used 174 uses 48 using 288
820	technology	technologies 366 technology 454
814	new	new 813 newer 1
695	research	research 677 researched 7 researches 1 researching 10
607	audience	audience 276 audiences 331

The prevalence of the terms ‘project’, ‘research’ and ‘new’ are to be expected since the descriptions describe research projects. The terms ‘immersive’, ‘technology’ and ‘audience’ are also expected as the dataset only contains projects involving immersive technologies, which often take the form of screen, performance and digital entertainment media designed to be shown to audiences.

The prevalence of ‘experience’ (and its variants) 1094 times points to a focus on developing user-oriented interactions rather than, for example, new technologies or academic knowledge creation. Looking at how many times the word ‘experience’ and its variants ‘experienced’, ‘experiences’ and ‘experiencing’ appeared each year relative to the number of projects funded, the high points for projects mentioning experience/d/s/ing was 2018, when there were, on average, 4 instances of these terms in each project description (see Figure 11).

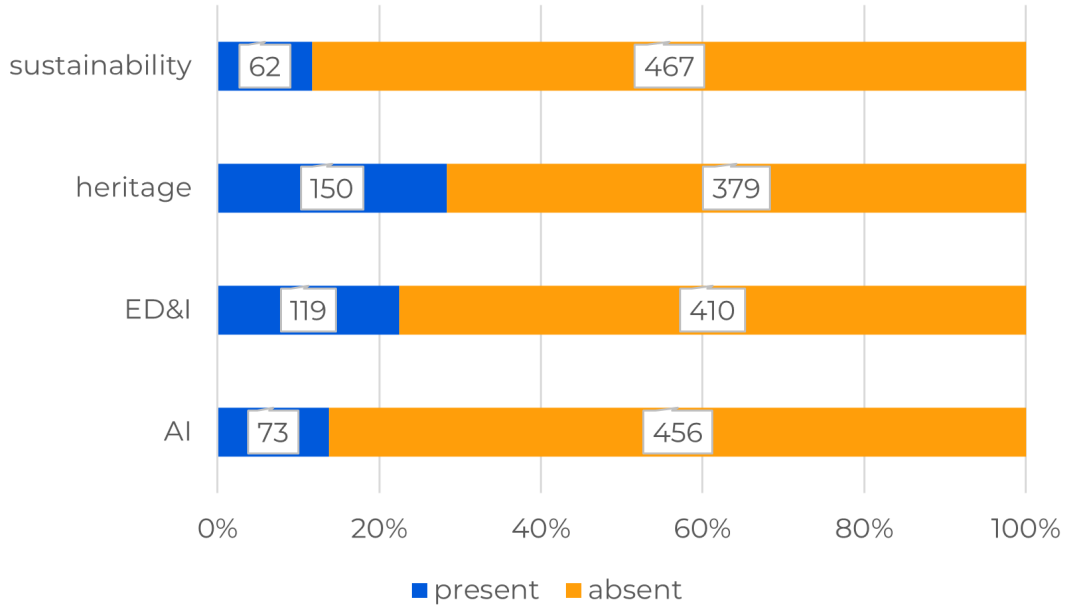
Figure 11. Average mentions of experience* per UKRI-funded XR project for screen, performance and digital entertainment each year, 2006-2024.



Trends in XR projects

During data collection we observed the presence of some themes in the UKRI-funded XR projects: artificial intelligence, ED&I, heritage, and sustainability. In order to determine how prevalent these themes were, and whether they changed over time, we manually annotated all 529 projects by reading their project descriptions and marking whether each of these four themes were present or absent (see Figure 12). All four themes were notably present.

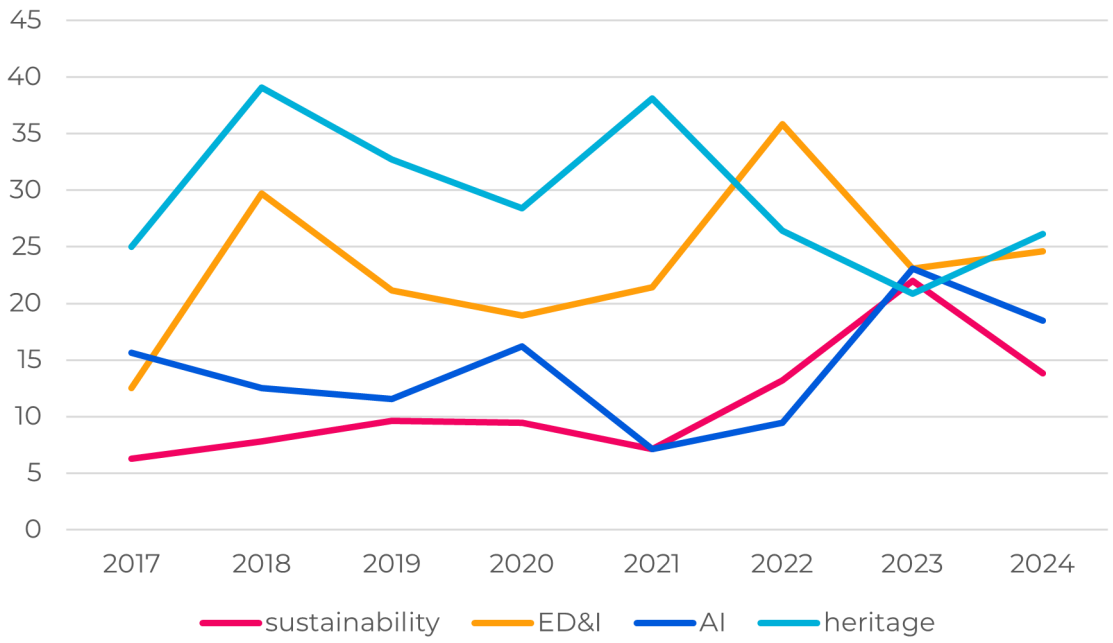
Figure 12. Presence of themes of artificial intelligence, ED&I, heritage, and sustainability in descriptions of UKRI-funded XR projects for screen, performance and digital entertainment, 2006-2024.



Themes over time

In order to determine whether the themes present in the projects changed over time, we graphed the percentage presence of each theme relative to the total number of projects for that year (See Figure 13). As there were comparatively few projects each year before 2017 (a total of 56 out of 529), we have omitted these from the graph.

Figure 13. Percentage of UKRI-funded projects for screen, performance and digital entertainment per year mentioning themes of artificial intelligence, ED&I, heritage, and sustainability, 2017-2024.



Projects mentioning AI peaked in 2023 and show a slight upward trend overall. The upwards trend is consistent with a greater interest in AI across all sectors over this time and the increase in work looking at the intersection of XR and AI has been noted (Hirzle et al. 2023).

Projects mentioning ED&I peaked in 2018 and 2022 and show a slight upward trend overall. It should be noted that this graph counts each project as one instance of each theme but, in practice, some projects are larger or smaller. For example, Co-Producing EDI Interventions for Virtual Production was a 4-year project with a clear ED&I focus whereas Morecambe Bay Timescapes; Engaging Young People in Visualising Coastal Futures was a 6-month project designed to promote young people's understanding of climate change while also making climate science more accessible to a

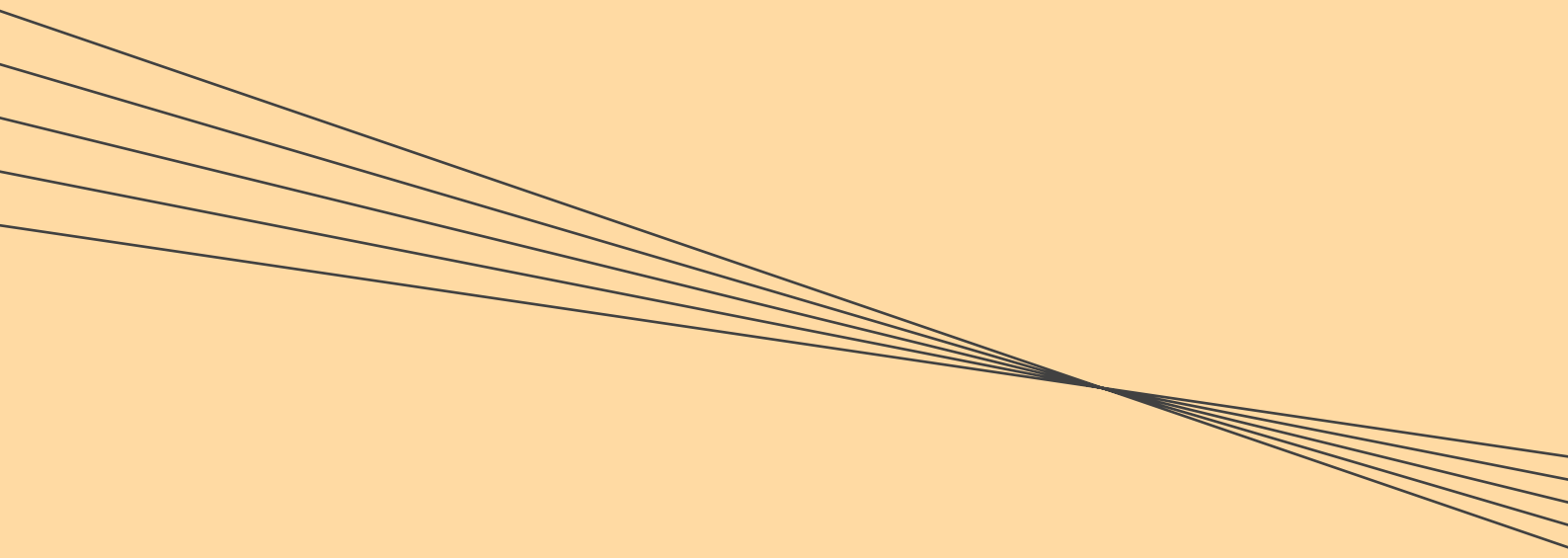
wider audience. The importance of understanding the ED&I consequences for XR and VP have been noted. There are claims that VP, for example, offers the chance to address existing inequalities in the screen industries, and although "[w]e must not be naive and assume virtual production will solve longstanding issues, many of which are rooted in wider societal structures of discrimination and exclusion … there are opportunities to make some change" (Willment and Swords 2023, 16).

Projects mentioning heritage peaked in 2018 and 2021 and show a slight downward trend since 2021 before a slight uptick in 2024. With 150 of the projects relating to heritage in some way, we find that this overlap between UKRI-funded XR projects and heritage sector merits further investigation in future work to explore the impact of XR investment in that sector.

Projects mentioning sustainability peaked in 2023 and show an upward trend. Research shows that the amount of scholarship looking at environmental applications of XR are increasing, but their impact has so far been limited (Cosio et al. 2023). VP in particular has the potential to reduce carbon and waste in certain areas – for example by reducing the number of cast and crew members who need to travel to remote locations (Keeney 2023). This stream of work is a focus for the CoSTAR Foresight Lab (see Neiman 2025).

As these results are based on project proposals, further research on the outcomes of these projects – the publications, events and products they generated – might provide more insight into the themes emerging from the activities the projects undertook.

CONCLUSIONS



Summary

Several reports have mapped aspects of the Creative Industries in the context of extended reality and immersive media technologies. This report has offered a comprehensive overview of the activity in this space funded by UKRI and focusing on the application of immersive technologies to screen, performance and digital entertainment media production between 2006 and 2024. We do this to align with the anticipated work being done by the five CoSTAR Network Labs over their duration (2024-2029) to facilitate comparison between this kind of activity in a pre- and post-CoSTAR landscape.

We have seen that since 2006 UKRI has funded 529 projects in this area, awarding £231,159,278, which was approx. 0.33% of UKRI's budget for that time period. The year 2017 saw a marked increase in UKRI investment into XR projects, and with this larger number of projects there was an increasing focus on virtual production, heritage use cases, AI, ED&I and sustainability. 35 of the projects were awarded over £1m and these were often large, multi-year and multi-organisation projects that included investment in technologies, infrastructure, HEIs and industry. Although the largest hub for activity is London, this dominance has decreased since reports from only a few years ago due to government investment in other areas of the UK. The importance of collaborations across HEIs, media production companies, tech companies and, as we have found, UK media infrastructure like the BBC and BFI are crucial to this work. It is therefore essential to find mechanisms and resources to support these networks as well as individual facilities.

Sustained investment

The CoSTAR Network Labs are located in Belfast (Screen Lab), Dundee and Edinburgh (Realtime Lab), London, Loughborough and Edinburgh (Foresight Lab), at Pinewood Studios near London (National Lab) and Yorkshire (Live Lab).

Some of these areas have repeatedly benefited from UKRI funding for XR and VP projects. Belfast was home to one of the CICP clusters, Future Screens NI, Dundee to InGAME, Edinburgh to Creative Informatics, London to Business of Fashion, Textiles and Technology and Storyfutures and York to XR Stories.

Outside of the scope of the Gateway to Research dataset, investment was made through UKRI's Digital economy theme between 2008 and 2022 into projects in the London and York areas: Media and Arts Technology at Queen Mary, University of London, and Intelligent Games and Games Intelligence (IGGI) at University of York, University of Essex and Goldsmiths College, University of London.

Between 2006 and 2024 the investment pattern of UKRI tells a story of how successive funding from UKRI – and from other funders – laid the foundations for creative R&D ecosystems, which UKRI can then choose to compound by investing into clusters in those areas. An example of which is the competitive process for funding for the CoSTAR Network Labs.

Other locations in the UK have been the sites of major creative R&D projects without later hosting a CoSTAR Network Lab. Two of these are Bristol and Bath, which were the locations of the UKRI's Digital Economy Theme projects The Centre for the Analysis of Motion, Entertainment Research and Applications (CAMERA) at the University of Bath and Centre for Digital Entertainment based at Bath and Bournemouth Universities, and are currently the sites of MyWorld

and leading on XRtists: Artists Extending Realities. Cardiff has media.cymru. The Northeast of England has been the location of several projects including a 5G production studio.

Predictions are that the value of the XR sector will only increase in the next five years, and this is supported by further investment by UKRI. In addition to the CoSTAR Network (2024-2029), UKRI announced in 2024 two new clusters as part of a commitment in principle of at least £50m in a new round of Creative Industries clusters (UK Research and Innovation 2024). CreaTech Frontiers in the West Midlands will be led by Birmingham City University with Coventry University, the University of Birmingham, the University of Warwick and the Royal Shakespeare Company and focus on creative technologies like video games, virtual production and immersive reality. Liverpool City Region's MusicFutures will be led by the University of Liverpool with Liverpool John Moores University and other partners and will focus on artificial intelligence and extended reality.

Future work

There are some areas in which more targeted analysis would be beneficial: the correlation between the locations of organisations receiving UKRI-funding, population density and the relevant indexes of multiple deprivation; the role of international collaborators (especially China and Hong Kong) in UKRI-funded XR activity; and the role of XR activity in the heritage sector. Future work is needed on the outcomes and impacts of the projects covered in this report.

This report takes as its focus XR and immersive projects for screen, performance and digital entertainment funded by UKRI between 2006 and 2024. Therefore, it does not address other uses of similar technologies, such as in the manufacturing and medical sectors. It does not address similar activity funded by other means than UKRI. The CoSTAR Foresight Lab will publish a further report offering a comparable overview of other XR investment and activity in the UK.

DATASET

The dataset of 529 UKRI-funded XR projects between 2006 and 2024, which underpins this work, is available on the Foresight Lab Zenodo page, published with an open license. Please cite as:
Black, S., & Carter, S. (2025). UKRI-funded Extended Reality (XR) Projects 2006-2024 [Data set]. Zenodo. https://doi.org/10.5281/zenodo.15188609

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REFERENCES

- Anthony, Lawrence. 2018. 'AntConc'. Tokyo, Japan: Waseda University. http://www.laurenceanthony.net/software.
- Bastian, Mathieu, Sebastien Heymann, and Mathieu Jacomy. 2009. 'Gephi: An Open Source Software for Exploring and Manipulating Networks'. *Proceedings of the International AAAI Conference on Web and Social Media* 3 (1): 361–62. https://doi.org/10.1609/icwsm.v3i1.13937.
- Beauhurst, and Huckletree. 2022. 'Future Insights: The New Media & Immersive Tech Report 2021'. https://cdn.buttercms.com/Vy6fueCrRiSytcgiOMB9.
- Bennett, James, and Amanda Murphy. 2020. 'Skills for Immersive Experience Creation: Barriers to Growth in the UK's Immersive Economy'. StoryFutures Academy. https://www.storyfutures.com/uploads/images/SFICC-Report-2019-20.2.20.pdf.
- Chitty, Andrew. 2023. 'How Much Does the UK Invest in Publicly Supported R&D in the Creative Industries? And How Does This Compare to Other Sectors?' *CRAIC* (blog). 5 October 2023. https://craic.lboro.ac.uk/essays/how-much-does-the-uk-invest-in-publicly-supported-rd-in-the-creative-industries-and-how-does-this-compare-to-other-sectors/.
- Comunian, Roberta, Calvin Taylor, and David N. Smith. 2014. 'The Role of Universities in the Regional Creative Economies of the UK: Hidden Protagonists and the Challenge of Knowledge Transfer'. *European Planning Studies* 22 (12): 2456–76. https://doi.org/10.1080/09654313.2013.790589.
- Cosio, Laura D, Oğuz 'Oz' Buruk, Daniel Fernández Galeote, Isak De Villiers Bosman, and Juho Hamari. 2023. 'Virtual and Augmented Reality for Environmental Sustainability: A Systematic Review'. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–23. CHI '23. New York, NY, USA: Association for Computing Machinery. https://doi.org/10.1145/3544548.3581147.
- Creative Industries Council. 2021. 'The Createch Report 2021: Mapping the Intersection of Technology and Creativity Part 1 Investment'. https://web.archive.org/web/20210316115601/https:/technation.io/the-createch-report-2021/.
- Cremona, Cinzia, and Manolya Kavakli. 2023. 'The Evolution of the Virtual Production Studio as a Game Changer in Filmmaking'. In Creating Digitally: Shifting Boundaries: Arts and Technologies—Contemporary Applications and Concepts, edited by Anthony L. Brooks, 403–29. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-31360-8_14.
- Cuny, Lara. 2022. 'The Government and the Economic Potential of the Arts'. In *The History of the Arts Council of Northern Ireland, 1943–2016: Between the State and the Arts*, edited by Lara Cuny, 255–68. Springer International Publishing. https://doi.org/10.1007/978-3-031-13409-8_14.
- Doeser, James, and Graham Hitchen. 2021. 'A Bibliometric Assessment of UK Research Strengths and Collaborations in the Creative Industries'. *CRAIC* (blog). 31 March 2021. https://craic.lboro.ac.uk/essays/a-bibliometric-assessment-of-uk-research-strengths-and-collaborations-in-the-creative-industries/.
- Elliott, David. 2023. 'New Belfast Film Production Lab Will Offer ABBA Voyage Virtual Technology'. Business Live. 16 June 2023. https://www.business-live.co.uk/technology/new-belfast-virtual-production-lab-27139470.
- Farquharson, Christine, Luke Heath Milsom, Imran Tahir, Gautam Vyas, and Bobbie Upton. 2024. 'How Do the Last Five Years Measure up on Levelling Up?' The IFS. https://doi.org/10.1920/re.ifs.2024.0323.
- FitzGibbon, Ali, Hyojung Sun, and Dan Acheson. 2023. 'Future Screens NI Evaluation'. Queen's University Belfast. https://pure.qub.ac.uk/en/publications/future-screens-ni-evaluation.
- Foord, Jo. 2013. 'The New Boomtown? Creative City to Tech City in East London'. *Cities*, Creative cities after the fall of finance, 33:51–60. https://doi.org/10.1016/j.cities.2012.08.009.

- Gitman, Lawrence J., Carl McDaniel, Amit J. Shah, Monique Reece, Linda Koffel, Bethann Talsma, and James C. Hyatt. 2018. *Introduction to Business*. Houston, Texas: OpenStax, Rice University. https://openstax.org/details/books/introduction-business.
- Hagberg, Arik A., Daniel A. Schult, and Pieter J. Swart. 2008. 'Exploring Network Structure, Dynamics, and Function Using NetworkX'. In *Proceedings of the Python in Science Conference (SciPy)*. http://conference.scipy.org.s3-website-us-east-1.amazonaws.com/proceedings/scipy2008/paper_2/.
- Hitchen, Graham, Amanda Cusimano, and Teodora Lazar. 2023. 'Virtual Production Ecosystem Mapping'. Loughborough University London and BOP Consulting. https://repository.lboro.ac.uk/articles/report/Virtual_production_ecosystem_mapping/24936582?file=43891083.
- Hirzle, Teresa, Florian Müller, Fiona Draxler, Martin Schmitz, Pascal Knierim, and Kasper Hornbæk. 2023. 'When XR and AI Meet - A Scoping Review on Extended Reality and Artificial Intelligence'. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–45. CHI '23. New York, NY, USA: Association for Computing Machinery. https://doi.org/10.1145/3544548.3581072.
- Hogan, Sophie. 2024. 'Funding for UK-China Joint Research Evaporates'. *Research Professional News* (blog). 18 December 2024. https://www.researchprofessionalnews.com/rr-news-uk-politics-2024-12-funding-for-uk-china-joint-research-evaporates/.
- Huggins, Robert, and Andrew Johnston. 2009. 'Knowledge Networks in an Uncompetitive Region: SME Innovation and Growth'. *Growth and Change* 40 (2): 227–59. https://doi.org/10.1111/j.1468-2257.2009.00474.x.
- Immerse UK and Digital Catapult. 2019. 'The Immersive Economy in the UK 2019'. Digital Catapult and Immerse UK. https://www.digicatapult.org.uk/publications/post/the-immersive-economy-in-the-uk-2019/.
- Immerse UK and HTC VIVE X. 2021. *UK Immersive Tech: VC Investment Report*. https://iuk.immersivetechnetwork.org/wp-content/uploads/2021/06/VIVE-X-Immerse-2021-UPDATED.pdf
- Innovate UK. 2018. 'Immersive Technologies for Audiences of the Future: New Funding'. GOV.UK. 28 March 2018. https://www.gov.uk/government/news/immersive-technologies-for-audiences-of-the-future-new-funding.
- Keeney, Declan. 2023. 'Virtual Production's Role in Carbon Reduction and Net Zero Production in the Screen Industries Future Observatory Cultural Policy Fellowship Report'. Studio Ulster at Ulster University. https://futureobservatory.org/files/dcmsreports/futureobservatory_culturalpolicyreport_studioulster.pdf.
- Kennedy, Kelli, and Sam Stockley-Patel. 2020. 'The XR Sector's Economic Contribution'. XR Stories. 2 September 2020. https://xrstories.co.uk/the-xr-sectors-economic-contribution/.
- Mateos-Garcia, Juan. 2021a. 'An Analysis of Createch R&D Business Activity in the UK'. Creative Industries Policy and Evidence Centre. https://pec.ac.uk/wp-content/uploads/2024/01/PEC-An-analysis-of-Createch-RD-business-activity-in-the-UK-v3-1.pdf.
- Mateos-Garcia, Juan. 2021b. 'Mapping the R&D Landscape for Creative Technologies'. *Insights for Policymakers*. Creative Industries Policy and Evidence Centre and Nesta. https://pec.ac.uk/policy_briefing_entr/mapping-the-r-d-landscape-for-creative-technologies/.
- McDonald, Caitlin, Jennie Jordan, and Graham Hitchen. 2024. 'R&D in the Creative Industries: Bringing the "Dark Matter" of the Sector to Light with Data'. In *Data-Driven Innovation in the Creative Industries*, edited by Melissa Terras, Vikki Jones, Nicola Osborne, and Chris Speed, 1st edition, 46–68. New York: Routledge. https://doi.org/10.4324/9781003365891.
- Montgomery, John. 2007. 'Creative Industry Business Incubators and Managed Workspaces: A Review of Best Practice'. *Planning Practice & Research* 22 (4): 601–17. https://doi.org/10.1080/02697450701770126.
- Nieman, Babet, Shrey Sood, Rhiannon Williams, and Florence Mansfield. 2025. 'Sustainability Impacts of Convergent Technologies in the UK Creative Industries'. Zenodo. https://doi.org/10.5281/zenodo.15124461.
- O'Hara, Ellen, and Deepa Naik. 2021. 'Mapping Creative Hubs in England'. British Council. https://resources.mereka.io/wp-content/uploads/sites/8/2023/08/Mapping_Creative_Hubs_In_England_4841dd96a1.pdf.
- Paavilainen, Janne, Hannu Korhonen, Kati Alha, Jaakko Stenros, Elina Koskinen, and Frans Mayra. 2017. 'The Pokémon GO Experience: A Location-Based Augmented Reality Mobile Game Goes Mainstream'. In *Proceedings of the 2017 CHI Conference on*

Human Factors in Computing Systems, 2493–98. CHI '17. New York, NY, USA: Association for Computing Machinery. https://doi.org/10.1145/3025453.3025871.

- Panneels, Inge, Candace Jones, Caroline Parkinson, Marlen Komorowski, and Anna Orme. 2024. 'Ecosystems and Partnerships: Enabling Factors for Data-Driven Innovation in the Creative Industries'. In *Data-Driven Innovation in the Creative Industries*. Routledge. https://doi.org/10.4324/9781003365891.
- Romer. 2017. 'New Fund to Help Arts Organisations Develop Immersive Content - Arts Professional', 2 October 2017. https://www.artsprofessional.co.uk/news/new-fund-help-arts-organisations-develop-immersive-content.
- Smith, Christopher, Andrew Chitty, and Paul Meller. 2023. 'A Deep Dive into the Creative Industries: Mapping UKRI's Engagement with the UK's Fastest Growing Knowledge Sector'. UK Research and Innovation. https://craic.lboro.ac.uk/wp-content/uploads/2023/10/DEEP_DIVE_June21-version-2.pdf.
- Stapleton, Dan. 2016. 'Oculus Rift Review'. IGN. 31 March 2016. https://www.ign.com/articles/2016/03/31/oculus-rift-review.
- Swords, Jon, and Nina Willment. 2024. 'The Emergence of Virtual Production – a Research Agenda'. *Convergence* 30 (5): 1557–74. https://doi.org/10.1177/13548565241253903.
- Thomas, Sarah. 2025. ''This Is the Way': ILM's StageCraft, Disney's Star Wars: The Mandalorian and Constructing the Rhetoric of Virtual Production'. In The Screens of Virtual Production. Routledge. https://doi.org/10.4324/9781003463139.
- UK Research and Innovation. 2022. '2022-23 - 2024-25 Budget Allocations for UK Research and Innovation'. https://www.ukri.org/wp-content/uploads/2022/06/UKRI-241023-BudgetAllocationExplainer2022To2025.pdf.
- UK Research and Innovation. 2024. 'Two Major UKRI Investments Continue to Boost Creative Industries'. 27 November 2024. https://www.ukri.org/news/two-major-ukri-investments-continue-to-boost-creative-industries/.
- UK Research and Innovation. 2025. 'UKRI China'. UKRI. 19 March 2025. https://www.ukri.org/what-we-do/international-funding/our-international-offices/ukri-china/.
- UK Research and Innovation and Department for Business, Energy & Industrial Strategy. 2021. 'UK Research and Innovations Management of the Industrial Strategy Challenge Fund'. National Audit Office. https://www.nao.org.uk/wp-content/uploads/2021/02/UK-Research-and-Innovations-management-of-the-Industrial-Strategy-Challenge-Fund-Summary.pdf.
- Wang, Yi, Greg Hearn, Shane Mathews, and Jenny Hou. 2024. 'Networks, Collaboration and Knowledge Exchange in Creative Industries: A Comparative Analysis of Brisbane and Shenzhen'. *Creative Industries Journal* 17 (1): 88–112. https://doi.org/10.1080/17510694.2022.2057062.
- Willment, Nina, and Jon Swords. 2023. 'What Is Virtual Production?: An Explainer and Research Agenda'. University of York. https://doi.org/10.15124/YAO-YVGQ-H730.
- Willment, Nina, Damian Murphy, Suzanne R. Black, Greg Mothersdale, Jane Harris, and Melissa Terras. 2024. 'Innovation in Future Convergent Media and Virtual Production Technologies: Reporting from XR Network+ Workshops 2023/4'. XR Network+. https://xrnetworkplus.xrstories.co.uk/wp-content/uploads/2024/10/XR-Network-WhitePaper-Report-Web.pdf.

APPENDIX. UKRI funding schemes

- Arts and Humanities Research Council (AHRC): funds research across the arts and humanities including the Creative Industries.
- Engineering and Physical Sciences Research Council (EPSRC): funds research across engineering and the physical sciences including digital technologies.
- Fund for International Collaboration (FIC): funds projects between the UK and 20 partner countries. This fund is now closed.
- Horizon Europe Guarantee: EU funding programme for research and innovation.
- Infrastructure Fund: funds infrastructure for research and innovation.
- Innovate UK: funds the development and commercialisation of new products, processes and services to grow UK businesses.
- Industrial Strategy Challenge Fund (ISCF): funds academic and industry collaborations across a number of targeted sectors.
- Underpinning UKRI Investment (UUI): Some projects have been listed this way in the Gateway to Research database. The projects referred to in this report as being funded by UUI are all ISCF and AHRC projects.

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