

September 2022

Evaluation of the ISCF Audience of the Future



Final report

Cristina Rosemberg, Charlotte Glass (Technopolis Group), Richard Naylor, Lizzie Parker, Marta Moretto (BOP Consulting)

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Executive Summary

This report

This is the **Final Report of the evaluation of the Industrial Strategy Challenge Fund ‘Audience of the Future’ (ISCF AotF)**. Overall, the evaluation included three phases: Baseline and Early Findings, Interim Findings and Final Evaluation.

The overall scope of the final evaluation is to assess the extent to which the programme is making, or has made, an impact considering its original high-level objectives. The evaluation has also tested the extent to which the programme has delivered its intended outcomes and impact for industry, and the extent to which these are attributable to ISCF funding.

The programme

The programme has spent £39.3m in the development of new immersive technologies such as virtual, augmented and mixed reality, and have commissioned research to better understand audiences for immersive productions in the fields of art, culture, heritage and entertainment.

The programme is comprised of three core areas of investment: the National Centre for Immersive Storytelling (£6.9m from ISCF AotF), the Demonstrators (maximum £17.7m), and the R&D programme (£10.2m), which consists of three instruments: the Production Innovation in Immersive Content, the Design Foundations 1, and the Investment Accelerator.

Subsequent investments were also made to support companies during the COVID-19 pandemic through further grants (£0.6m), and through a second Design Foundations competition (which is subject to a separate evaluation).

Overall, the programme has involved 128 participants among businesses (104), academic institutions (22), Public Sector Research Establishments (PSREs) and other public sector organisations (2).

Methodology

The evaluation has been guided by an Evaluation Framework set up at the beginning of the process, which included a Theory of Change for the intervention, and a detailed indicator framework. We have implemented a mixed methods approach, including those listed in the table below.

| | |
|------------------------|---|
| Desk review | Analysis of programme data including programme portfolio and Project Completion Forms |
| Market analysis | Sector level analysis Wider market analysis and conditions |
| Case studies | Grants & Investments case studies StoryFutures Academy case studies Demonstrator case studies |
| Surveys | Post-exit survey of PIIC and IA applicants (G&I) StoryFutures Academy survey Demonstrator quantitative survey |
| Focus groups | StoryFutures Academy focus groups Post-completion focus group: SFA internal stakeholders |
| Interviews | Demonstrator interviews Stakeholder interviews |

Key findings – the sector

Creative Immersive Content sector in the UK

Companies and workforce. The number of companies operating in the Creative Immersive Content sector in the UK (as defined in this study using an agreed list of keywords) has been declining since 2019, but the workforce has increased, suggesting a higher consolidation in the market.

According to our analysis, a total of 1,200 companies are working in the Creative Immersive Content sector in 2020, to some extent. This represents a decrease of 7% in comparison with the prior period, and of 15% in comparison with the baseline year (where we found 1,406 companies operating in this sector). The ISCF AotF programme is engaging with 104 companies from the sector (this means that approximately 9 out of 100 companies working in the Creative Immersive Content sector will directly benefit from the programme). This represents an increase from the baseline (when the reach was 6 out of 100 companies).

In contrast, the size of workforce in Creative Immersive Content sector is increasing. We estimate that a workforce of up to 43,158 people identified themselves as working in the Creative Immersive Content sector, a 53% increase in comparison with the baseline position. Furthermore, the proportion of the workforce in the sector that can be qualified as 'tech skilled' has also increased from 23% in baseline position to 29%. Given the increase in the Creative Immersive Content sector workforce in total, this means an increase in 'tech skilled' workforce of 73%, in comparison with the baseline position. We also find that the sector is overall retaining talent and increasing the levels of seniority overtime. This data speaks of a growing sector, not only in terms of business but also skills.

There is also a good geographical spread in terms of specialisation in the Creative Immersive Content sector, which means that any public investment in this sector is likely to contribute to the government's Levelling up agenda. The London workforce accounts for almost 61% of the total UK Creative Immersive Content workforce (slightly higher than the baseline position of 58%). However, although the absolute numbers are large, the size of the creative workforce in London means that the employment in the capital in Creative Immersive Content currently accounts for only 0.65% jobs in the CI sector in the region. The highest penetrations – for regions with a workforce of 100 or more – are instead to be found in Oxford (145, 1.01%), Cambridge (317, 0.97%) and Sheffield (253, 0.92%), and Brighton and Hove (306, 0.77%).

Investment. Private investment is considerably more substantial, partly because it includes total investment far beyond R&D. We estimate that private investment in the Creative Immersive sector in the UK has been \$183m (£153m) in the past year, based on the values raised in the last investment round (and on disclosed information). This represents an increase of 51% in comparison to the baseline (calculated as a yearly average, based on the information from the prior three years). Moreover, in comparison with France, a country that also has a strong immersive content sector, we find the UK is performing better, with investments that are over 6 times higher. Seven companies that have participated in different strands of the AotF programme have secured deals during the period 2018 to 2022.

Further analysis reveals that the profile of investment in the UK has shifted towards early-stage companies, i.e., towards riskier investments, with 63% and 13% of the deals related to Pre-seed/Seed and Series A, respectively (and 76% across both).

UKRI grants in Creative Immersive Content (use here as a proxy of public investment) have remained constant and relatively low. At roughly twice the total average value of other UKRI grants, the support provided via the ISCF AotF programme (£39.3m in 2018-2021, i.e., ~£10m per year) constitutes a substantial additional investment in this area by the UK government.

Creative Immersive Content sector internationally

Recent estimates of the combined Augmented reality/Virtual reality (AR/VR) global market size in 2021 are considerably lower than were forecast at baseline stage. While inflated growth forecasts are not uncommon in relation to new technologies, immersive hardware supply chain issues arising from the pandemic may also have impacted the growth of the market over the past few years.

Nevertheless, industry analysts still envisage strong growth over the coming years, with the combined AR/VR global market projected to reach \$455bn in 2030.

AR remains better positioned for immediate growth than VR. Distribution platforms for AR have already converged whereas VR distribution remains segmented. However, tech brands are committing to the hardware market and Meta's Quest2, launched in late 2020, represents a significant improvement in VR hardware.

While gaming activity remains the largest segment of the immersive technology market, there is increasing investment from social media companies: Meta has recently invested \$10bn into its in-house Extended reality (XR) business, with a further \$3.3bn invested in immersive tech between 2020 - 2022 via major deals and acquisitions from social network providers.

XR remains a niche segment within the wider games market. The success of flagship AR product, Pokémon GO remains highly atypical of the sector.

In terms of challenges ahead for the industry, analysts report a global shortage in technical and creative skills in immersive technologies. Additionally, data protection issues are becoming increasingly pertinent around XR and VR in particular.

In terms of main players, China is the leading market for XR, estimated to account for almost 56% of global AR/VR spending in 2021, although new restrictions that limit gaming hours among under 18s may affect demand.

In terms of prestige and visibility, we find that the share of international awards in creative immersive tech being awarded to US companies has declined since baseline phase, which may indicate an increasingly competitive picture globally, though the smaller UK share of awards is stable.

External stakeholders still see the UK's strength as content creation, although they characterise the global market as increasingly competitive. ISCF AotF is viewed as unique in terms of government support for creative immersive tech.

In summary, we find that, despite some challenges, the Creative Immersive Content sector internationally is set to grow, with increasing investment and competition between immersive hardware manufacturers and content producers.

Key findings – the programme

Overview

Overall, ISCF AotF has largely met its intended goals and objectives. This is particularly true of the Grants and Investments strand, which supported the creation of new immersive products and services, and the Story Futures Academy (SFA) strand, which succeeded in upskilling its participants and embedding knowledge and capacity across the sector (see below for further analysis against objectives).

The picture of success is more mixed across the Demonstrators. The investments in the four consortia have always been the riskiest element of the programme, given the size of the investment across such a small spread, and the level of ambition that the Demonstrators were tasked with achieving. It must also be recognised that the delivery of AotF, particularly the

Demonstrators, coincided with the Covid pandemic. The resilience and resourcefulness of the beneficiaries, coupled with the flexibility and care extended to them by UKRI, is notable.

Across the wider industry, the programme has enjoyed significant reach and interest across the UK's creative immersive sector, with stakeholders attesting to the contribution that it has made to the positive state of the sector, including its international standing.

Demonstrators

All of the Demonstrators projects experienced challenges related to the Covid-19 pandemic which led teams to 'pivot' their projects to deal with new realities. The extent to which Demonstrators were exposed to these challenges was related to how much of their original plans involved physical elements, which had to be either abandoned or postponed.

Easing of restrictions in the last eighteen months allowed projects to fulfill their Covid-adjusted plans and ambitions, in particular with respect to the Location Based Experiences that were delayed by the pandemic. This last period also enabled organisations to test different business models and (to some degree) test commercial viability, as well as think about building upon their projects.

At the end of the project, **100% of the participants reported that their projects would had not have gone ahead** without the UKRI funding (base: 23, Project Completion Form data), indicating strong additionality for the Demonstrator investment. Outputs from across the Demonstrators have typically generated significant industry traction and met with critical acclaim.

Two of the four Demonstrators – the eSports and Moving Image Demonstrators – have attracted follow-on interest and investment. In both cases, the investment has come from trade sources (in this case, larger companies) rather than external investors, as is typical of creative industries investment.

Meeting the audience target of 100,000 (for each Demonstrator) has been more difficult. Two of the four Demonstrators (eSports and Immersive Performance) met this target. Still, **overall audience engagement** across the four consortia amounted to **approximately 2.4m**, driven principally by the eSports Demonstrator.

The following observations can be made about the experience of the Demonstrators:

- A strong and positive involvement with the knowledge base (in three of the four Demonstrators: eSports, Performance and Visitor Experience) with examples of further collaboration, both with existing and new academic partners.
- Shifts to wholly digital products and services, accelerated due to Covid restrictions, meant the development of outcomes that were more technologically mature and better aligned with broader market trends towards in-home entertainment, cloud-based platforms and Web3 technologies.
- The overhead on collaboration within the largest consortium, the Immersive Performance Demonstrator, was considerable, leading to partners having to sometimes curb their collaboration in order to get things done. However, overall 68% of respondents reported being either satisfied or very satisfied with the effectiveness of the consortium in project delivery.
- There are clear benefits of setting up consortia with organisations that share similar characteristics (in terms of size, public or private, sectoral or sub-sectoral background, and their degree of existing knowledge and experience in digital media and tech). Having partners that share similar structural organisational characteristics (e.g. size, funding models) means that it is also likely that they share similar ways of working, decision-making processes

and attitudes to risk, as well as having the skills to engage as peers. The positive aspects of this were again shown in relation to the rollout of the Visitor Experience and Moving Image Demonstrators Location Based Experiences.

- For the audience-facing consortia partners, there was often a tension between creating something novel and technically innovative, while also creating something that met the quality and production values they expect to deliver to their audiences.
- Structuring deals for uncertain IP and fluid circumstances also proved difficult across the Demonstrators, with different approaches undertaken but no one approach having proven to be better than others.
- All four Demonstrators trialled new business models and explored the commercial viability of their projects; the results suggest that not much has changed in the marketplace regarding the ways to make commercial returns from immersive creative content, which remain challenging.
- In contrast to the Demonstrators focused on unique experiences tied into specific IP, the two Demonstrators that focused more on creating reusable assets and scalable processes have both attracted follow-on interest and investment.

Grants and Investments

We find that the **Grants and Investments strand** has delivered across its main objectives.

The programme has provided a good platform to enhance existing partnerships and to build new ones. Most participants had collaborated with at least one new partner, with more than half stating they had established a new partnership with a micro business. Almost all respondents agreed the programme played a big role in enhancing these partnerships.

Most participants had developed at least one new creative immersive product (79%) and/or service (56%) because of their ISCF AotF project. A significant share had also improved their existing offering(s). The majority of participants had progressed at least one TRL level and a third had progressed from Feasibility (TRL 1 – 2) to Commercialisation (TRL 9). As a result, close to half of participants reported that they had already generated revenue from new product/services or customers, and another 40% stated they expected to achieve this in the future. This is in stark contrast to unsuccessful applicants, most of whom had not progressed the TRL of their project or had not continued with their project at all.

This seems to have translated into additional sources of income. Based on survey results, we find **that turnover has improved substantially for programme participants, in particular, the value of turnover derived from immersive content or technologies.** As the number of employees has remained the same, the levels of (labour) productivity for participating businesses (Gross Value Added per employee) has also increased.

Around half of the participating businesses had not generated turnover from exports, suggesting that there is scope for further growth if this option is successfully explored in the future.

StoryFutures Academy (SFA)

At the end of the final reporting quarter in September 2021, **SFA had exceeded all of its targets.**

This includes objectives to support the development of new skills within the creative immersive sector: survey results show a significant majority of participants (across the different workstreams) have improved their knowledge of creative immersive production processes, and of the opportunities and challenges of creative immersive production. The programmes also developed technical skills, with over half of participants reporting increased skills in development with real time game engines (53%); creative art direction (57%) and writing for Immersive experiences (57%).

In terms of embedding knowledge and capacity, 78 educational/skills programmes and courses were developed or modified across participating UK higher education institutions as a result of SFA activity, which includes 50 courses developed through the Train the Trainer (TTT) project.

For delivery partners Royal Holloway (RHUL) and National Film & Television School (NFTS), the experience and approaches to talent development in immersive have also become institutionally embedded in ways that will last beyond the lifespan of SFA, including an increased focus on immersive within the core course portfolio at NFTS and a new research catalyst on digital storytelling at RHUL. Academics who participated in the Train the Trainer workstream also reported changed attitudes towards, and greater recognition for, immersive within their institutions as a result of their participation in the programme.

SFA also had a positive impact on attitudes towards immersive among participants: **92%** said their SFA involvement made them **convinced or enthusiastic about the future of immersive storytelling** (SFA Annual Report, 20/21).

External stakeholders from the immersive sector (investors, industry professionals, trade bodies and other higher education institutes) recognised the level of demand for skills development in the creative immersive vertical and praised the impact SFA has had in meeting this need.

SFA also pledged that 50% of the people engaged through the programme would be female and at least 20% from BAME backgrounds. SFA consistently met these targets throughout the programme, reaching **52% female participants and 23% BAME participants.**

Progress towards achievement of high-level objectives

The table below summarises our key findings vis-à-vis the programme's three high-level objectives, based on the evidence presented above.

| AotF high-level objectives | Conclusion and summary evidence |
|--|--|
| <p>1. The UK will be a world leader for immersive creative content in terms of reputation, specialist skills and investment ecosystem</p> | <p>The programme has contributed to enhancing the UK's global position in Creative Immersive Content, by:</p> <ul style="list-style-type: none"> • supporting the development of specialist skills (mostly via the StoryFutures Academy, SFA), with the equivalent of 21% of the estimated skilled workforce in the Creative Immersive Content benefiting from courses developed by the programme (=2,680 students/12,617 skilled workforce in Creative Immersive Content) • supporting the development of new curricula that would continue to underpin skills development going forward (with 78 educational/skills programmes and courses developed or modified as a result of SFA activity) • funding a relatively high proportion of companies operating in the Creative Immersive Content sector in the UK (~9 out of 100 companies), a percentage of which (~40%) are already generating income from new product/services or customers develop under the programme • funding innovative projects and ideas that would not have gone ahead without the programme, some of which have now attracted further private investment (including notable examples such as VU.City and Tiny Rebel Games). <p>UK's reputation in the Creative immersive Content sector was already high at the outset of the programme, and there is no evidence to suggest this has changed. There was consensus among external stakeholders (investors and industry representatives) interviewed for this research that the UK is internationally recognised for its content creation, specifically its ability to take new technologies and develop attractive content.</p> |
| <p>2. The UK has an increased skilled workforce to create immersive content, will lead to the UK becoming the number 1 destination in Europe for investment in immersive content production</p> | <p>All the evidence above (for Objective 1) supports the achievement of this objective. Additionally, the sectoral analysis reveals that:</p> <ul style="list-style-type: none"> • there has been an increase in skill levels across the UK Creative Immersive Content sector workforce in comparison with the baseline (73% increase in number of 'tech skilled' people in the sector) • the UK continues to perform better than comparator European countries in terms of private investment in the Creative Immersive sector (e.g., over x6 higher investment than France), although this was also the case at baseline (when the UK was actually attracting x11 more investment than France). <p>These results cannot be fully attributed to the programme, but high penetration of the programme, to both workforce and companies, and better performance of AotF participant companies in comparison with the control group, suggest that programme's contribution is high.</p> |
| <p>3. Increased private investment in immersive technology, so that UK will double its share of global investment in immersive technologies.</p> | <p>Again, the evidence above (for Objectives 1 and 2) supports the achievement of this objective. Additionally, the sectoral analysis reveals that the amount of private investment the Creative Immersive sector has increased by 51% in comparison with the baseline (although the global share is unknown).</p> <ul style="list-style-type: none"> • For the reasons given above, we also conclude that programme has contributed to these results. • Note that despite the UK's strengths in content creation, stakeholders (investors and industry representatives) characterised the global market as very competitive, with challenges from the US, Japan, China, France, and Israel. |

1 Introduction

1.1 The Audience of the Future Programme

The Audience of the Future (AotF) programme was launched in March 2018 as part of the Creative Industries Sector Deal with an original allocation of £33.3m from the Industrial Strategy Challenge Fund (ISCF) to support the development of immersive experiences and technologies in the UK-based creative sector. This was later extended with additional funds to £39.3m.

The programme is comprised of three main areas of investment:

- The National Centre for Immersive Storytelling (NCIS) called the StoryFutures Academy (SFA), which aimed to generate training and research programmes to provide talent for the emerging sector with the skills and creative capacity to meeting industrial demand in immersive production.
- The Demonstrator programme, which aimed to create four new large-scale immersive experiences and test them with a mass audience
- Grants and Investments instruments to support research and development (including Production Innovation for Immersive Content, Design Foundations, and Investment Accelerator).

Originally expected to conclude in March 2021, some projects were extended till December 2021 due to the Covid-19 pandemic.

The programme's high-level objectives are:

1. The UK will become a dominant market leader in the creative immersive sector by 2025, creating 10% of global creative immersive content and become a net exporter of Immersive content;
2. The UK has an increased skilled workforce to create immersive content, will lead to the UK becoming the number one destination in Europe for investment in immersive content production; demonstrated through
3. Increased private investment in immersive technology, so that UK will double its share of global investment in immersive technologies.

1.2 The evaluation

The scope of the evaluation is to assess the extent to which the Audience of the Future Challenge is making or has made an impact considering its original aims. The evaluation tests the extent to which the programme has delivered the expected outcomes and impact and the extent to which these are attributable to ISCF funding.

The main evaluation questions are:

- To what extent has AotF delivered intended outcomes and impacts? To what extent are these attributable to the ISCF funding?
- To what extent has AotF led to unanticipated outcomes?
- Do the benefits of the programme outweigh the costs?
- To what extent has the programme's design, governance and processes enabled it to meet its objectives?

The evaluation is organised as follows:

- Evaluation framework report, submitted in September 2019
- Baseline and Process evaluation report, developed in Autumn 2019

- The Baseline and emerging findings report for the NCIS, submitted in July 2020
- Interim report and updated process evaluation, submitted in January 2021
- The Final evaluation report (this report), in July 2022.

1.2.1 This report

The remainder of this section sets out an overview of the evaluation methodology. The rest of the report is organised as follows:

Section 2 sets out the context for the Creative Immersive Content sector in the UK and internationally.

Section 3 sets out the evidence of the impact of the AotF programme for programme participants:

- Section 3.1 presents an updated **portfolio analysis** of the AotF programme
- Section 3.2 presents the process evaluation, developed at the baseline stage
- Section 3.3.2 presents finding related to the **Demonstrators**
- Section 3.4 presents the findings relating to the **Grants and Investments competitions**, including the Production Innovation in Immersive Content, the Design Foundations and the Investment Accelerator. This section includes an analysis of the counter-factual, as provided by the unsuccessful applicants.
- Section 3.5 presents the outcomes relating to the **StoryFutures Academy**, including the results from the Train the Trainer focus groups and the survey of participants in other activities.
- Section 3.6 presents a summary of the role and impact of the **Digital Catapult** in the AotF programme.

Section 4 presents the **conclusions**.

1.2.2 Methodology

Table below summarises the activities undertaken to complete this report.

Table 1 Methods and activities for this report

| Evaluation approach | Details |
|--|--|
| Grants & Investments case studies | We conducted interviews at the baseline and again post-exit with G&I recipients that were chosen at random as case study subjects to record the impact during and beyond their AotF projects. |
| Post-exit survey of PIIC and IA applicants (G&I) | CATI post-exit survey of PIIC and IA applicants, successful and unsuccessful, conducted October – November 2022. |
| StoryFutures Academy survey | We conducted a survey of participants in the StoryFutures Academy activities in February 2022 |
| StoryFutures Academy case studies | We conducted two sets of case studies on participants in the StoryFutures Academy activities: two in July 2020 and a further three in June 2022 |
| StoryFutures Academy focus groups | In February 2022 we conducted two focus groups with academics and teachers who had undertaken projects as part of the SFA Train the Trainer programme, to understand the impact of this programme and to what extent it had achieved its aims of capacity-building within UK HEIs. |

| Evaluation approach | Details |
|---|---|
| Analysis of programme data including programme portfolio and Project Completion Forms | We ran analysis of the programme portfolio to provide an overview of the participants and spend for the programme across the different strands. We have also run an analysis of the project completion forms completed by the Grants & Investments and Demonstrators projects. |
| Demonstrator interviews and quant instrument | We have undertaken interviews with participant organisations and consortia leads at three points throughout the process: at baseline phase (2020), at the interim point (2021) and at post-exit phase (2022). We have also collected quantitative data against indicators that is not already collected as part of the Project Completion Forms through a quant instrument (baseline and post-exit) |
| Demonstrator Counterfactual | We undertook interviews with 3 counterfactual case studies for the Demonstrator projects at baseline phase (2020) |
| Interviews with Digital Catapult participants | We undertook interviews with participants in Digital Catapult activities to understand their impact |
| Stakeholder interviews | We have interviewed stakeholders at the Interim Phase (2020) and project completion phase (2022) to ascertain their thoughts on the achievements and process of the AotF programme. |
| Interviews UKRI AotF leads and internal stakeholders | At Interim stage (2020) we undertook interviews with Challenge Director and a workshop with delivery team to evaluate the delivery process of the programme. |
| Interviews / focus group with SFA internal stakeholders | We have spoken to NCIS internal leads to assess how experience from the Centre has been transferred into teaching & research. |
| Sector level analysis | We conducted a sectorial analysis (extracting data from companies' websites, LinkedIn, Pitchbook and Gateway to Research) at the baseline (2019), interim (2020) and final stage (2022). |
| Wider market analysis and conditions | We conducted a desk research review on wider market analysis at the baseline (2019), interim (2020) and final stage (2022). |

2 Wider context

2.1 Sector- level analysis

2.1.1 Introduction

We have used an experimental methodology to estimate the size of the “Creative Immersive Content” sector in terms of number of businesses, workforce, public R&D and private investment, both at the baseline, interim and at this final stage of the evaluation.

The nature of the ‘sector’ (not actually a sector but a set of sub-sectors vertically and horizontally integrated) requires the use of these methodologies as standard classifications, such as Standard Industrial Classification (SIC) codes or thematic fields, do not capture it in its entirety. In fact, our analysis has revealed that **23% of companies active in Creative Immersive Content fall outside the Creative Industries definition established by DCMS** (which relies on SIC codes).

At this final stage, we are paying special attention to how the sector has changed since the baseline for the AotF programme. Whenever possible (or relevant) we have tried to connect these results back to the programme, understanding that some of the results are contextual (and beyond the remit and influence of the AotF programme).

Period of analysis

The trends presented in this section relate to the following periods, unless indicated otherwise:

- Baseline: July 2016-July 2019
- Interim position: July 2019 – Oct 2020
- Current position: Nov 2020 - May 2022

Methodology

We briefly summarise the methodology below and provide main results in the following subsections.

- **Businesses:** The methodology is built on web scraping of companies’ websites, to identify those that identify themselves as working in Creative Immersive Content, using a list of agreed keywords (as presented in E.1). These results are then manually checked to exclude any false positives returned by the web scraping. Results were cross-referenced against Companies House records (parsed via DueDil) to establish a population of active UK companies. The resulting list was analysed by SIC code to show: companies within DCMS Creative Industries (CI) sub-sectors; and companies in other SIC codes that nevertheless still showed evidence of creative immersive content production. These results were further analysed by: Geography (NUTS1 and UK top 23 cities, as shown in Appendix E - E.1.2) and by Age of business.
- **Workforce:** Using LinkedIn as a sample frame, we searched for immersive keywords against a list of LinkedIn industry categories, related to the DCMS CI sector definition. This produced the following results in the following categories: Total workforce for each industry category; Job roles; Level of experience (number of years worked); Level of seniority; Size of immersive sector as proportion of total CI employment (expressed as a percentage). All results were broken down by NUTS1 and a list of the top 23 UK cities and conurbations by scale of their immersive sectors. Results have not been grossed-up to reflect variance between number of LinkedIn users and total sector employment.
- **Public R&D:** We have mined Gateway to Research, which contains information on all grants funded by all the seven Research Councils and Innovate UK (now all under the umbrella of

UKRI), although not those made by the Digital Catapult (e.g., Creative XR). The analysis provides an estimate of Public R&D investment in the Immersive Sector over the past three years. Our analysis uses the agreed keywords to identify (see Appendix E E.1.1) projects related to “Creative immersive content”. A wider discussion of other investments which do not appear in our analysis is included below.

- **Private investment:** We have extracted information from Crunchbase used to identify all companies that fitted an immersive content profile (not hardware) that had secured investment. Please note that Crunchbase data does not distinguish between investment for R&D and other investment (e.g., scale up, marketing, M&A).

2.1.2 Companies

According to our analysis, a total of 1,200 companies are working in the Creative Immersive Content sector in 2020, to some extent. This represents a decrease of 7% in comparison with the prior period, and of 15% in comparison with the baseline year (where we found 1,406 companies operating in this sector).¹

This decline suggests that some companies active in this sector have struggled to recover from the economic restrictions imposed by the COVID-19 measures, since March 2020.

Note that the companies classified outside the DCMS definition of the Creative Industries (DCMS CI)² (which represent 23% of the total number of companies), are driving the total decline in the number of companies (with 34% decrease in comparison with the baseline, equivalent to 166 companies). This suggests a stronger resilience among those companies active in the Creative Immersive Content sector and also specialised in sectors more closely linked to the creative industries.

Similarly to the baseline, two sub-sectors dominate: “IT, software and computer services (incl. games)” (24%) and “Film, TV, video, radio and photography” (17%) (see Table 2).

Table 2 Number of companies working in the Creative Immersive Content sector, by DCMS CI classification (2022)

| Sector | Baseline (2016-19) | | Interim position (2019-20) | | Current position (2020-22) | | Change from baseline |
|---|--------------------|----------|----------------------------|----------|----------------------------|----------|----------------------|
| | Number | Percent. | Number | Percent. | Number | Percent. | |
| Other (Non DCMS CI) | 493 | 35% | 390 | 30% | 327 | 23% | -166 |
| IT, software and computer services | 395 | 28% | 367 | 29% | 336 | 24% | -59 |
| Film, TV, video, radio and photography | 226 | 16% | 228 | 18% | 245 | 17% | 19 |
| Music, performing and visual arts | 106 | 8% | 110 | 9% | 124 | 9% | 18 |
| Design: product, graphic and fashion design | 71 | 5% | 68 | 5% | 62 | 4% | -9 |

¹ The total figures (both at the baseline and at this final stage) represent a conservative figure as there are a number of ‘known immersive sector’ companies that do not identify themselves as such on their websites (or on any of the databases used for this analysis). These companies have therefore been left out of the analysis as it would be impossible to replicate identification across the country.

² See Appendix E for full DCMS CI definition. This prominence of companies classified outside the DCMS CI demonstrates the variety of companies operating within the Creative Immersive Content sector, but also the need to use innovative techniques (such as web scraping / text mining) to explore and size the sector and analyse its economic potential and growth as the standard SIC are not fit for purpose.

| Sector | Baseline (2016-19) | | Interim position (2019-20) | | Current position (2020-22) | | Change from baseline |
|----------------------------------|-----------------------|----------|-------------------------------|----------|-------------------------------|----------|----------------------------|
| | Number | Percent. | Number | Percent. | Number | Percent. | |
| Advertising and marketing | 53 | 4% | 50 | 4% | 43 | 3% | -10 |
| Architecture | 40 | 3% | 44 | 3% | 39 | 3% | -1 |
| Publishing | 17 | 1% | 23 | 2% | 12 | 1% | -5 |
| Museums, galleries and libraries | 5 | 0% | 6 | 0% | 12 | 1% | 7 |
| Grand Total | 1,406 | 100% | 1,286 | 100% | 1,200 | 100% | -206 |

Source: Technopolis and BOP Consulting (2020, 2022)

The ISCF AotF programme is engaging with 104 companies from the sector (this means that 9 out of 100 companies working in the Creative Immersive Content sector will directly benefit from the programme). This represents an increase from the baseline (when the coverage was 6 out of 100 companies).

Companies tend to have been operating for 3 to 10 years or 10+ years across all sub-sectors, with relatively low percentages of start-ups (3 years younger or less). Of note, at the interim stage there was a relatively high percentage of newcomers in the "IT, software and computer services" (22%), however as of 2022 only 6% of companies were start-ups. The latter two were found to have only 8% and 15% newcomers respectively at the baseline point.

In comparison with the interim position, the data shows the appearance of newcomers on the "Film, TV, video, radio and photography" and "Music, performing and visual arts" sectors.

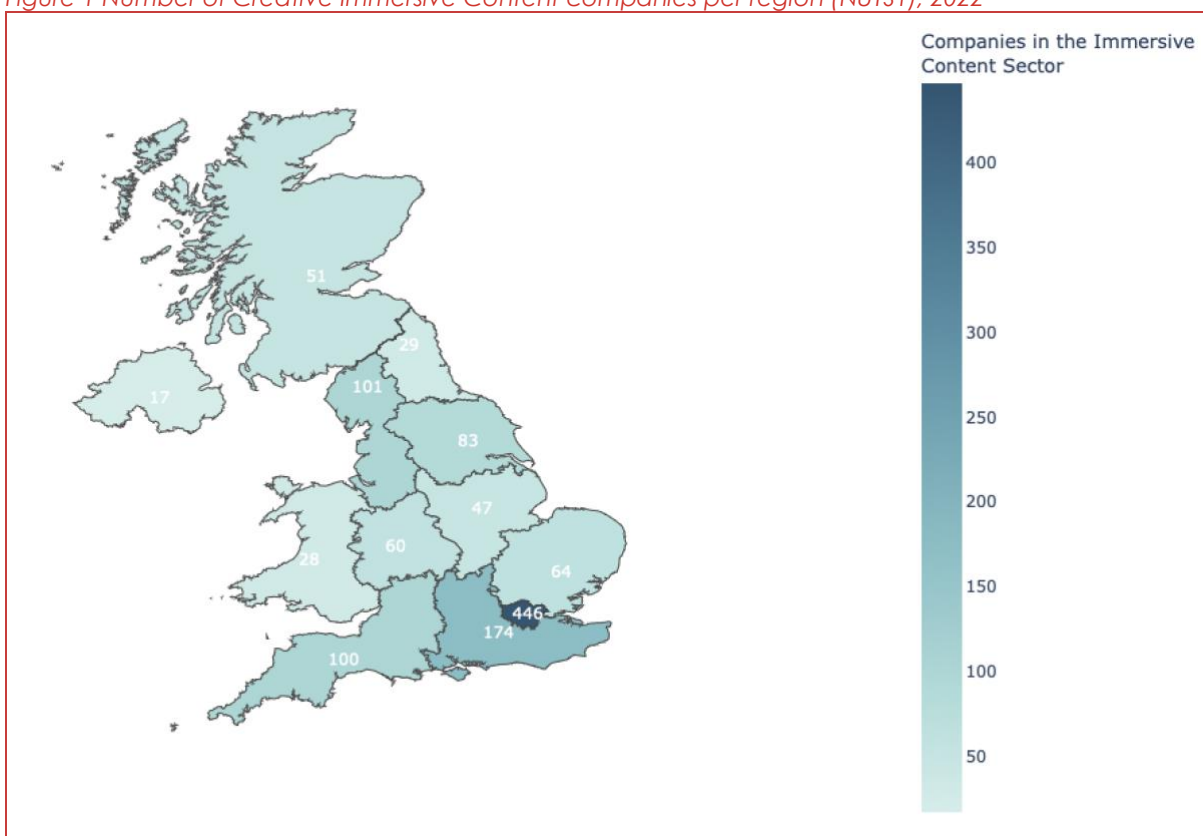
Table 3 Age of companies working on the Immersive Content sector, by DCMS CI classification (2022)

| Sector | <1 Yr. | 1-3 Yrs. | 3-10 Yrs. | 10+ Yrs. | Total | Newcomers * |
|---|--------|----------|-----------|----------|-------|-------------|
| Advertising and marketing | 0% | 2% | 35% | 63% | 100% | -7 pp |
| Architecture | 0% | 3% | 62% | 36% | 100% | -5 pp |
| Design: product, graphic and fashion design | 0% | 5% | 56% | 39% | 100% | -6 pp |
| Film, TV, video, radio and photography | 1% | 3% | 51% | 44% | 100% | +17 pp |
| IT, software and computer services | 0% | 6% | 63% | 30% | 100% | -31 pp |
| Museums, galleries and libraries | 0% | 0% | 25% | 75% | 100% | +6 pp |
| Music, performing and visual arts | 1% | 5% | 38% | 56% | 100% | +14 pp |
| Non DCMS CI | 1% | 3% | 47% | 50% | 100% | -63 pp |
| Publishing | 0% | 8% | 50% | 42% | 100% | -11 pp |

Source: Technopolis and BOP Consulting (2020 and 2022). * New companies in comparison to interim position.

More than a third of the companies (37%, or 446 companies) are located in London (which is in line with the baseline results). This is significantly higher than the 19% of all UK businesses that are based in London, suggesting that the region is specialised in these activities related to creative immersive content.

Figure 1 Number of Creative Immersive Content companies per region (NUTS1), 2022

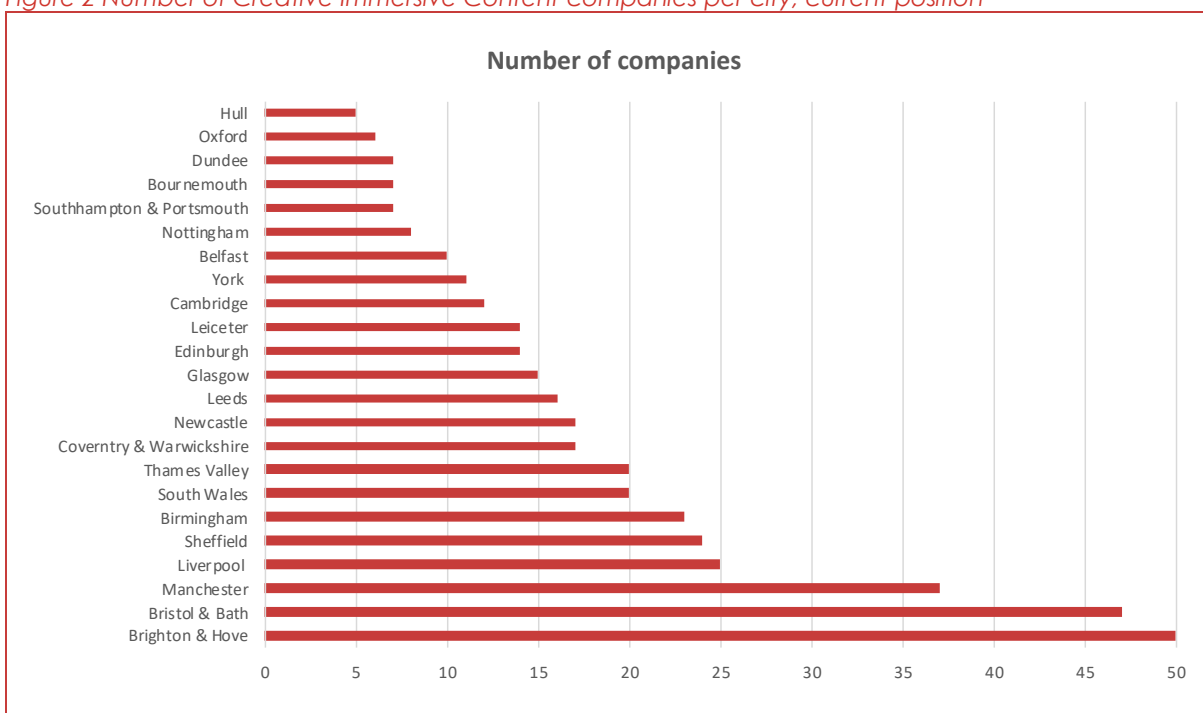


Source: Technopolis and BOP Consulting (2022)

Figure 2 below shows overall results at city level, with focus on the DCMS CI sector to allow for comparison with official figures on the Creative Industries.

Additionally, a higher percentage (38%) of the young companies (3 years or less) are located in London, suggesting that the specialisation of these activities within London is being reinforced over time.

Figure 2 Number of Creative Immersive Content companies per city, current position



Source: Technopolis and BOP Consulting (2022)

2.1.3 Workforce

In contrast to the number of companies, there seems to be an increase in the workforce connected to the sector.

We estimate that a workforce of up to **43,158 people identified themselves as working in the Creative Immersive Content sector** or in related roles/tasks, this includes:

- **15,213** people working within the DCMS CI sectors. This figure represents 0.7% of people working in the Creative Industries Sector³ (and 2.4 percentage points higher in comparison with the baseline).
- **27,945** people working outside the DCMS CI sectors.

The overall total represents a 53% increase in comparison with the baseline position, as shown in Table 4. At the baseline, we estimated 28,211 people identified themselves as working in Creative Immersive Content sector, and within the DCM CI sectors. This means that the increase in workforce is being driven by an increase in people with related experience in Creative Immersive Content working both inside and outside the creative industries.

Furthermore, looking again at the entire workforce, **we estimate that there is a 73% increase in the percentage of the workforce in the sector that can be qualified as 'tech skilled', in comparison to the baseline position.** This could be in part driven by the fact that people are more proactively showcasing specific skills in their LinkedIn profiles (e.g., virtual reality, or natural processing language). However, the scale of the increase does suggest that more people are acquiring those skills over time.

³ Based on latest report from DCMS, published in 2022 with figures for 2021. <https://www.gov.uk/government/statistics/dcms-sector-economic-estimates-workforce-2021>. Accessed in July 2022.

The table below also presents the EU27 figures. It shows that the proportion of the UK workforce in the Creative Immersive Content Sector in comparison with the EU27 workforce has decreased slightly since the baseline position. This is mainly due to substantive expansion of the EU27 workforce mostly around the 'tech skilled' category (87% growth in comparison to the baseline).

Table 4 Workforce: total all UK and EU27 Creative Immersive Content

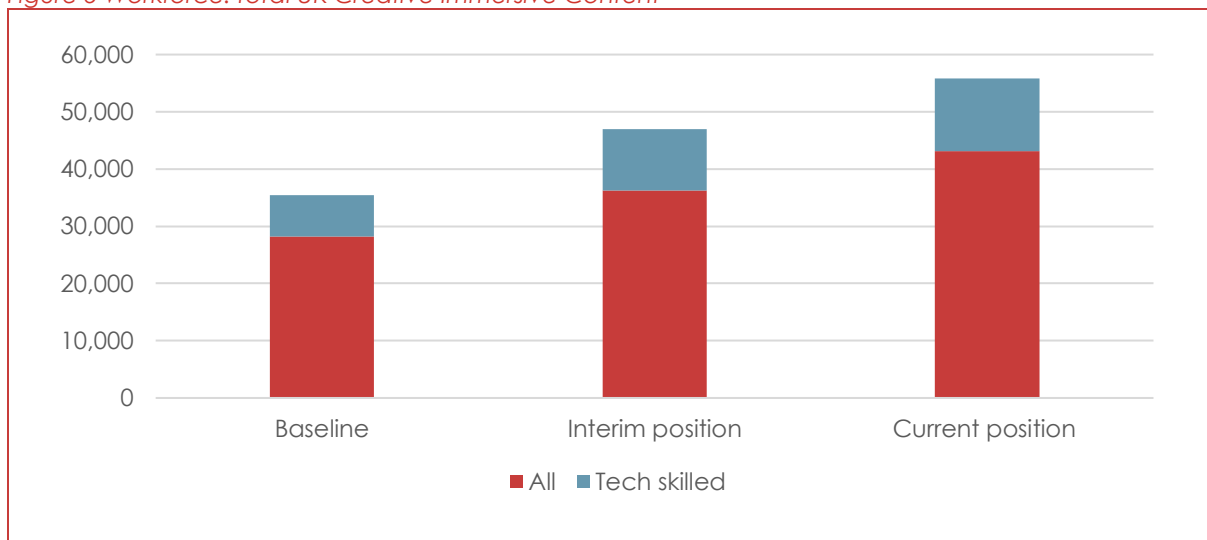
| | Baseline (2016-19) | Interim position (2019-20) | Current position (2020-22) | Change from baseline (in percentage) |
|---|------------------------------|--------------------------------------|--------------------------------------|--|
| Total all UK immersive content | 28,211 | 36,258 | 43,158 | 53% |
| Total all UK immersive content, tech skilled | 7,281 | 10,716 | 12,617 | 73% |
| Total EU27 immersive content (incl. UK) | 92,107 | 130,176 | 157,909 | 71% |
| Total EU27 immersive content, tech skilled (incl. UK) | 21,294 | 33,597 | 39,769 | 87% |
| | Baseline | Interim position | Current position | Change from baseline (in percentage points) |
| UK immersive as % of EU27 | 31% | 28% | 27% | -4pp |
| UK immersive as % of EU27, tech skilled | 34% | 32% | 32% | -2pp |

Source: Technopolis and BOP Consulting (2022)

Additionally, Figure 3 and

Table 5 below, show that **not only the UK workforce in Creative Immersive Content has increased and but the proportion of that workforce that is 'tech skilled' has also increased.**

Figure 3 Workforce: total UK Creative Immersive Content



Source: Technopolis and BOP Consulting (2022)

Table 5 Workforce: total all UK Creative Immersive Content

| | Baseline (2016-19) | Interim position (2019-20) | Current position (2020-22) | Change from baseline |
|--|-----------------------|----------------------------------|----------------------------------|-------------------------|
| Total all UK immersive | 28,211 | 36,258 | 43,158 | 53% |
| Total all UK immersive, % tech skilled | 26% | 30% | 25% | -1pp |

Source: Technopolis and BOP Consulting (2022)

In terms of experience and looking again at the entire Creative Immersive Content sector, we see a natural shift toward more years of experience, which also means that **the sector is overall retaining talent and increasing the levels of seniority overtime** (see Table 6).

The distribution across top roles has remained the same in comparison with the baseline, with these top roles including positions across Arts and Design, Business Development, Engineering, Media and Communication and Information Technology (see Table 7).

Table 6 Workforce: years of experience (Total all UK immersive)

| Years of experience | Baseline (2016-19) | Interim position (2019-20) | Current position (2020-22) | Change from baseline (in percentage points) |
|---------------------|-----------------------|-------------------------------|----------------------------------|---|
| 0-5 yrs. | 24% | 19% | 18% | -6pp |
| 5-10 yrs. | 28% | 26% | 26% | -2pp |
| 10+ yrs. | 49% | 55% | 56% | +7pp |

Source: Technopolis and BOP Consulting (2022)

Table 7 Workforce: Creative Immersive content – top five roles

| Top five roles | Baseline (2016-19) | Interim position (2019-20) | Current position (2020-22) | Change from baseline (in percentage points) |
|-------------------------|-----------------------|-------------------------------|----------------------------------|---|
| Arts and Design | 17% | 17% | 16% | -1pp |
| Business Development | 15% | 14% | 14% | -1pp |
| Engineering | 11% | 12% | 12% | +1pp |
| Media and Communication | 8% | 8% | 7% | -1pp |

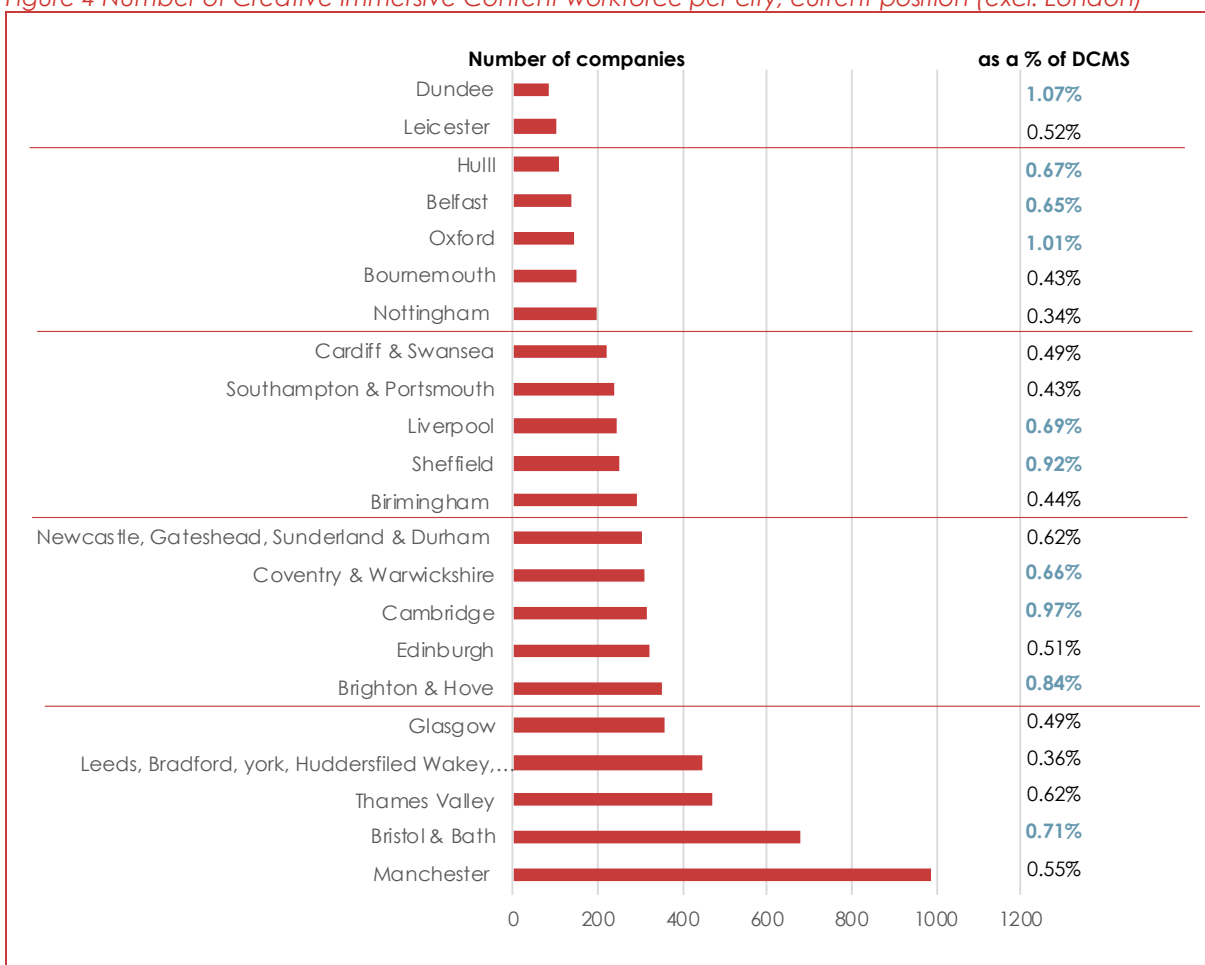
Source: Technopolis and BOP Consulting (2022)

Regarding geographical distribution, and focusing on the DCMS CI sector sub-group, London has the largest workforce (10,601). This represents an increase of 56% in comparison with the baseline position (~3,824 more people). Furthermore, the London workforce accounts for almost 61% of the total UK Creative Immersive Content workforce (slightly higher than the baseline position of 58%).

Figure 4 below shows overall results at city level, again with focus on the DCMS CI sector to allow for comparison with official figures on the Creative Industries.

Although the absolute numbers are large, the size of the creative workforce in London means that the employment in the capital in Creative Immersive Content currently accounts for only 0.65% jobs in the CI sector in the region. The highest penetrations – for regions with a workforce of 100 or more – are instead to be found in Oxford (145, 1.01%), Cambridge (317, 0.97%), and Sheffield (253, 0.92%), and Brighton and Hove (306, 0.77%).

Figure 4 Number of Creative Immersive Content workforce per city, current position (excl. London)



Source: Technopolis and BOP Consulting (2022)

LinkedIn members have the possibility of signalling if they are open to new opportunities. We have collected this data and can use it as a proxy for estimating the proportion of people that may be considering a change in jobs. In this current climate, we understand this as a possible signal of the proportion of the workforce that may be considering other options in response to a potential deterioration of their current working conditions.

We estimate that, currently, 37% of the workforce in the Immersive Creative Content sector is open to new opportunities. This represents a substantial increase in comparison to the baseline (when the figure was 19%). Furthermore, 40% of those looking for new opportunities are currently working full-time, while in the baseline this group represented only 23% of the total.

Notably, this is also embedded within the wider trends associated with 'the great resignation'.⁴ The UK Labour Force Survey released in November 2021 also showed that around 38% of people who moved jobs between July and September 2021 (391k of 1.02m) had resigned - the highest spike ever recorded by the survey. A survey of UK employees in 2021 found that 38% were looking to change roles in the coming 6 or 12 months and a further 14% would do so once the

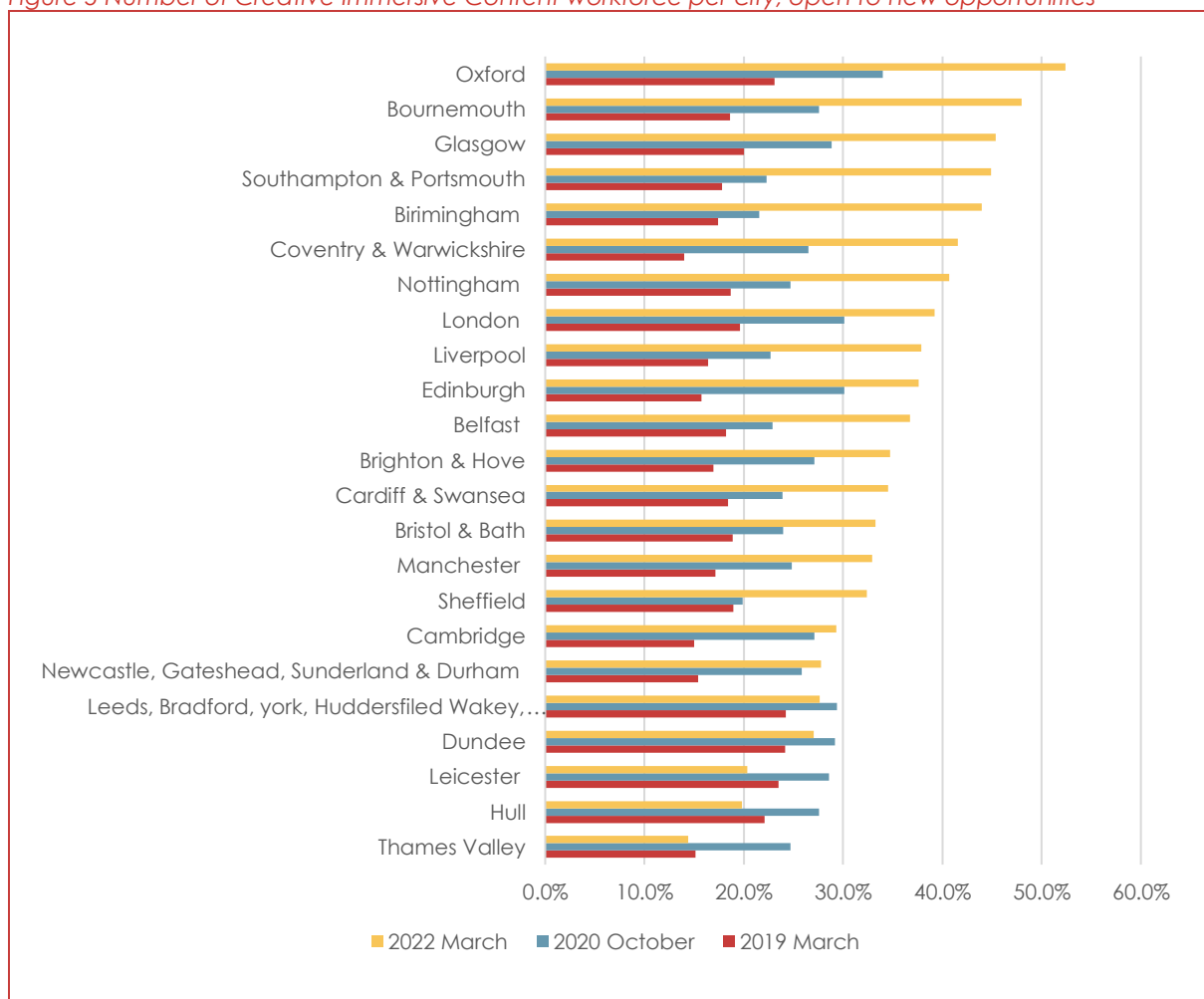
⁴ <https://www.pwc.co.uk/press-room/press-releases/pwc-workforce-survey-2021.html#:~:text=The%20Great%20Resignation%20will%20continue,leave%20the%20workforce%20temporarily%20o> and <https://www.london.edu/think/whats-driving-the-great-resignation>

economy had strengthened.⁵ Therefore, this increase in the proportion of people who are 'open to new opportunities' is not unique to the Creative Immersive Content workforce.

Figure 5 below presents the results at the city level. The highest shift since the baseline is shown in Bournemouth (29.4 pp), Oxford (29.3 pp), Brighton and Hove (27.5pp), Southampton and Portsmouth (27.1 pp) and Birmingham (26.6 pp).

Finally, and to complement this picture, we also find that there is a decrease in the percentage of people working in full-time employment with respect to the baseline (from 72% to 64% as mentioned above). This is however higher than the interim position (59%) and may reflect that the sector has stabilised following changes in working patterns as a result of the restrictions imposed as part of the response to the COVID-19 pandemic.

Figure 5 Number of Creative Immersive Content workforce per city, open to new opportunities



Source: Technopolis and BOP Consulting (2022)

2.1.4 Public R&D and Private investment

In terms of Public R&D, we looked at Gateway to Research (GtR) which includes all projects funded by all seven Research Councils and Innovate UK (now under the umbrella of UKRI). The

⁵ https://hr.personio.de/hubfs/EN_Downloads/202104_HRStudy_UK1.pdf

analysis excludes the ISCF AotF projects to illustrate government investments outside the programme.

In this case, the baseline period corresponded to the three years of data up to June 2019, and we have annualised the figures to provide year to year estimates of change. Prior to the start of the AotF programme, we identified 87 projects with a total value of £16.8m over a period of three years. In other words, 29 projects and £5.6m funding per year, on average.

At the interim stage, we identified a total of 30 projects, with a total value of £5.6m (in terms of public investment), focusing on organisations that we classified as being part of the Creative Immersive Content Sector and have a commercial partner.

Over the past year we have identified a total of 42 projects, with a total value of £35.4m (in terms of public investment). This does however include the MyWorld project supported by £29.9m from UKRI's Strength in Places fund. Led by the University of Bristol, MyWorld will support research and innovation in the creative technology industry in the West of England.⁶ Excluding this project, the total value of projects supported over the past year is £5.5m.

We can therefore see that the levels of public investment in creative immersive R&D in the UK (excluding AotF) has remained consistent with around £5.6m of investment per year since 2016. **At roughly twice this total value, the support provided via the AotF programme (£39.3m in 2018-2021, i.e., ~£10m per year) constitutes a substantial additional investment in this area by the UK government.**

The projects are led by 27 businesses and 15 Higher Education Institutions, with projects lead mainly by organisations operating in 'IT, software and computer services' (8 out of 24, 33%) and 'Film, TV, video, radio and photography' sectors (5 out of 24, 21%).

Most of the projects (43%) are valued between £30k-£100k, and around a fifth are of a larger scale (£250k-£1m). Examples of (large scale) projects include:

- Designing Mixed Reality Heritage Performances to Support Decolonisation of Heritage Sites, led by Brunel University, Budget: £200,470 from AHRC
- Augmented Reality Musical Ensemble (ARME), led by University of Birmingham, Budget: £1,183,463 from EPSRC
- Cyborg Soloists: Advancing Interdisciplinary Music in the Post-Internet Age Through New Musician-Technology Interactions, led by Royal Holloway, Budget: £1,197,392 from UKRI

Private investment is considerably more substantial, partly because it includes total investment far beyond R&D. **We estimate that private investment in the Creative Immersive sector in the UK has been \$183m (£153m) in the past year, based on the values raised in last investment round** (and on disclosed information). **This represents an increase of 51% in comparison to the baseline** (calculated as yearly average, based on the information from the prior three years).

Furthermore, we estimate a total of 46 deals have taken place over the past year, 36 of which have disclosed information, which means that total investment goes beyond the estimated total. In other words, since this figure is based only on disclosed deals (78%) the actual level of investment would be well in excess of the estimated \$183m.⁷

The overall amount of private investment in the UK is lower compared to the rest of the EU27, \$183m versus \$269m (see The UK and EU27 levels of private investment present stronger results

⁶ <https://www.bristol.ac.uk/vision-institute/myworld/>

⁷ The decline in the value of deals shown in the text is not driven by a change in the number of disclosed deals, since the percentage of disclosed deals has actually increased in comparison to the baseline (from 60% to 76%).

when compared with the Rest of the World - which includes the US, China, India, Canada, Finland and Switzerland - where the increase has been a 23 pp increase in comparison to the baseline.

Further analysis reveals that the profile of investment in the UK has shifted towards early-stage companies, i.e., towards riskier investments, with 63% and 13% of the deals related to Pre-seed/Seed and Series A, respectively (and 76% across both). In contrast, those two rounds represented 27% of all deals at the baseline stage. These first rounds of investment tend to include companies that show a potential market opportunity but have not proven its commercial value just yet, and these results indicate a higher appetite for risk among those investing in UK based ventures. This increase (of 49 pp) is higher in comparison to the EU (where the increase in value of deals taking place in those two early rounds of investment is only 9 pp). This is also contrasted against the rest of world, which has seen a decrease of 6pp since the baseline (from 66% to 60%).

Table 8), **but still substantial considering that we are comparing one country against 27**. This presents a decrease in comparison to the baseline position, mostly driven by the substantial increase in the total value of deals within the EU27 in the past year (256%).

Even though the number of deals in the EU27 has remained constant (~68 at baseline to 63), the average value of each deal has more than double in size (from \$1.1m to \$5.4m). The number of deals in the UK also remained constant (45 at baseline to 46), and the average size of the deals also increased significantly (from \$2.9m in the baseline to \$6.6m in the current position).

Moreover, in comparison with France, a country that also has a strong immersive content sector, we find the UK is performing better, with investments that are over 6 times higher. After a sharp decline in investment at the interim position (50% decrease), this has since bounced back to investments at 177% since the baseline.

The UK and EU27 levels of private investment present stronger results when compared with the Rest of the World - which includes the US, China, India, Canada, Finland and Switzerland - where the increase has been a 23 pp increase in comparison to the baseline.

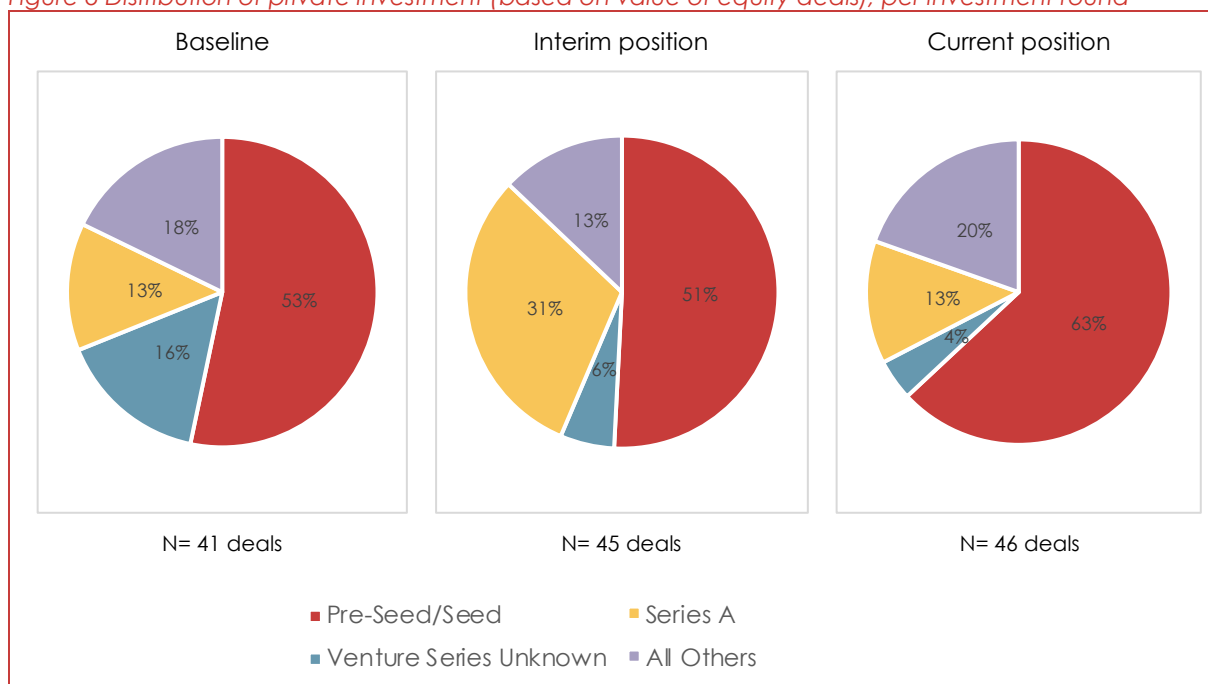
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Table 8 Private investment (based on value of equity deals)

| | Baseline* | Interim position** | Current position*** | Change from the baseline (in percentage) |
|-------------------------------|-----------------|--------------------|---------------------|---|
| UK | \$120,997,465 | \$99,783,741 | \$183,304,934 | 51% |
| France | \$10,298,461 | \$5,080,099 | \$28,501,271 | 177% |
| EU27 | \$75,583,688 | \$168,655,034 | \$269,296,782 | 256% |
| Rest of the world | \$3,478,418,587 | \$3,367,792,920 | \$4,289,657,866 | 23% |
| | Baseline* | Interim position** | Current position*** | Change from the baseline (in percentage points) |
| UK as a proportion of EU27+UK | 62% | 37% | 37% | 25% |

Source: Technopolis and BOP Consulting (2022) * Average based on data from prior 3 years up to July 2019. ** July 2019 - end of Oct 2020. *** Nov 2020 - May 2022

Figure 6 Distribution of private investment (based on value of equity deals), per investment round



Source: Technopolis and BOP Consulting (2022)

The table below shows that seven companies that have participated in the AotF programme have secured deals during the period 2018 to 2022. The total amount raised by all Creative Immersive Content companies (between Nov 2020 and May 2022) was on average \$4.7m.

Table 10 provides short case studies with information on companies that have secured substantial deals, including Tiny Rebel Games, which again was supported by the AotF programme. The company reported, via its project completion form that the AotF programme, has led to new opportunities for future collaboration, new investors or contacts for commercial exploitation:

Yes, it's opened doors for us with a variety of major investors globally. It has also cemented strong relationships with technology partners like Unity, Apple, Google. And it has led to a variety of relationships with content holders (i.e., Disney, Netflix)

Table 9 Activity among participant companies in the AotF programme

| Company | Location | Funding Type | 2018 | 2019 - 2020 | 2021-2022 |
|--------------------------------------|-------------|-----------------|--------|---------------|-----------|
| Also Known As / Head Set Studio Ltd* | London | Pre-Seed | | £30k | |
| Facesoft Ltd ** | London | Seed | ND | | |
| Go Jauntly Ltd | London | Seed | ND | | |
| Gravity Sketch Limited | London | Seed / Series A | \$1.7m | \$3.7m | \$32.5m |
| Igloo Vision Limited | Craven Arms | Series Unknown | £548k | £550k & £435k | \$2.8m |
| Maze Theory Limited | London | Seed | | £1.1m | |
| Tiny Rebel Games | Cardiff | Seed | | | \$7m |

* Company name change 25/08/2020, ** Company is in voluntary liquidation 30/07/2020

Table 10 Private investment – case studies

| | |
|--|---|
| <p>Kuato Studios (UK) Limited http://www.kuatostudios.com/</p> <p>Description: Kuato Studios is an educational games developer that inspires and engages learners by capturing the excitement of learning through games. It is estimated that the company has between 25-49 employees and an estimated revenue range of between \$1m to \$10m.</p> <p>Number of funding rounds: 2 (1 non equity assistance)</p> <p>Kuato raised \$6.2 million in a venture series (unknown) funding round, led by Horizon Ventures, announced on Jan 4th 2021. The money was used towards the launch of Panic Room, Kuato Studio's first virtual reality title.</p> <p>"Our vision is to test out the technology with 'Panic Room' and then extend it to our library of games, which align with Kuato's education-driven ethos where children can learn and play, whilst parents, carers or teachers can oversee gameplay."⁸</p> | <p>Location: London Founded: 2011</p> |
| <p>Tiny Rebel Games http://www.tinyrebelgames.com/</p> <p>Description: Tiny Rebel Games is an award-winning developer of games and AR. The company has expanded significantly following the successful delivery of the Audience of the Future Moving Image grant which produced Wallace & Gromit: Big Fix Up / Fix Up the City. The company is estimated to have between 11-50 employees.⁹</p> <p>Number of funding rounds: 2</p> <p>Tiny Rebel raised \$7 million in a seed round led by Fabric Ventures and includes participation from investors including Animoca Brands, Dapper Labs, CMT Digital, Sfermion, Spin Master, Skyvision, Fenbushi, A41, Fourth Revolution Capital, Double Peak, Pirata, 6th Man, Ready Player DAO, Triangle Capital, and Sterling Capital. The investment was announced on March 3rd 2022.</p> <p>The funding will be used to further develop The Petaverse Network which combines games, XR, and Web 3.0 to define an open standard for digital pets in the metaverse.</p> | <p>Location: Cardiff / London Founded: 2016</p> |
| <p>REtiníZE Limited https://www.retinize.com/</p> | <p>Location: Belfast, Northern Ireland Founded: 2019</p> |

⁸ <https://www.pocketgamer.biz/news/75514/kuato-studios-raises-45-million-as-it-launches-vr-title-panic-room/>

⁹ <https://www.tmcnet.com/usubmit/2022/03/04/9557472.htm>

Description: Retinize is a multi-award-winning immersive media studio, creating VR and AR experiences for clients like National Geographic, BBC, Seagate, BMW, National Museums NI etc. Their mission is to create new and incredible immersive experiences that push the boundaries of what the viewers/users are typically expecting from similarly designed content and what the medium (VR/AR) is currently capable of. It is estimated that the company has between 10-24 employees.

Number of funding rounds: 1

Retinize raised \$2.6 million in a Seed round, led by Sun Valley Ventures and announced on Mar 16th 2022. The money will be used for the global rollout of Retinize's VR enabled 3D animation production software [Animotive](#).

Company Name: XR Games Limited

<http://www.xrgames.io/>

Location: Leeds

Founded: 2017

Description: XR Games is an award-winning game development studio founded in 2017 and led by industry veterans from Rockstar, EA, Codemasters, Sumo, Team 17 and Dubit. In careers spanning two decades, they have created immersive games for some of the world's biggest brands. The company has an estimated revenue range of \$10m to \$50m.

Number of funding rounds: 4

XR Games latest funding of ~\$2 million was announced on Aug 16, 2021 from a Venture series (unknown) round. The investment was led by Maven Capital Partners - part of the Northern Powerhouse Investment Fund (NPIF). The funding will allow the business to invest in product development and create 20 new roles in their Leeds based studio.¹⁰

2.1.5 Stakeholder perception of the investment environment for immersive content

External stakeholders we spoke to¹¹ acknowledged that investors can be risk averse when it comes to technologies with no proof of concept. They also observed a lack of creative industries expertise within the investor community which can lead to withheld capital for new concepts and projects.

Despite this, Immerse UK, a cross-sector network for businesses, research and educational organisations working in immersive technologies, characterised the private investment environment for immersive in the UK as buoyant.

Stakeholders also recognised the role government grant funding – and the AotF programme specifically – have played in raising the investment profile of the immersive content sector.

One investor recognised the role of AotF in mitigating the risk profile of the sector and contributing to demonstrations of concepts that investors can feel comfortable investing in. Another stakeholder gave the example of two local VR/AR companies that have been bought by venture capital following the end of their AotF funding, contributing to the South Wales investment ecosystem.

AotF provided a demonstration of what the entertainment industry could do with these technologies. It has enabled a record around technologies that had not been used commercially.

¹⁰ <https://www.angelnews.co.uk/blog/venture-capital/xr-games-secures-15m-investment-round-led-by-npif-maven-equity-finance/>

¹¹ Investors and industry representatives – for full list see Appendix D.6)

2.2 Wider market analysis

2.2.1 Introduction

The following section provides an update to the analysis of the wider international market that was undertaken at baseline phase and provides an overview of the market conditions that have been a key part of the operating environment for the AotF programme. It has been assembled through secondary web and data research. The bulk of this section consists of a scan of recent market research related to the international immersive technology industries and how it relates to the creative sectors. The section concludes with reflections from investors and industry stakeholders about the UK's market position. This data was gathered through interviews undertaken in Spring 2022.

It provides a snapshot of the size and make-up of the international immersive technology industry and includes a summary of growth and size projections. It also summarises top-line market research about perceived market drivers and barriers to growth. The majority of available international market research relates to AR and VR and consequently, the AR and VR markets and their related devices and creative applications are the focus of this study.

Reviewing international market conditions is very broad in scope and consequently, this short overview cannot possibly cover all the areas necessary, and the depth required for a comprehensive market study. Many areas require further and deeper analysis. Source material has been referenced throughout and readers are encouraged to use that source material to further explore any specific areas of interest.

2.2.2 Key findings

This section outlines key findings from the Wider Market Analysis that is included below in Appendix E.2. The data covered in this analysis are mainly produced by commercial market research and forecasting companies. As they are effectively in competition with each other, it is perhaps not surprising to find that no attempt has been made across the various reports to align or cross check with each other. This means that the reports provide varying scenarios of growth, development and market size. In reviewing this plurality, we have therefore concentrated on the main trends and headlines that seem broadly consistent across the studies.

2.2.2.1 Market size and growth

Estimates of the global market value of Creative Immersive Content are not available. Figures do exist for the broader area of immersive technologies and content, though they are produced infrequently and show little agreement across the differing market reports.

Industry analysts have estimated the size of the combined Augmented reality/Virtual Reality (AR/VR) global market in 2021 at \$17bn to \$28bn, considerably lower than the 2021 forecasts of \$55bn to \$108bn cited in the 2019 baseline analysis (although it is not uncommon for market analysis in all sectors to produce inflated growth estimations). Nevertheless, industry analysts still envisage strong growth over the coming years as a result of the trends outlined below, with the combined AR/VR global market projected to reach \$455bn in 2030.

2.2.2.2 Trends

AR remains better positioned for immediate growth than VR

- At a baseline stage (2019), industry forecasts predict stronger global growth for AR than VR.
- Distribution platforms for AR have already converged to the iOS app store and Android's Google Play Store whereas VR distribution remains segmented and split across different platforms.

- Quest 2 represents a significant improvement in VR hardware but given the degree of smartphone penetration there is immediate and strong potential for mobile in the AR immersive technology gaming segment.
- 5G rollout is now underway and in time it will improve the speed and latency of mobile data, bringing an enhanced user experience to mobile AR.

Investment in hardware is growing, with more companies, including the top tech brands, committing to the hardware market

- Microsoft is already active in the immersive technology hardware market. Launched in late 2020, Meta's Quest 2 VR headset became the most popular headset of 2021. Apple and Google are expected to launch consumer hardware devices, with further speculation that XR hardware R&D is underway at Amazon.
- These are powerful and influential brands and their shared commitment to immersive technology can only increase the potential for global market expansion and content development opportunities.
- Hardware production is not limited to the 'Tech Giants': manufacturers Sony, Samsung, Canon and HTC have also released or are developing wearable XR hardware
- Annual headset sales are forecast to reach 49m in 2024 - at which point they are expected to exceed sales of gaming consoles.

Alignment between social networks and immersive technology

- As estimated at baseline stage (2019), gaming activity remains the largest immersive technologies sector, accounting for an estimated 80% of AR and VR revenue.
- However, social media companies are also investing in immersive technologies.
- Meta now envisages Extended reality (XR) as central to its future and has invested \$10bn in its inhouse XR business. Snap (owner of Snapchat) now describes itself as "a leading augmented reality platform."
- Social network providers are increasing their immersive technology capability via acquisitions, spending \$3.3bn in major deals between 2020 and 2022.
- What this may mean for creative content producers over the long term is not clear. Over the near term, it demonstrates the value of integrating compelling AR features into existing non-AR smartphone apps.

2.2.2.3 Barriers

Barriers to growth: Demand side (gaming)

- A lack of demand can be attributed to the current market for XR games. XR remains a niche segment within the wider games market. Pokémon GO is a flagship AR product, generating around \$1bn annually since launch in 2016, although its success remains atypical the AR gaming sector.
- It is reported that many developers and producers are waiting for greater adoption before entering the market and producing new titles.
- These barriers relate to consumer gaming use of immersive technology and do not take into account a range of AR/VR uses cases across sectors such as education, healthcare, architecture, fashion and automotive, to name but a few.

Barriers to growth: Supply side

- A global skills shortage within the industry continues to be a challenge with businesses reporting the need for relevant education and training.
- Global supply chain issues during the pandemic led to hardware shortages with producers unable to fulfil growing demand.

- As a result of increasing manufacturing and shipping costs, Meta increased the price of Quest 2 headset by US\$100 in January 2022.

Regulatory

- Data protection is an emerging question around XR and VR in particular. It can be expected that sector growth will be accompanied by scrutiny of its data protection standards.
- China is the leading market for XR, estimated to account for almost 56% of global AR/VR spending in 2021, although new restrictions that limit gaming hours among under 18s may affect demand.

Technology

- VR headsets are wearable technology with a reputation for not being very wearable. They are often considered heavy, bulky and uncomfortable. The tethering to additional hardware, battery life and price are still regarded by many in the industry as barriers to consumer adoption.
- However there are indications that these barriers may dissipate: the 2020 release of Quest 2 provides the most important illustration of this to date. Quest 2 is a standalone device that offers both power and affordability. These consumer-facing benefits have contributed to its success in the marketplace.

2.2.2.4 International awards

In the baseline report, the UK's reputation in international markets was benchmarked via an analysis of the number of awards that UK creative immersive products or productions (or co-productions) have won at key events.

The updated analysis¹² shows that since September 2019 there has been a minor increase in the share of international awards being awarded to immersive productions produced or co-produced by UK companies. In the approximately two and a half years between September 2019 and May 2022, 207 awards were made to creative immersive productions of which **20 (9.7%) were produced or co-produced by companies based in the UK**. This compares with **13 (7.7%) of the 169 awards** awarded between January 2017 and August 2019.

It should be noted that this is not a like-for-like comparison, as some awards awarded between January 2017 and August 2019 have been discontinued, while new award categories have been opened since September 2019.

Some of the UK companies and products that received international awards between September 2019 and May 2022 have been supported through the AotF programme.¹³ These include:

- CUTE CIRCUIT's SoundShirt, which won Biggest Societal Impact at the US-based Auggie awards, was awarded AotF funding through the Design Foundations competition.

¹² The data gathering and research has used the following method: Desk research of Awards and Festivals awarding XR productions; excluding those that function merely as market places or exhibitions. We have also excluded awards open for submission of material from specific geographies (e.g., EU-specific) and those focusing in content other than creative (excluded e.g. AR/VR for health or education)

¹³ This list includes only those award-winning projects and companies which won international awards between September 2019 and May 2022. Other AotF supported companies and projects have been awarded – or shortlisted – for awards outside of the scope of this research task.

- Wallace & Gromit: The Big Fix Up, created by the Moving Image Demonstrator consortium, won Best in Augmented Reality Apps/Games and Best in the World (across all categories) at Australia-based Qld XR Festival 2021 Awards.
- Wallace & Gromit: The Big Fix Up was also overall winner of the Digital category at the international Bloolooop Innovation Awards 2021.
- Another winner, Passion Animation, winner of the 'Animation: Immersive and mixed reality video – people's voice' category at the Webby Awards, has been supported by the StoryFutures Academy.

For comparison, companies based in the **US won 77 awards (37.2% of those available)** from September 2019 – May 2022, down from **91 awards (54% of those available)** between January 2017 and August 2019.

2.2.3 Stakeholder analysis of UK market position

There was consensus among external stakeholders (investors and industry representatives – for full list see Appendix D.6) interviewed for this research that the UK is internationally-recognised for its content creation, specifically its ability to take new technologies and develop attractive content.

The UK is the home of creative content and can be quite innovative - it provides content that travels abroad, that has traction whether that is in the film, music, television or theatre, or gaming - particularly gaming. So I think that we are well respected.

Despite the UK's strengths in content creation, stakeholders characterised the global market as very competitive, with challenges from the US, Japan, China, France, and Israel.

Stakeholders also expressed their view that the AotF programme is relatively unique in terms of government support across the immersive industries internationally, and that, given the level of global competition, it would be detrimental to UK's market position not to maintain the momentum gained through the programme through further support. They also felt unsure about what the UK's long-term plan is for continuing to support growth in the creative immersive space.

There will be a huge hole in the market if we lose Audience of the Future. It is a really good moment to double down and strengthen what we've already built – it would be catastrophic to lose this momentum. Other countries have not done this yet and no one else has that kind of government backing.

3 The AotF programme

3.1 The programme

The programme has invested £39.9m in supporting the development of creative immersive content. Of this, £36.4m of AotF funding has been allocated to its primary work strands and secured a further £13.5m in matched funding from project participants. This does not include further funds raised for follow-on projects or any other aligned activities.

The programme is comprised of three core areas of investment:

1. **Demonstrators** (£17.8m from AotF) that bring in end users and supply chains to build awareness and secure feedback to tailor solutions, supported also by the Digital Catapult to deliver coordination and knowledge sharing across the Demonstrator projects
2. **Grants and Investments** (£10.2m in total from AotF), which consists of three instruments:
 - Design Foundations (£1.2m) to generate ideas and to create and test low-cost prototypes
 - Production Innovation in Immersive Content (£7.6m), individual R&D grants that allow industry and academia to work together on narrower, proprietary solutions
 - Investment Accelerator (£1.5m), a unique and novel instrument within the portfolio of UKRI, designed to decrease the risk of investment through both grant funding and venture capital investment, and boost the finance and investment ecosystem within the immersive content sector.
3. A **National Centre for Immersive Storytelling (NCIS)**, delivered by the StoryFutures Academy (SFA), funded by £6.9m from AotF to support skills development through experimental labs, workshops, placements and higher education courses

The **Digital Catapult** had a special remit and a budget of £976k to support cross-fertilisation between the AotF strands, particularly to build synergy across the Demonstrator projects.

Other components of the programme include support from the KTN for the delivery of events, sometimes with funding which is additional to its grant agreement with Innovate UK, the programme provided additional grants to support companies in response to the COVID-19 pandemic (£0.6m).

Following the success of the first Design Foundations competition, the AotF programme launched a second competition (Design Foundations 2). This competition is supported by £1.09m from the programme (included within the £39.3m total but is subject to a separate evaluation, the final report of which will be produced in 2023).

The programme is underpinned by a series of ad-hoc other activities supporting engagement with government, wider industrial stakeholders and international partners, and communication and dissemination activities and events.

Table 11 Investment per programme strand

| | Total investment | ISCF AotF Funding | Matched funding | Average total investment per project | Average investment per organisation |
|------------------|------------------|-------------------|-----------------|--------------------------------------|-------------------------------------|
| Demonstrators | £25,909,293 | £17,796,214 | £8,113,078 | £6,477,323 | £863,643 |
| Digital Catapult | £963,663 | £975,756 | −£12,093* | £963,663 | £963,663 |

| | | Total investment | ISCF AotF Funding | Matched funding | Average total investment per project | Average investment per organisation |
|----------------------|---------------------------------|-------------------------|--------------------------|------------------------|---|--|
| NCIS | | £7,966,448 | £6,994,382 | £972,066 | £7,966,448 | £7,966,448 |
| Grants & Investments | PIIC | £10,732,015 | £7,624,466 | £3,107,549 | £536,601 | £223,584 |
| | Design Foundations ¹ | £1,588,591 | £1,152,497 | £436,094 | £51,245 | £31,149 |
| | Investment Accelerator | £2,151,600 | £1,506,120 | £645,480 | £307,371 | £307,371 |
| Other components | | £619,999 | £370,000 | £249,999 | £310,000 | £310,000 |
| <i>Total</i> | | <i>£49,931,608</i> | <i>£36,419,435</i> | <i>£13,512,173</i> | <i>£16,612,650</i> | <i>£10,665,857</i> |

Source: Technopolis (2022) based on client data. *Digital catapult strand invested more money than the funds received.

The programme has involved 128 unique participants across the programme, including among businesses, public sector organisations and charities, universities, Research Technology Organisations (RTO) and Public Sector Research Establishments (PSREs). Most participants are businesses (104), followed by academic institutions (22).

25 participants are involved in more than one programme strand (19% of all unique participants). Nine of these participating organisations are involved in at least two different programme strands, including companies such as Maze Theory Ltd and Focal Point VR Ltd, and universities such as University of Portsmouth and University of Surrey.

Table 12 Number of unique participants, per instrument and type of organisation

| Instrument | Business | Public Sector/ Registered Charity | Academic | RTO / PSRE | Total unique |
|------------------------|-----------------|--|-----------------|-------------------|---------------------|
| Demonstrators | 21 | 2 | 6 | 1 | 30 |
| PIIC | 37 | 2 | 7 | 0 | 46 |
| Design Foundations | 41 | - | 8 | - | 49 |
| Investment Accelerator | 7 | - | - | - | 7 |
| Total unique | 104 | 4 | 22 | 1 | 128 |

Source: Technopolis (2022) based on client data

3.2 Process evaluation

This section presents the key findings from the interim process evaluation, conducted in 2020 with the aim of understanding the effectiveness of the programme design, governance, and processes of establishing the programme. For a full summary, see Appendix F. A process evaluation was not undertaken as part of the final evaluation.

The key findings can be summarised as follows:

Added value: Evidence from both the survey and interviews with programme participants suggested that the combined AotF programme mechanisms were deemed relevant and appropriate.

Delivery mechanisms: We found that the mechanisms had value in their own right but there was little evidence at this stage of mechanisms that had been put in place to allow for cross-fertilisation between the programme strands.

Governance: We found the Programme Board and the Challenge Director were seen to demonstrate strong leadership of the programme, with an effective balance between the Challenge Director and Programme Board ensuring the programme was both flexible, innovative and reflective of the needs of the programme, whilst also ensuring that due process was followed to ensure programme integrity through robust and coherent decisions.

Processes: Pre-application briefing activity to engage creative sector businesses who may have had limited prior exposure to Innovate UK was well-received and resulted in a high-level of participants who were new to Innovate UK. The Challenge received many strong applications, meaning there was a higher bar set in terms of the projects that got funding compared to other comparable programmes.

As to the overall appropriateness of the AotF processes for creative sector SMEs, interviews carried out across the evaluation suggest that the sector saw participating in the AotF programme as carrying a high / very high managerial and administrative burden. This presented a real difficulty and barrier to micro and small companies. Any future UKRI programmes aiming at the creative industries could usefully reflect upon how to further adapt and streamline the processes for selection and the monitoring of spend accordingly.

3.3 Demonstrators

3.3.1 Methodological considerations

This section presents the findings on the Demonstrator strand. Findings are based on interviews with consortia participants, undertaken at baseline, interim and post-exit phases of the evaluation.

This report also brings in data from the Project Completion Forms (PCFs), submitted to InnovateUK (IUK) by participating companies at the project end.

Due to IUK's monitoring processes, six participants who received two grants in relation to their Demonstrator project were asked to provide a PCF response per grant. Where is this the case, analysis has taken a project-level view rather than measure outcomes by individual grant. For example, if a company has reported an outcome from one grant but not the other, this outcome has nevertheless been counted in the total number of companies who reported the outcome in question as a result of their participation in the Demonstrators.

We also undertook a supplementary survey (Demonstrators quant instrument) undertaken April – June 2022, which is jointly used with the PFC data to reflect on the Demonstrators' contribution to the indicators in the evaluation framework.

A full list of interviewees can be found in Appendix D.4 and the profile of project completion form submissions in Appendix D.3.

3.3.2 Audiences

Each Demonstrator project was given the target of reaching a total audience of 100,000. **Two of the four Demonstrators met this target** (the eSports and Immersive Performances Demonstrators). In total, the four Demonstrators reached a total audience of 2.38m (mostly driven by the eSports Demonstrator).

Table 13 Total audiences of Demonstrator projects

| Demonstrator | Target audiences | Total audiences |
|--|------------------|-----------------|
| Weavr: Immersive Cross-Reality Experience in eSports | 100,000 | 2.1m |
| Immersive Performances of the future | 100,000 | 160,000 |
| Visitor experience: Dinosaurs and Robots | 100,000 | 60,000 |
| Moving Image: The Big Fix Up / Fix Up the City | 100,000 | 68,000 |

Source: Demonstrator quant instrument / Demonstrator interviews

3.3.3 Collaboration (outcome area 1)

The Demonstrators consortia brought together industry, academic and culture sector partners. 64% (14 companies) expect to continue collaboration with partners beyond the programme (base: 22, PCF data) and five out of seven respondents to the Demonstrator quant instrument reported that they had collaborated with organisations that they had not previously worked with as a result of the programme.

Examples of follow up collaboration reported in interviews include joint funding applications, shared use of labs and facilities and researchers being contracted for freelance work by participating enterprises.

The case studies provide good evidence that the Demonstrators had a positive impact on industry-academia collaboration. ESL, Dock10 and Factory42 have all described a shift in their attitudes towards the opportunities and benefits of working with academic partners. All three enterprises are currently working with academic researchers / and partners in ways they would not have considered prior to their participation in the programme.

There is also evidence that companies value the opportunity and space to experiment and test that is offered by universities. From an academic perspective, universities feel that working with industry partners through the Demonstrator project gives their research credibility and raises its profile.

3.3.4 Innovation (outcome area 2)

3.3.4.1 New products, services, and processes

63% responding companies said that they expected to **introduce new products, services, and processes** as a result of their participation in the Demonstrator project (base: 19, PCF data).

Examples from the case studies includes new cloud-based production workflows, new virtual production services and a new live performance games engine product.

3.3.4.2 Outputs and revenue streams

Business model innovation and commercialisation: Demonstrator participants have trialled and tested – and in some cases, put into practice – new business models through their participation. Examples include:

- Virtual production accounted for 25% of Dock10's revenues in 2021 - up from 0% prior to the project
- Natural History Museum (NHM) have commissioned further research into business models for immersive experiences building on their participation in the Demonstrator
- Royal Shakespeare Company trialled business models and payment options for online immersive performances through *Dream*.

Spin out companies: Six respondents reported plans to create new commercial entity (spin-outs) to develop the innovation further within the UK as a result of the Demonstrator, and a further three said they have plans to create a commercial entity overseas to develop the innovation further (PCF data). Across academic partners, one spin out has already been established (see Weavr case study) with two further spin-out companies from universities planned (PCF data).

New IP and/or exploitable trade secrets: At the project end, ten companies reported having been granted IP rights in some form, and a further three organisations said they were considering but have not yet applied for IP protections. IP granted includes eight trademarks and six instances of copyrighted material. (base: 24, PCF data).

3.3.4.3 R&D Roadmaps

At the project end, 48% (11 companies) said they were planning further R&D to commercially exploit the product or service developed through their Demonstrator product (base: 23, PCF data).

Planned sources of funding for this R&D included further InnovateUK funding (8 companies), business funds (7 companies) venture capital (7 companies) and through business angels (5 companies).

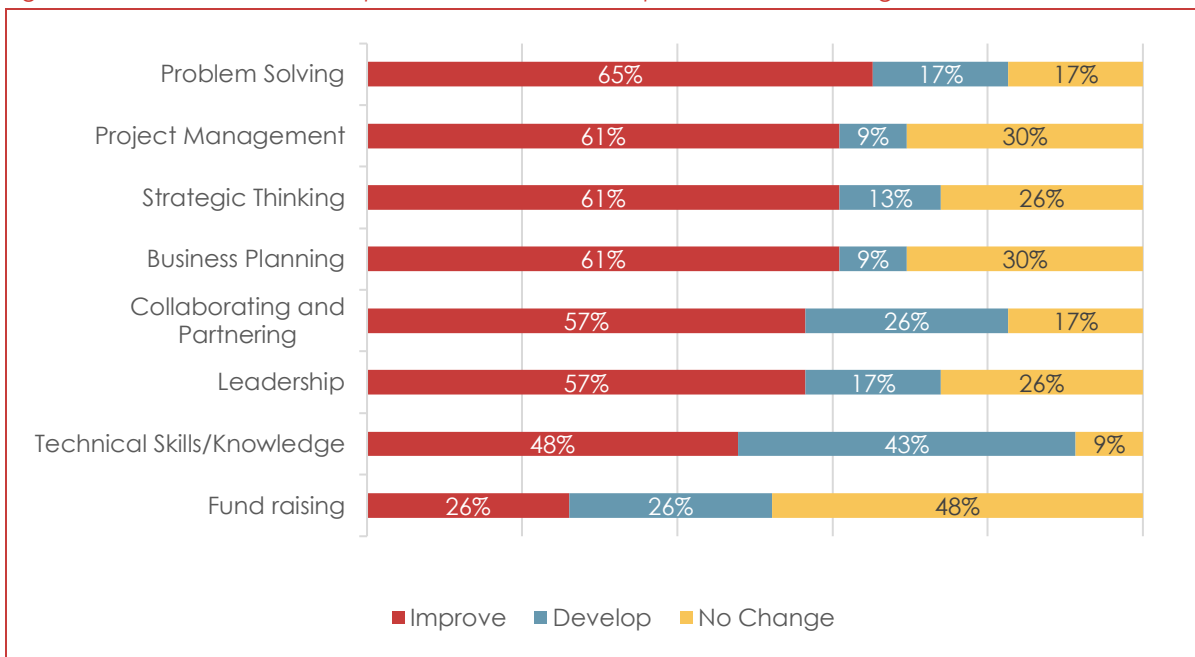
3.3.4.4 Capacity building

Demonstrator participants reported a range of skills outcomes for their workforce. The most widely report skills either developed or improved were technical skills/knowledge (91%), collaborating and partnering (83%) and problem solving (82%) (base: 23, PCF data).

Increased understanding of the way in which users and audiences interact with immersive technologies was reported as a key outcome for participating organisations across all four of Demonstrators, whether this was gained through dedicated audience research or more organically through producing audience-facing prototypes and outputs.

In addition to technological competency, the 'soft' skills needed to produce immersive content, products and services was another significant area of development for participants. This includes project understanding of budgets, timelines, approaches to collaboration and the (often unanticipated) practical considerations of digital-physical experiences.

Figure 7 Demonstrators: development of new skills or improvement of existing skills



Source: Demonstrator Project Completion Forms. Base: 23

By the point of project completion, participants reported four peer-reviewed papers with a further eleven planned (base: 4, PCF data). De Montford University have proposed a special edition journal on live performance in digital environments that will share, among other things, the learnings from the Demonstrator. Marshmallow Laser Feast and Nesta, members of the Immersive Performance Demonstrator, have created websites and platforms to share designs schematics, creative processes and information on innovation and investment.

Participants have presented the learnings of from the project at industry and academic events: ESL and the IBC conference, the Royal Shakespeare Company at academic institutions around the world, including MIT and Harvard.

3.3.5 Organisational or strategic change

Several participating organisations reported changes in their organisational strategy towards immersive as a result of the Demonstrator project. Examples include:

- Marshmallow Laser Feast have changed their approach to the potential of digital-first projects and the type of work they want to develop in the future
- Royal Shakespeare Company have established a new digital development structure and R&D lab
- Factory42 reported that academic collaboration has become much more important to their organisational strategy following the project
- The Big Fix Up has made a major contribution to Aardman Animations establishing a dedicated R&D policy and budget

3.3.6 Economic (outcome area 3)

3.3.6.1 Employment

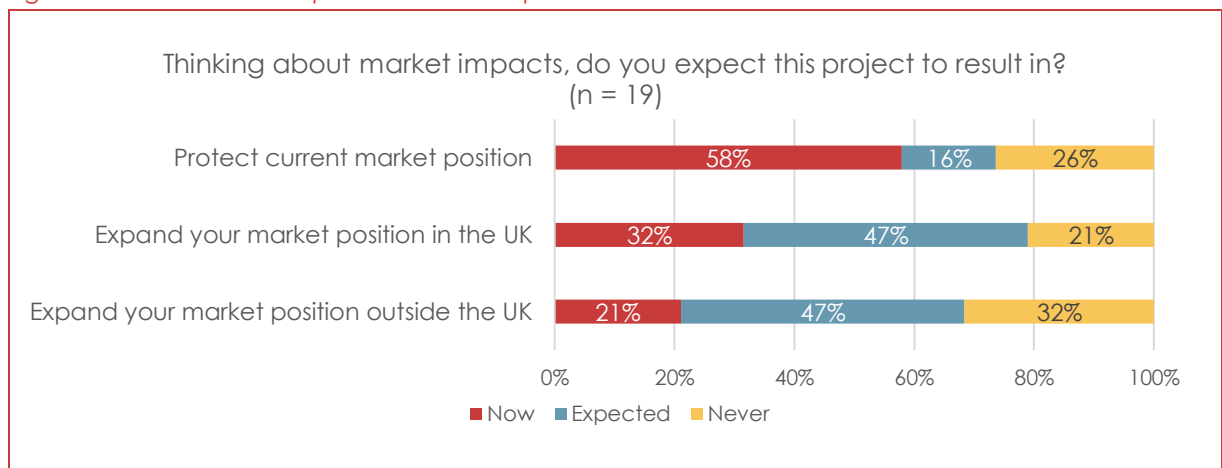
Across all participating organisations, a total of 79 FTEs were reported as having been 'created' as a result of the Demonstrator, with a further 110 FTEs reportedly retained thanks to the

programme (base: 16, PCF data). Across the four organisations who returned data, three organisations had increased the number of FTEs employed since baseline (including one organisation which went from 14 to 25 FTEs) and one of the organisations had one fewer FTEs (quant instrument).

3.3.6.2 Market impacts

79% participants said that the Demonstrator project had already helped them to expand their market position in the UK (6 companies) or would do in the future (9 companies). A further 68% said that they either had or would be able to expand their international market position.

Figure 8 Demonstrators: expected market impacts



Source: Demonstrator Project Completion Forms. Base: 19

3.3.7 Case studies

Full case studies of the four Demonstrator projects are provided in Appendix B. These are summarised below. Following the case study overviews, we provide some cross-Demonstrator analysis of the strand.

Overview - WEAVR: Immersive Cross-Reality Experiences in Esports

'The research is really cutting edge - TRL 123 research - all the way up to a large-scale demonstration with, in the end, millions of people. It's the volume, it's the ambition [...] that was really, really brilliant for us.'

By the end of the Demonstrator, Weavr had reached audiences of tens around the world with personalised, mixed-reality experiences that were broadcast from virtual facilities. The project had changed course during the pandemic, sidelining planned in-venue experiences and bringing forward deliverables related to online experiences, something that all of the consortium members agreed had been a positive development

As part of Weavr's emphasis on remote and digital working, the consortium was able to develop a new cloud-based platform and more efficient production workflow.

Consortium lead ESL changed ownership over the course of the Demonstrator programme and merged with UK eSports business Face It. At the time of writing, the new owners, Savvy Gaming Group (SGG), are likely to make UK entity, ESL Face It Group, the main technology and innovation hub for the entire global conglomerate. ESL believe their experience on the Audience of the Future programme have made the UK the 'obvious choice' to become the Group's innovation arm.

'In Weavr, we were five years ahead of the time. A lot of the thinking that we had within Weavr is now becoming quite apt for the overall innovation direction that that the Group is taking. So it's kind of like a told you so moment.' ESL

Project outcomes include:

1. Acceleration of a significant shift in broadcast partner Dock10's business model towards virtual production
2. A new on-site television studio at the University of York that has been established to build on the technology and workflows pioneered through Weavr
3. ESL/Weavr participated in another consortium for a location-based 5G cross-reality project as part of an IBC Media Innovation accelerator. The project was awarded the top prize at the conference and ESL/Weavr hope to demonstrate the results at the Commonwealth Games this year.

While they regard the project as a success, ESL feel they could have generated even more interest in Weavr from the industry – and reached greater numbers of audiences - if they had been able to budget for marketing activity as part of the project.

Since the project end, consortium partners are continuing to work together or have projects or opportunities in the pipeline.

Overview – Immersive performances of the future

The immersive performance demonstrator aimed to investigate new ways to incorporate immersive technologies into location-based live performance. The initial project design was entirely location-based, requiring a significant shift of focus when the pandemic struck towards a greater emphasis on virtual production environments with live components.

In March 2021, the RSC live-streamed 11 shows set in a virtual forest and using real-time motion capture of live actors performing digital avatars, that people could see on a bespoke platform on their desktop, mobile and tablet. There was also an element of interactivity enabled: audiences could become fireflies and interact with the performance.

Dream performances were well-received and highlighted by multiple stakeholders external to Audience of the Future as a high-quality, cutting-edge output of the programme – evidence of external validation for the project outputs.

The performances reached over 65,000 people, 40% of whom were 'Gen Y or Gen Z' (under 40s) and 76% of whom had not previously booked shows with the RSC. The performance was seen in 92 countries. Across all project outputs, the Demonstrator reached 160,000 people.

Alongside audience-facing outputs, the consortium developed prototypes exploring how the assets of cultural organisations – such as orchestral pieces - could be performed and interacted with in the digital realm.

Project outcomes include:

- Freelancers who worked on the Demonstrator that have gone on to start their own companies benefitting from the experience and profile they gained by taking part of the project.
- Consortium members have given talks and presentations at industry events and academic institutions, including MIT and Harvard, all over the world to share the outcomes and learnings of the project
- Following the project end, the RSC have become the first performing arts organisation to have been awarded Independent Research Organisation (IRO) status by the Arts and Humanities Research Council (AHRC) which they attribute to their participation in the Demonstrator.
- The RSC now has a new digital development structure which includes an R&D lab and the learnings from the project have been deeply embedded within the organisation.
- De Montford University has recently rewritten its undergraduate programmes, incorporating lessons from AotF, especially its interdisciplinary approach to programming and performance.

The consortium highlighted the tension inherent in producing a research piece that also has ambitions to reach significant audiences and the challenges of maintaining the quality of experience while pushing technological boundaries.

"There are challenges around R&D going into an audience setting. I don't think people had really thought about how challenging it is. Because whatever you say, audiences don't care whether it's research, development, they care wherever it works, and it's a success."

Overview – Visitor Experience: Dinosaurs and Robots

“What I bring individually back to the Almeida is huge. My skills development is enormous. And certainly, if we do an immersive show at the Almeida, which I'm sure we will at some point, my knowledge of how to do that will support us enormously.”

“In terms of the depth of pipeline, the quality of customers, we are competing on a global scale now and that wasn't the case at the start of the project.”

The Visitor Experience Demonstrator consortium aimed to create a new genre of participatory MR experience to broaden audiences and seek new commercial opportunities ('immersive theatre meets highly interactive museum exhibit'). The project outputs reached 60,000 audiences / users in total: 3,000 of which were on location and the remaining 57,000 of which were online / digital audiences.

The location-based output, Lost Origin, ran for six weeks in Autumn 2021 and combined theatre and mixed-reality technologies. Audiences joined a narrative journey in which they were part of a 'mission' to investigate illegally trafficked dinosaur bones which had ended up in the experience venue, a warehouse in Hoxton.

Lost Origin received critical acclaim and has been identified by stakeholders external to AotF as a stand-out output. The experience was ambitious in scale and turned around in under twelve months – some of which were subject to lockdowns. Both Factory42 and Almeida noted the extraordinary challenges – both technical and creative - of putting something together a high-quality, cutting-edge, audience-facing output in such a short timeline.

The consortium also developed two augmented reality learning mobile apps for children using content from each museum, launched in 2020.

Project outcomes include:

- The Almeida have been able to develop an in-depth understanding of this considerations and demands of immersive LBEs, from batching to synchronization and creative ways of incorporating the technology into the narrative. They feel they are now well-position to undertake a similar project in future.
- Factory42 have been able to use the experience gained through the Demonstrator in other funding bids. They are also working with the University of Nottingham and StoryFutures on a follow up project.
- Science Museum are applying the learnings from their audience research to the development of a new AR app they are developing with Niantic (the developers of Pokémon Go).
- NHM commissioned further research exploring potential business models for immersive within the Museum and has also undertaken their own evaluation of the Demonstrator project, the learnings of which have been shared and embedded across the organisation.

The Visitor Experience consortium also identified challenges that arose throughout the project when it came to balancing technological innovation, audience experience and, for the museums, scientific rigour.

Overview – Moving Image: The Big Fix Up / Fix Up the City

The Moving Image Demonstrator used Aardman Animation's Wallace & Gromit characters to produce two AR experiences: an at-home app and a city-based LBE. However, the ultimate objective was to use these experiences to build an IP agonistic platform and back end for handling immersive projects, the MUST (Multi User Story Telling) platform.

The at-home app, *The Big Fix Up*, launched in January 2021. Originally only released in the UK, US and Canada, the app was eventually released worldwide and, at the time of interview, had engaged 68,000 users. The LBE, *Fix Up the City*, ran in Bristol and Cardiff between August 2021 and December 2021 / January 2022, as well as a cutdown demonstration version that ran in San Francisco to coincide with a major international XR conference.

The at home app was not part of the original plans and was instead a pivot that the consortium made when the Covid pandemic hit. However, all partners agreed that this had a serendipitous impact on the project as it made the consortium, *“move away from a city-based experience and into the digital ‘at home’ realm – and then return to the LBE... we learnt a lot more.”*

The development of the project has been technically and creatively complex. It became clear early on in the project that the genre of narrative-based AR experiences did not really exist. In addition to the technical production challenges that this threw up, it also led to challenges at the distribution stage and in audience expectations. Fictioneers were largely successful in meeting these challenges and garnered a lot of industry interest and accolades, including winning a number of awards.

All partners in Fictioneers felt that the experience of the Demonstrator had been very positive for them as organisations. The AotF grant gave them a huge degree of creative freedom which was essential to the success of the Demonstrator. Although not a formal consortium partner, Aardman still felt very involved in the project as they contributed the narrative for the project as well as the IP assets. Again, their experience was very positive, and Aardman cited their participation as a major contributing factor in setting up, for the first time, a dedicated internal R&D policy and budget. Crucially, the project succeeded in overcoming some internal doubts in the company about the balance of risks of innovating in a new environment and format with much loved characters and IP.

“There was an internal challenge all the way through... [But] we are more willing to understand now that it's not the end of the world if things don't quite work out... we have more of an open mind... this just helped people to see that that the future is not so scary that you don't go near it.”

The biggest challenge encountered over the final period of the project lay in efforts to commercialise the AR experiences. The apps were free to download and then there were opportunities to make in-app purchases, though these were small in number. Increasing these sales would have required a much larger installed app user base, but in practice this was not possible to achieve without significant marketing spend (which was not allowed within the terms of the AotF grant).

The partners also encountered a number of challenges in relation to the LBE, all of which pointed towards the need for the city-based experiences to become, *“something that's driven as much as a managed experience, rather than a self-directed experience... you need to build that more managed experience, otherwise things can go wrong.”*

Fictioneers were actively looking for external investment in the MUST platform to commercialise the asset and they have secured investment. However, this has not come from an external source. But from the multinational parent company of one of the partners (Potato). As a result, the shareholding and rights distribution arrangements have changed as Potato have taken sole ownership.

In general, the collaboration between the core partners in Fictioneers went very well and this also extended to Aardman's involvement. Going forwards, Potato are investing in MUST, focusing on developing narrative AR journeys for both B2C and B2B markets. Sugar has grown their capacity and skills in AR and have re-shaped their business to become more focused and specialised in this area. Tiny Rebel Games have returned to making games, and Aardman want to continue to explore the further exploitation of the Wallace and Gromit AR experiences, as well as pushing ahead with other interactive and immersive projects in new sectors.

The project/Fictioneers have won a number of accolades and awards, including:

- BIMA's Top 10 for 2021

- Qld XR Festival Awards 2021: Best in the World (Across All Categories)
- Bloo Loop Innovation Awards 2021 Winner: Digital
- Shortlisted in TIGA 2021 Game Industry Awards
- Creative Industries Council: top 100 companies to watch

3.3.8 Demonstrator Cross Analysis

3.3.8.1 Challenges

All of the Demonstrators projects experienced challenges related to the Covid-19 pandemic which led teams to 'pivot' their projects to deal with new realities. The extent to which Demonstrators were exposed to these challenges was related to how much of their original plans involved physical elements, which had to be either abandoned or postponed.

Another important impact that some of the Demonstrators had to cope with more than others is the degree to which their existing businesses and revenues were hit by the pandemic. For a few companies participating in the Demonstrators, an inability to trade resulted in loss of capacity as staff were furloughed.

However, all of the Demonstrators came through this turbulent and uncertain period intact and each delivered elements and adaptations of the project. The steadfast support and encouragement given to the projects by UKRI through the pandemic was referred to by all the consortium leads we spoke with.

Towards the end of the project, most challenges were raised in relation to the outstanding elements of work, which were often the Location Based Experiences (LBEs) that had not been possible during pandemic restrictions. As companies were also in the active phase of testing business models and commercial viability, challenges related to these areas were also raised.

The table below summarises the challenges reported by the Demonstrators at different phases of the project.

Table 14 Challenges reported by the Demonstrators over the course of the project

| | Baseline – April 2020 | Interim – February 2021 | Final – August 2022 |
|--|---|---|---|
| WEAVR: Immersive Cross-Reality Experiences in Esports | <p>Commercial: finding media rights for esports (current media rights frameworks are not fit for purpose in esports)</p> <p>Commercial: developing the post-programme exploitation plan and establishing the ownership of NewCo and sorting out the IP arrangements</p> <p>Technical: lots of challenges to overcome (e.g. getting data and content off-device and streaming requires 5G but this infrastructure is fragmented at present; deciding on which hardware WEAVR will run</p> | <p>Commercial: now focused on commercial trials re how to monetise online esports audiences and how to integrate immersive into other traditional sectors</p> <p>Organisational: Due to travel restrictions planned in-venue activities, where audiences would have been exposed to high-end VR experiences, had to be postponed (it was replaced with online surveys and focus groups)</p> <p>Organisational: ESL originally wanted to reduce R&D when pandemic hit, but were</p> | <p>Commercial: Consortium members found it challenging not having a structure or agreed approach when it came to the joint exploitation of the IP that was created over the course of the project. Subsequent negotiations between consortium partners to resolve this were complex and slow.</p> <p>Commercial: Consortium lead ESL reported that it was harder for them to articulate WEAVR as an investment proposition in comparison to a typical commercial project, due</p> |

| | Baseline – April 2020 | Interim – February 2021 | Final – August 2022 |
|--------------------------------------|---|--|--|
| | <p>on in terms of proliferation of end user VR devices)</p> <p>Organisational: initially convincing senior management about investing in the project, given the size of the investment and the lack of clearly defined commercial benefits beyond the Demonstrator</p> <p>Organisational: fierce competition exists for skilled staff not just from esports or broadcast, but also from immersive start-ups, marketing agencies, Google and Facebook, and other sectors, such as health and automotive not using common development environments (e.g. Unreal and Unity)</p> | <p>ultimately convinced to increase it instead</p> <p>Organisational: hiring and retaining appropriately skilled talent is an ongoing challenge</p> <p>Technical: Barriers to adoption remain in relation to headsets (prices are still too high and still not enough reasons to buy in terms of content and experiences)</p> | <p>to the challenge of 'productising' (to make or develop a concept into a product) the large amount of R&D that had taken place over the course of the project.</p> |
| Immersive performances of the future | <p>Commercial: reaching and converting international audiences for immersive content requires a different model of marketing to the model UK cultural organisations are familiar with.</p> <p>Commercial: a lack of IP, licencing and distribution skills within some of the cultural businesses, which is a barrier to making the potential new business models work</p> <p>Technical: balancing experimentation and R&D with delivering "something amazing" for large audiences is a tension within the project</p> <p>Organisational: skills shortages in immersive content production and distribution mean experienced candidates can command good salaries - which makes it hard for cultural organisations to attract and retain skilled staff</p> | <p>Commercial / Organisational: major loss of revenues for the RSC and other organisations has led to widespread furloughing and permanent loss of staff, including related to immersive</p> <p>Commercial: not clear what the revenue and IP model is for the shared virtual production environments</p> <p>Technical: the major project pivot is to move to developing and testing shared virtual production environments, the plans on how to do this are still in formation</p> | <p>Organisational: some partners reported that the cost of collaborating across a consortium with so many organisations, in terms of time and resources, had been high.</p> <p>Commercial: private sector businesses in the consortium reported that the costs of producing immersive experiences remain high and that this still stymies commercial viability at present.</p> |

| | Baseline – April 2020 | Interim – February 2021 | Final – August 2022 |
|---|--|--|--|
| Visitor Experience: Dinosaurs and Robots | <p>Operational: installing large-scale paid-for MR experiences inside very busy national museum building envelopes</p> <p>Commercial: sorting out IP arrangements in order to monetise the project downstream; in part because it is a moving target (i.e. do not know at this stage which module(s) and format(s) will be viable)</p> <p>Technical: the project has to ensure wide accessibility in physical terms (e.g. for wheelchair users, deaf users, blind users, etc.) but (unlike websites) there are currently no accessibility standards for immersive projects</p> <p>Organisational: managing complexity and different working practices and cultures - the project is pushing at the boundaries in a lot of ways (operational, tech, commercial, marketing) and the different creative dimensions pull in different directions and work at different paces</p> <p>Organisational: recruiting skilled people that are able to blend games, TV and live performance is a real challenge</p> | <p>Commercial: one of the project partners (Intu) went into administration, leaving the consortium with no non-museum physical distribution partner</p> <p>Commercial / organisational: differing priorities, processes and working cultures created tension across the consortium; the museums will no longer be involved in the LBE</p> <p>Technical: the Magic Leap headsets proved difficult to work with and unreliable in certain conditions</p> <p>Organisational: the museums' schedule of building works and exhibitions and lack of alternative spaces meant that the LBE has not, and will not, be tested in the museums</p> <p>Technical: the pivot to a digital only experience (for now) meant creating and distributing two apps within a very short timeframe (6-7 months)</p> <p>Organisational: shifting to a younger age group and more educational content for the apps required bringing in more science learning skills into the production team</p> | <p>Technical / production: there were a number of aspects of the LBE that proved challenging, including batching (the process of sending audience groups through the experience to a particular time schedule), achieving synchronisation of key narrative moments, and onboarding audiences with the Magic Leap glasses without disrupting the narrative flow.</p> <p>Commercial: The additional cost of the commercial rental of the LBE warehouse site (not covered in the AotF budget as partners were to have run this in-house) prevented a longer run, despite being sold-out (2 weeks paid after 4 weeks soft launch).</p> |
| Moving Image: The Big Fix Up / Fix Up the City | <p>Creative: producing immersive experiences that are suitable for young children (i.e. 8 and upwards) as well as adults, including how to navigate the age restrictions of some platforms (e.g. YouTube)</p> <p>Technical: creating ambitious and compelling AR content that will still work on the average mobile phone</p> | <p>Commercial: navigating differing US states' laws regarding data required specialist legal advice</p> <p>Commercial: the structure of the Fictioneers JV is no longer optimal for where the project is now and to attract investors, so it is being re-shaped</p> <p>Technical: testing the tech to choose to build the project took a long time; the UX build was also</p> | <p>Technical / production: there were a number of aspects of the LBE that proved challenging, including a delay to the start in Bristol (due to unexpected changes in the appearance of a key building), and the need for a more 'managed' experience (e.g., to help onboard audiences and better manage interaction with the general public).</p> |

| | Baseline – April 2020 | Interim – February 2021 | Final – August 2022 |
|--|---|---|--|
| | <p>Commercial: replacing the original rights owner after the award had been made with Aardman has meant establishing new project objectives and going through a commercialisation process with their new partner in rapid time</p> | <p>difficult as no similar projects to build upon</p> <p>Creative / Technical: abandoning / delaying the LBE component of the project meant having to create a 3D model of the city of Bristol in quick time to replace the physical experience</p> <p>Technical: lot of work spent optimizing the app to work on top 50 headsets and to be able to be downloaded from app stores</p> | <p>Commercial: the plans for driving uptake of the app were too reliant on partners' in-kind marketing efforts and free media, leading to disagreements between consortium members on whether to spend additional cash to drive uptake.</p> <p>Commercial / organisational: partners' aspirations changed as the project reached the end which required the original apportioning of IP rights to be re-visited, which caused some friction.</p> |

3.3.8.2 Observations on the findings

Easing of restrictions in the last eighteen months have allowed projects to fulfill their Covid-adjusted plans and ambitions, in particular with respect to the Location Based Experiences that were delayed by the pandemic. This last period also enabled organisations to test different business models and (to some degree) test commercial viability, as well as think about building upon their projects.

The following observations can be made from the experiences of the Demonstrators:

Involvement of the knowledge base: three of the four Demonstrators (eSports, Performance and Visitor Experience) report that the involvement of the academic knowledge base in the Demonstrator consortia has been strongly positive and they can now point to further collaboration, both with the existing and new academic partners.

Covid accelerated shifts to digital products and services. This was largely seen as a positive development by the Moving Image, Immersive Performance and eSports Demonstrators, who felt the constraints of the pandemic resulted in outcomes that were more technologically mature and better aligned with broader market trends towards in-home entertainment, cloud-based platforms and Web3 technologies.

Project and consortium management. We previously observed challenges in project and consortium management, with some Demonstrators managing these challenges better than others. The interviews for the Immersive Performance Demonstrator that were carried out this year, with a greater number of consortium members, also reveal the challenges of simply managing a consortium that consists of many partners. The overhead on this collaboration was considerable, leading to organisations having to sometimes curb their collaboration with partners in order to get things done. However, overall 68% of respondents reported being either satisfied or very satisfied with the effectiveness of the consortium in project delivery, with just 13% saying they were unsatisfied or very unsatisfied (the remaining 14% said they were indifferent). (base:29, PCF data).

Composition of the core consortia. The Interim Findings drew attention to how some of the positive, as well as some of the negative, aspects of collaboration across the Demonstrators seemed to be related to how similar the partner organisations were in terms of size, public or

private, sectoral background, and their degree of existing knowledge and experience in digital media and tech. The Interim findings suggested that having partners that share similar structural organisational characteristics means that it is also likely that they share similar ways of working, decision-making processes and attitudes to risk, as well as having the skills to engage as peers. The positive aspects of this were again shown in relation to the rollout of the Visitor Experience and Moving Image LBEs.

Engaging audiences in innovation vs reputational risk. The ambition in Audience of the Future to engage audiences was both highly valued and also, for some consortium members, the source of considerable challenges. For the eSports Demonstrator the emphasis on engaging audiences was what made the programme distinctive and attractive and helped them to maintain an experience-led approach to innovation. However, in the Visitor Experience and Immersive Performance Demonstrators, the cultural partners struggled with what they felt was a tension between creating something novel and technically innovative, while also creating something that met the quality and production values they expect to deliver to their audiences.

Structuring the input of cultural organisations / rightsholders. The consortia provide differing ways in which cultural organisations / the rightsholders played featured within each Demonstrator. Where cultural organisations have been core partners within the consortia, it was not entirely successful. This is most apparent with regard to the museum partners within the Visitor Experience Demonstrator, who left the consortium once the apps had been delivered. In large part, this was related to the point above about there being a big difference in size, outlook and experience between the consortium partners (in this case the two museums and the two remaining project partners). However, as also noted above, this relates to the tension that some of the cultural organisations perceived between needing to innovate and experiment, yet also avoiding reputational damage in the eyes of audiences and critics. Some similar views were expressed internally by the rightsholder in the Moving Image Demonstrator at the outset of the project, concerning the risks the project raised for their well-cherished characters and IP. However, because the rightsholder was not a core partner in the Moving Image demonstrator (instead providing a license to the IP for the core partners), any such internal doubts were kept at 'arms-length' from the core consortium and production process.

Structuring deals for uncertain IP and fluid circumstances. This proved difficult across the Demonstrators, even though projects took different approaches to how to do this. For instance, the Moving Image Demonstrator structured their new company (Fictioneers) as the asset holding entity from the outset of the project, but still found themselves having to unwind the arrangements towards the end of the project, to reflect changed aspirations of the partners. eSports took the alternative approach – that the IP was too uncertain at the outset to try and structure an agreement – but still found that the negotiations and arrangements to structure the IP were difficult, even at this later stage once the IP became knowable, particularly given that legal costs could not be covered by the AotF grants.

Business model innovation and commercialisation. All four Demonstrators trialed new business models and explored the commercial viability of their projects. The results suggest that not much has changed in the marketplace regarding the ways to make commercial returns from immersive creative content. The pivot to apps was one way that two of the Demonstrators could keep their projects alive during a time when LBEs were not possible. But in doing so, the projects ran into the same issues that other app and games developers face: a congested market with distribution gatekeepers that means marketing spend is a necessary (if not sufficient) condition of driving downloads. However, unlike other developers, AotF projects were not allowed to spend their grants on marketing (which caused some tensions in consortia as they struggled to meet the audience KPIs previously set for their projects). Equally, the Moving Image Demonstrator also found that app-based revenues (e.g., 'in-game' / in-

experience purchases) are weak without a high volume of downloads. In terms of the commercial viability of immersive LBEs, partners in the Immersive Performance Demonstrator report that the cost implications of the technology and infrastructure remain prohibitively high so constrain commercial returns (and therefore also private investment). However, the Visitor Experience LBE did manage to show in its short, paid-for run that – had there been a different venue solution with no hire costs – the experience could have run on commercial lines.

Reusable assets and replicable and scalable processes: project exploitation and attracting further investment. In contrast to the Demonstrators focused on unique experiences tied into specific IP, the two Demonstrators that focused more on creating reusable assets and scalable processes have both attracted follow-on interest and investment. Both the eSports and Moving Image Demonstrators have seen the main assets created through AotF be effectively acquired by larger companies, either through an existing relationship as the parent company to one of the consortia partners (Moving Image), or as part of an acquisition deal (eSports) in which WEAVR has become a key innovation asset that the overseas acquiring entity wants to build on.

Lastly, at the end of the project, 100% of the participants reported that their projects would not have gone ahead without the UKRI funding (base: 23, PCF data), **indicating strong additionality** for the Demonstrator investment.

3.4 Grants and investments

This section presents the findings on the 'Grants and Investments' strand. These findings are mostly based on data collected via survey. The survey of Design Foundations applicants was conducted in Sep-Oct 2020, and the survey of Production Innovation in Immersive Content (PIIC) and Investment Accelerator applicants was conducted in Oct-Nov 2021.

Where appropriate, this section also brings in information and data collected in the Project Completion Forms (PCFs) which projects are required to complete c.3 months after the end of their projects. The profile of respondents to the PCFs is presented in Appendix D - D.3.

3.4.1 Some methodological considerations

The ex-post results presented in the following section are based on two separate surveys which were conducted one year apart. As projects in the Design Foundations strand concluded sooner than the rest, the post exit data reflects the financial year 2019/20. Post-exit data on the other two strands correspond to the financial year 2020/21. The baseline measurements for the programme are captured for the financial year 2017/18.

To increase sample size for the analysis of economic indicators and therefore the statistical significance, we have presented the results for all three Grants and Investments strands together. For some indicators, we have also presented the breakdowns by strand, although the results should be interpreted with caution (especially for the Investment Accelerator strand which has only three respondents¹⁴).

Longitudinal indicators correspond to those businesses for which we have data at both baseline and ex-post points to ensure comparability. In addition, for a small number of observations where information was provided in a range, we have calculated a mid-point to arrive to a numeric estimate.

¹⁴ Of the six awards granted through the Investment Accelerator

Organisations that were unsuccessful in their applications to the AotF competitions in scope here but were successful in their applications to the Design Foundations 2 competition have been classed as 'unsuccessful applicants' for the purpose of this analysis.

3.4.2 Main findings (overview)

Table 15 below presents a summary of key indicators, which are discussed in further detail in subsequent sub-sections.

Table 16 shows longitudinal indicators with comparison against the baseline position for the same population. Median values are presented to mitigate the effects of outliers in the dataset (given the small sample size). Appendix C - C.2 provides a comparison with the mean values for the same indicators.

Overall, participants reported positive outcomes derived from their involvement in the programme. **Our survey results indicate that turnover has improved substantially for participants. Furthermore, there is a substantial increase in the value of turnover derived from immersive content or technologies.** As the number of employees has remained the same, the levels of (labour) productivity for participating businesses (Gross Value Added per employee) has increased.

Around half participating businesses had not generated turnover from exports, suggesting that there is scope for further growth if this option is successfully explored in the future. Those businesses who had generated turnover from sales abroad had seen a net increase in the value of those sale compared to the baseline. Unsuccessful applicants have experienced growth but to a much smaller extent, indicating that the programme has had a positive impact on these key performance indicators.

The programme has provided a good platform to enhance existing partnerships and to build new ones. Most participants had collaborated with at-least one new partner, with more than half stating they had established a new partnership with a micro business. Almost all respondents agreed the programme played a big role in enhancing these partnerships.

Most participants had developed at least one new creative immersive product (79%) and/or service (56%) because of their Audience of the Future project. A significant share had also improved their existing offering(s). Most participants had progressed at least one TRL level and a third had progressed from Feasibility (TRL 1 – 2) to Commercialisation (TRL 9). As a result, close to half of participants reported that they had already generated revenue from new product/services or customers, and another 40% stated they expected to achieve this in the future. This is in stark contrast to unsuccessful applicants, most of whom had not progressed the TRL of their project or had not continued with their project at all.

Table 15 Grants and Investments, post-exit indicators overview

| Indicator | Design Foundation | PIIC | Investment Accelerator | |
|---|---------------------------------|--------------|------------------------|------------|
| Outcome area 1: Collaboration | | | | |
| Number of new partnerships for participating enterprises, organisations, and researchers | 68% (71/104) | 56% (79/142) | 50% (13/26) | |
| % agree/strongly agree programme led to enhanced partnerships | 95% (21/22) | 100% (16/16) | 100% (3/3) | |
| % of organisations that indicate that they can see avenues for future collaboration with industry/academia due to the programme | 91% (20/22) | 100% (16/16) | 100% (3/3) | |
| Outcome area 2: Innovation | | | | |
| Number of organisations reporting new production methods | 54% (13/24) | 62% (13/21) | 100% (3/3) | |
| Number of organisations reporting improved production methods | 42% (10/24) | 57% (12/21) | 100% (3/3) | |
| Number of audience-facing prototypes or pilots developed | 79% (19/24) | 67% (14/21) | 100% (3/3) | |
| Number and % of organisations reporting new creative immersive product | 79% (19/24) | 76% (16/21) | 100% (3/3) | |
| Number and % of organisations reporting new creative immersive service | 50% (12/24) | 57% (12/21) | 100% (3/3) | |
| Number of organisations reporting new or improved working processes | New | 79% (19/24) | 57% (12/21) | 100% (3/3) |
| | Improved | 54% (13/24) | 38% (8/21) | 100% (3/3) |
| Number and % of organisations reporting improved content, product or service | Product | 29% (7/24) | 62% (13/21) | 100% (3/3) |
| | Service | 33% (8/24) | 38% (8/21) | 100% (3/3) |
| Number of successful organisations who have developed R&D roadmaps | 50% (12/24) | 67% (14/21) | 67% (2/3) | |
| Number of organisations which indicate they have trialled/tested new business models | 42% (10/24) | 57% (12/21) | 67% (2/3) | |
| Number of signed IP license agreements as a result of AotF | 10 | 4 | 10 | |
| Number of organisations indicating they have developed new IP and/or exploitable trade secrets as a result of the programme | 46% (11/21) | 38% (8/21) | 67% (2/3) | |
| Number of new spin-out companies from projects from existing enterprises | 2 | 2 | 0 | |
| Number of organisations indicating they anticipate or have developed new revenue streams from new products/services or new customers. | Developed | 42% (10/24) | (11/21) 52% | 33% (1/3) |
| | Anticipated | 42% (10/24) | (8/21) 38% | 33% (1/3) |
| Value of revenue streams from immersive content (median) – total revenue to date | New products/services/customers | £25,000 | £45,000 | £250,000* |
| | New immersive platforms | £20,000 | £22,500 | £40,000 |
| Number and % of firms reporting that participating in programme has led to an increase in internal capabilities | New skills among staff | 96% (23/24) | 85% (18/21) | 67% (2/3) |
| | Improved internal capabilities | 92% (22/24) | 90% (19/21) | 100% (3/3) |

Source: Technopolis analysis using longitudinal survey. Base: 21 PIIC, 3 IA, and 24 Design Foundation.

Table 16 Grants and investments, Longitudinal indicators overview

| Indicator | | Successful | | Unsuccessful | | Assessment |
|---|--------|---|---|---|---|------------|
| | | Baseline | Post-exit | Baseline | Post-exit | |
| Outcome area 3: Economic performance | | | | | | |
| Business and organisation turnover † | Median | £72,000 | £200,000 ▲ | £50,000 | £70,000 ▲ | |
| Turnover derived from products or services in immersive content or technology † | Median | £0 | £62,500 ▲ | £10,000 | £30,000 ▲ | |
| Turnover in immersive content or technology attributable to exports † | Median | £0 | £0 ■ | £0 | £2,438 ▲ | |
| Annual spending on external suppliers for activities related to immersive content or technologies | Median | £0 | £25,000 ▲ | £5,000 | £10,000 ▲ | |
| Number of full-time equivalent employees † | Median | 3.0 | 3.0 ■ | 4.0 | 2.0 ▼ | |
| Number of freelancers/ contractors (FTE) employed in immersive, businesses only | Median | 2.0 | 2.0 ■ | 1.0 | 1.0 ■ | |
| Average salary of employees | Median | £27,500 | £35,000 ▲ | £25,000 | £31,000 ▲ | |
| GVA (as calculated by applying an average ratio of turnover to GVA for the creative industries) ¹⁵ † | Median | £36,395 | £100,400 ▲ | £25,100 | £35,140 ▲ | |
| Productivity (GVA per FTE) ¹⁶ † | Median | £12,550 | £37,650 ▲ | £9,852 | £20,080 ▲ | |
| Outcome area 4: Investment | | | | | | |
| Value of R&D investment in immersive content or technologies, businesses only | Median | £25,000 | £25,000 ■ | £10,000 | £20,000 ▲ | |
| R&D investment in immersive by source, businesses only, % of R&D investment | Median | Self-financed:100% Loan: 0% Equity: 0% Grant: 0% | Self-financed:100% Loan: 0% Equity: 0% Grant: 0% | Self-financed:100% Loan: 0% Equity: 0% Grant: 0% | Self-financed:100% Loan: 0% Equity: 0% Grant: 0% | |

Source: Technopolis analysis using longitudinal survey. Base: 17 - 31 successful and 35 - 95 unsuccessful businesses. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and FTE of 7,000 and one unsuccessful academic research group with 2,500 FTE. Excluding one successful company with turnover of £138m and 1,100 FTE and one successful company which split into two.

3.4.3 Counterfactual (self-assessment)

Overall, 72% (96/133) of unsuccessful applicants said they did not continue with their intended project. From the organisations that have continued, the majority indicated that they did so with fewer partners, reduced scope, and/or longer timeframe (base: 31). Around 14 organisations indicated that they continued with the help of alternative private and/or public funding.

¹⁵ GVA calculated by applying a ratio of Turnover to GVA of 0.502. The ratio was calculated using the Annual Business Survey 2017 (released May 2019) and is the average ratio of Total Turnover to Approximate GVA for SIC codes aligned with the Creative Industries according to DCMS's SIC Code categorisation.

¹⁶ Where companies reporting turnover have also reported the number of employed persons as '0' for the financial year, number of employees has been assumed to be 1 (i.e., one person company).

3.4.4 Collaboration (outcome area 1)

One of the programme's objectives is to invite collaborations between organisations. Around 85% of participants were working in collaboration with at-least one other partner and 71% were collaborating with at least one new partner, indicating that the programme has provided a platform to strengthen existing relationships and build new ones. This includes both formal partners within the project, as well as those partnerships and collaborations that have emerged as a result of the project.

By strand, the share of participants reporting new partnership(s) is slightly higher for both IA (100%) and Design Foundations (79%) than the PIIC participants (57%). This is likely due to the design of these competitions, where the Investment Accelerator is designed to create new partnerships between SMEs and investors, and the Design Foundations supports smaller, lower-TRL projects, enabling more exploratory partnership building projects.

Almost all respondents to the survey strongly agree or agree that their Audience of the Future project enhanced their partnerships (98%, 40/41). In response to the PCFs, the majority of both PIIC and Design Foundations participants (75% of 63 respondents) expected to continue to collaborate with the rest of the participants, and both had an equal proportion of participants who indicated this was a possibility.

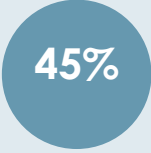
Notably, though the Investment Accelerator projects formally only funded a single SME participant, respondents to the survey and the PCF forms reported collaborating with other organisations. In their extended remarks to the survey and PCFs forms, IA participants reported that the projects have led to further projects and collaborations with companies, universities, and a range of other organisations such as the Digital Catapult and other non-creative sector organisations (a hospital and a professional body for the Police).

3.4.4.1 Collaboration with industry

| | |
|--|---|
| | <ul style="list-style-type: none"> Collaborating with micro-businesses (base: 34). The corresponding figures by strand are 55% (11/20) for PIIC, 100% (3/3) for IA, and 83% (20/24) for Design Foundation. Overall, 82% of these partnerships were new and 94% see avenues for future collaborations. For half of respondents, this was the first time they had collaborated with micro-businesses. |
| | <ul style="list-style-type: none"> Collaborating with SMEs (base: 20). The corresponding figures by strand are 38% (8/21) for PIIC, 33% (1/3) for IA, and 46% (11/24) for Design Foundation. Overall, 75% of these partnerships were new and 90% see avenues for future collaborations. For 26% of respondents, this was the first time they had collaborated with SMEs. |
| | <ul style="list-style-type: none"> Collaborating with large businesses (base: 16). The corresponding figures by strand are 57% (12/21) for PIIC, 67% (2/3) for IA, and 8% (2/24) for Design Foundation. Overall, 63% of these partnerships were new and all see avenues for future collaborations. For 42% of respondents, this was the first time they had collaborated with large businesses. |

Almost half of survey respondents were collaborating with academic partners (9/21) and almost all of these were new collaborations and see avenues for future collaboration. As a result of these collaborations, 9 of 12 academic partners who submitted their PCFs reported an increase in the use of university facilities and resources by other organisations.

3.4.4.2 Collaboration with Academia and industry

| | |
|--|--|
|  <p>45%</p> | <ul style="list-style-type: none"> Collaborating with Academic research groups or PROs (base: 21). The corresponding figures by strand are 40% (8/20) for PIIC, 33% (1/3) for IA, and 50% (12/24) for Design Foundation. Overall, 90% of these partnerships were new and 95% see avenues for future collaborations. For all respondents, this was the first time they had collaborated with academic research groups or Public Research Organisations. |
|  <p>31%</p> | <ul style="list-style-type: none"> Collaborating with a charity or public sector organisation (base: 15). The corresponding figures by strand are 33% (7/21) for PIIC, 67% (2/3) for IA, and 25% (6/24) for Design Foundation. Overall, 87% of these partnerships were new and 93% see avenues for future collaborations. For 71% of respondents, this was the first time they had collaborated with charity or public sector organisations. |

AI-driven narrative characters and immersive environments, Maze Theory (PIIC)

Maze Theory is working to develop a production system which will allow the creation of experiences within VR where the non-player characters that users encounter respond to a player's body and voice input socially and naturally, rather than just cycling through a set of pre-defined scripts.

The technology Maze Theory have developed through their project is being used in different ways: some parts are being used to enhance character performances, whereas other characters have more AI-orientated mechanics. These more complex AI elements are what the company plan to build on going forward.

Collaboration with academia

Maze Theory worked on this project with two partners: the AR/VR studio Dream Reality Interactive and Goldsmiths University of London. It was the first time that they had collaborated with academia and Maze Theory credit the programme with giving them the opportunity to work with academic partners that, as a small developer, they otherwise couldn't afford. The partnership is ongoing, and the company has hired two interns from Goldsmiths over this time – with one joining the team full time.

New IP and/or exploitable trade secrets

Maze Theory have licensed new IP as a result of the characters and work created through the Peaky Blinders project.

Emotion sensing for improved content creation and personalised immersive experiences, Emteq (DF)

Emteq are developing a product to explore the potential of real-time emotion recognition technologies for VR/Mixed reality by using biosensors to capture implicit emotional responses especially designed for use in Virtual Reality settings

Emteq used the AotF funding to test their system with almost 800 participants supporting the technical development of the product's design, as well as running interviews with key opinion leaders to assess the market appetite for such a product.

Emteq is now confident that a market for this product exists, based on the encouraging feedback received through face-to-face interviews with key opinion leaders and organisations active in immersive content development. The process also allowed them to identify their customer personas more clearly, and the pricing models they could apply, as well as allowing them to patent their technology. Furthermore, Emteq reported that the project has generated a pipeline of potential customers, some of which were keen to engage immediately in testing the technology.

Collaborating with a charity or public sector organisation

The system has now been applied in various settings, including areas beyond the Creative Industries. For example, they recently collaborated with the British Red Cross, which are using this system to evaluate whether VR acts as a better medium to engage potential donors and increase empathy.

3.4.5 Innovation (outcome area 2)

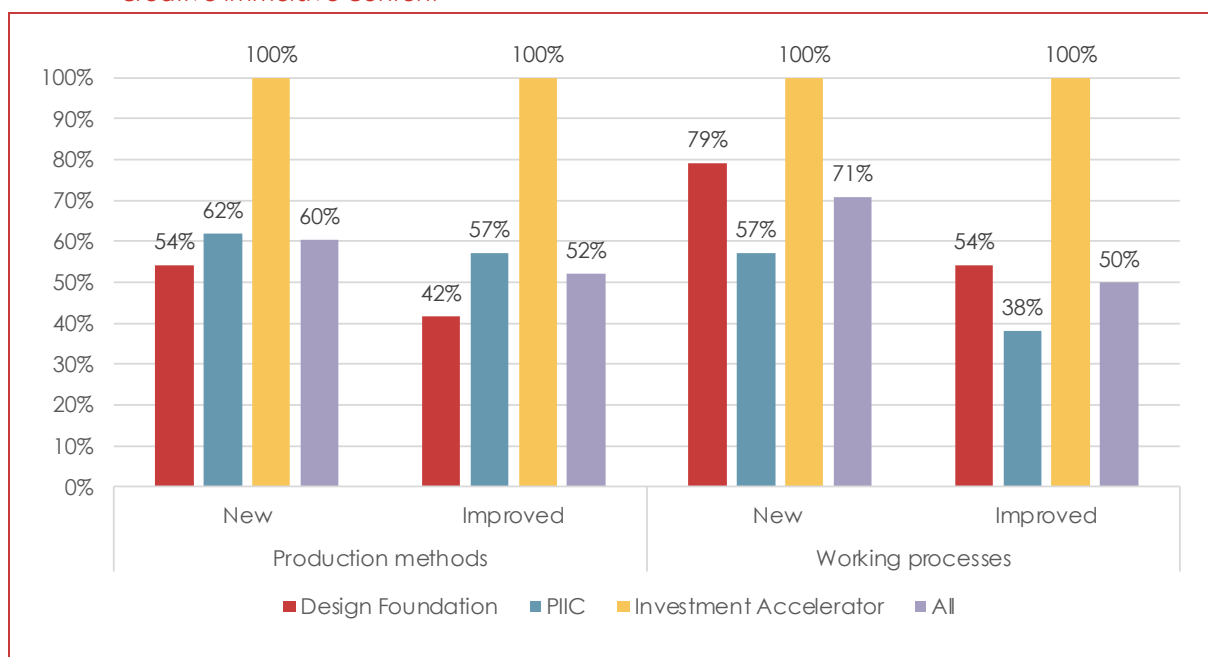
3.4.5.1 New and improved products, services, and processes

One of the primary objectives of the programme is to support the development of new and improved production methods, prototypes, working processes, and products and services.

New and improved methods and processes: From the 48 surveyed participants, 71% had developed new working processes and 50% had improved existing working processes in relation to creative immersive content. As a result of their AotF project, respondents also indicated that they had developed new or improved methods (60% and 52% respectively).

Figure 9 shows the breakdown by strand. PIIC participants were more likely than Design Foundations participants to report new or improved methods, but slightly less likely to report new or improved processes.¹⁷ All Investment Accelerator participants reported positive performance across the four indicators, albeit this group only represents a small number of respondents (base: 3).

Figure 9 Share of organisations that have developed new/improved methods or processes in relation to creative immersive content



Source: Technopolis analysis using longitudinal survey. Base: 21 PIIC, 3 IA, and 24 Design Foundations

When asked to give a brief description of a new or improved method/process, PIIC participants shared the following examples:

“We took a fresh look at the workflow involved in creating of a production, particularly relating the possibility of providing more immersive access services. We produced a completely new integrated digital production planning environment which brought together information about stage

¹⁷ Where processes refer to organisational processes, and methods refers to the technology and approaches for immersive content production.

choreography with the sound and lighting cues and the evolving script, all in one integrated application which could be accessed locally or remotely over the internet. It's a fantastic product."

"We created a hardware software machine that allowed us to make use of 85% of the recording time that we had with an A list celebrity. It was a high risk, high [gain] film shoot. We created a completely new hybrid fast reacting method of filming so that takes were approved there and then."

"We developed a method of producing video interactive content for VR and a production process for doing that, with visual and audio."

FIRA Toolset: Fast Immersive Rigging and Animation, Framestore (PIIC)

In partnership with micro-enterprise WeightShift, the project intended to tackle two barriers holding back growth in immersive animated content: the quality of character, creature and performance animation and the time it takes to create new work. Framestore needed funding to develop toolsets (FIRA) that would support their animators in their creative process reducing the time and effort necessary to produce their outputs while maintaining outstanding quality.

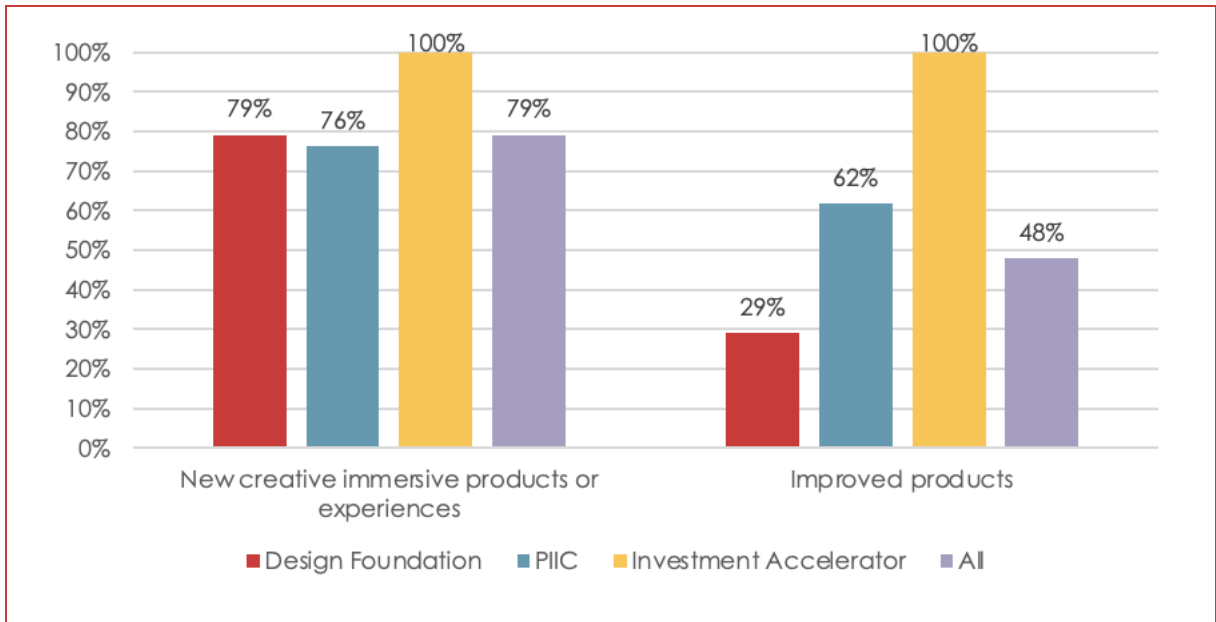
New and improved methods and processes

Thanks to FIRA, the character rigging process runs between two and 500 times faster than before. The process is now semi-automated, and something that used to take weeks or months now only requires one or two days. The WeightShift user interface has been vastly improved as part of FIRA, therefore, removing the barrier to entry for animators, to the point that multiple projects and departments within Framestore are picking it up and using it. Both systems have already been applied on multiple shows, including HBO's series His Dark Materials, and the assets have been proved crucial in business development and winning of new work. It is expected that FIRA will be soon used in the production of immersive experiences.

New and improved content and products: Most participants had developed at least one new creative immersive product or experience because of their AotF project (79%, 38/48). Half of respondents reported just one new product or experience and the remaining half reported more than one (median=1.5).

From the 48 participants in the programme, 48% had improved at least one existing product. The share is slightly lower for Design Foundations participants (29%) and slightly higher for both PIIC and Investment Accelerator participants (62% and 100% respectively). The highest number of improved products per organisation is equal to five, but most had improved just one product.

Figure 10 Share of organisations that have developed new/improved product or experience in relation to creative immersive content



Source: Technopolis analysis using longitudinal survey. Base: 21 PIIC, 3 IA, and 24 Design Foundations

Immersive broadcast content experience for inclusive audiences, Open Inclusion (DF)

This feasibility project investigated the potential for publicly broadcast content to be more inclusive and better appreciated by audiences with specific access needs, including sensory, physical and cognitive impairments/disabilities and advanced age, using immersive technologies. They worked in collaboration with Brunel University and Channel 4 to gather a body of research on the key hardware challenges for immersive and inclusion – two partnerships which Open Inclusion see as valuable to their business and likely to lead to new opportunities.

Revenue streams from new products/services

Open Inclusion now have a new market proposition in immersive inclusion which has enabled them to win work they wouldn't otherwise have won. This work includes a significant 3-year project as partner with Brunel University and Cambridge University looking at the barriers and design challenges for people with disabilities engaging with immersive content. In addition, Open Inclusion have been commissioned by the StoryFutures Academy to deliver an inclusive accelerator in partnership with XR Access (a research consortium at Cornell Tech, in collaboration with Yahoo) that will disseminate the research and knowledge base that was developed through the programme.

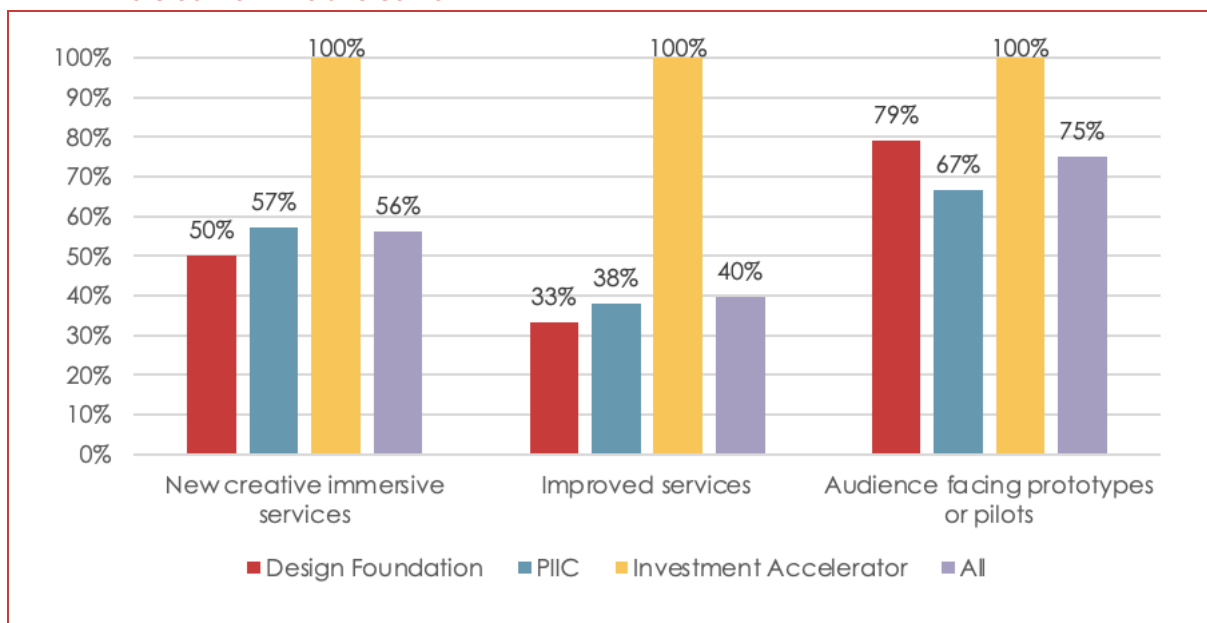
Open Inclusion's partnership with XR Access was developed through Managing Director Christine Hemphill, who presented at the 2021 XR Access symposium. Christine credits the Audience of the Future programme as helping her to position herself globally as innovator in disability inclusive tech. She has recently been named as an 'entrepreneur-in-residence' for multinational telecommunications company Verizon and is shaping their Disability Innovation programme.

New and improved services and audience facing prototypes or pilots: **Most participants had developed at least one new audience-facing prototype or pilot because of their AotF project** (75%, 36/48). Figure 11 shows that participant's performance is strong across all strands, although participants in the Design Foundations strand reported a slightly higher share than those in the PIIC strand (79% vs 67%).

More than half of participants had developed at least one new creative immersive service because of their AotF project (56%, 27/48). Most had produced just one new service, although

some organisations had produced as many as three-to-four new services. 19 organisations (40%) had improved an existing service, an average of one per participant.

Figure 11 Share of organisations that have developed new/improved services or prototypes in relation to creative immersive content



Source: Technopolis analysis using longitudinal survey. Base: 21 PIIC, 3 IA, and 24 Design Foundations

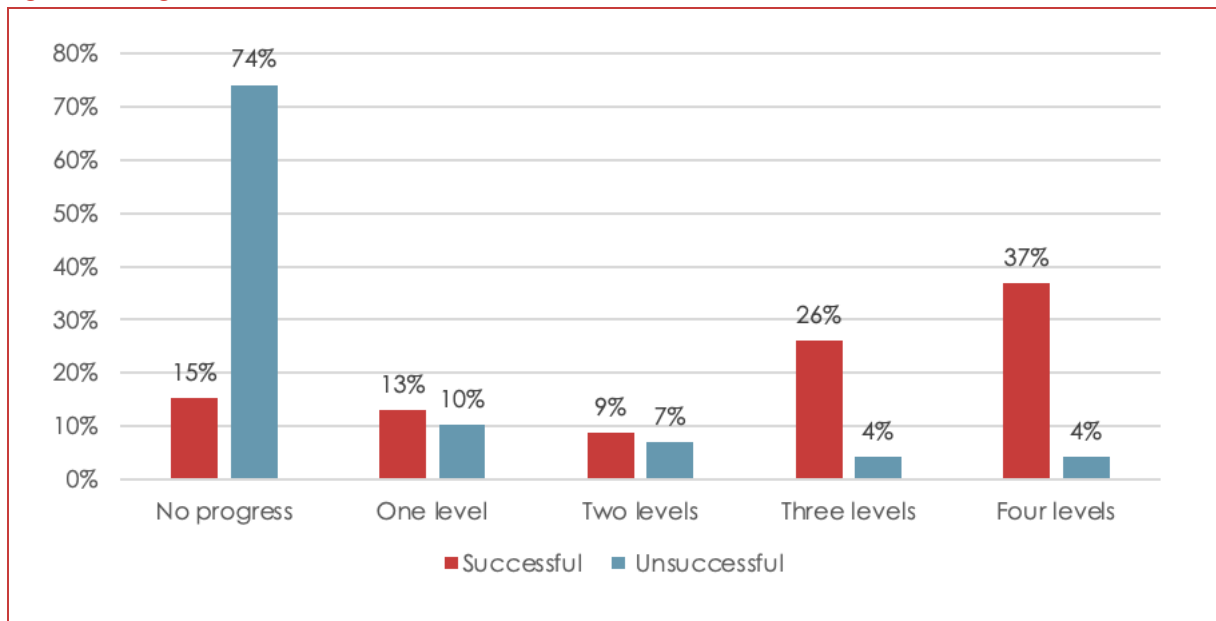
3.4.5.2 Technology Readiness Levels

Funded projects have made **very good progress in terms of their Technology Readiness Levels (TRL)**. Most successful applicants have progressed the TRL of their project by at-least one level, with only 15% showing no progress at all. Around 17 successful applicants (37%) have progressed the TRL of their projects by four levels, from Feasibility (TRL 1 -2) to Commercialisation (TRL 9). As of Oct-Nov 2021, 54% of participants (base: 26) had reached the Commercialisation stage (TRL 9), and further 17% (base: 8) had reached the demonstration in a real environment stage (TRL 7 – 8).

This is in stark contrast to unsuccessful applicants, 74% of whom had not progressed by a single TRL level between the baseline and the latest survey. As of Oct-Nov 2021, only 12% had reached the Commercialisation stage (TRL 9), with 64% still at early development (either the feasibility or proof of concept stages).

Overall, participants in the programme reported a substantial increase in the average TRL rating, from 2 to 7. In comparison, unsuccessful applicants reported a more modest average increase from 3 to 4. This provides further evidence that the programme has helped to accelerate the development and validation of early-stage products and experiences for further development.

Figure 12 Progress in TRL since the baseline



Source: Technopolis analysis using longitudinal survey. Base: 46 successful and 116 unsuccessful

3.4.5.3 Outputs and revenue streams

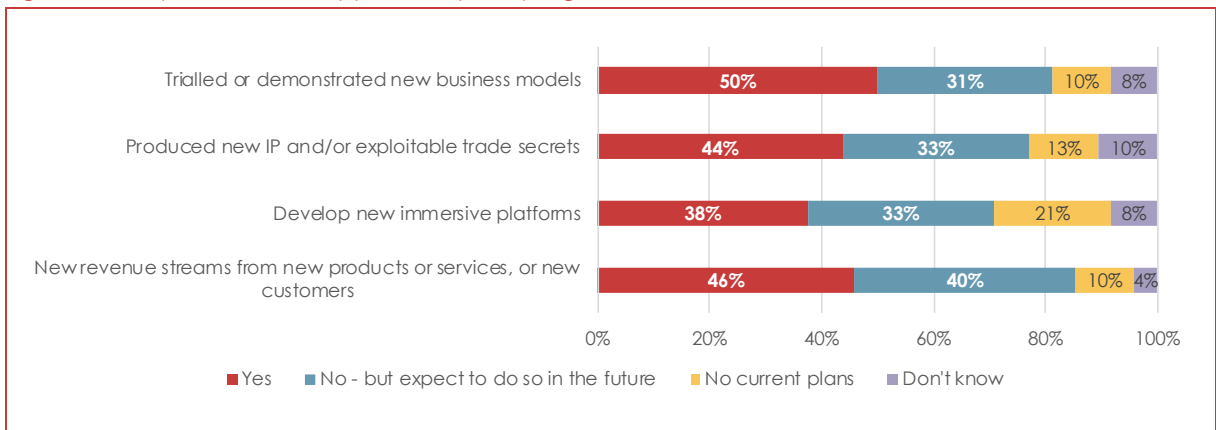
Half of participants had **tried or demonstrated new business models**, and a further 31% stated that they had plans to do so in the future. From these companies, 11 reported a median financial return of around £25k, while eight other companies had not secured any financial returns from their new business models.

As part of their Audience of the Future projects, 44% of participants had produced **new IP and/or exploitable trade secrets** (base: 21). From these companies, eight reported a median gain of £25k, while eight other companies had not secured any financial returns from the new IP or trade secrets. One third of participants expected to develop new IP in the future.

Around 38% of respondents had **developed new immersive platforms** as part of their projects (base: 18). For nine of these companies, the median financial return from immersive platforms was £40k. Five other companies reported zero financial returns. Around a fifth of respondents said that they had no intentions of developing new immersive platforms.

Almost half of participants had developed **revenue streams from new products/services or customers** (46%, base: 22). Fifteen of these companies reported median financial returns worth £45k, and three other companies reported no gains yet. Around 40% of participants expect to generate new revenue streams in the future, but for 10% this seemed unlikely.

Figure 13 Output activities supported by the programme



Source: Technopolis analysis using longitudinal survey. Base: 21 PIIC, 3 IA, and 24 Design Foundations

Survey respondents reported two new spin-out companies from projects from existing enterprises. Of the 12 academic partners who submitted PCFs, nine indicated that involvement in this programme has increased the possibility of an academic spinout

Efficient Workflow for Real-Time Simulation of Virtual Garments, Numerion Software (PIIC)

Numerion set out to build a prototype workflow, that enables artists to efficiently deliver real-time simulation of virtual garments at a quality level suitable for fashion garment design, and promotion on the virtual catwalk and on the web.

As a company, their goal was to expand into the fashion industry – a new market which has been less influenced by digital technology than Numerion's existing client base in the film industry.

New business models

As the project evolved, Numerion chose to focus on matching the workflow with a SAAS (Software as a service) delivery platform – which means their product can be accessed remotely with an internet connection. This was a new approach as their products had traditionally run on desktop. This technology is allowing them to explore a new service-based 'pay-as-you-go' business model rather than upfront sale of their product.

By the end of their project, Numerion had secured a customer who wanted to take the product forward. However, this was disrupted when the customer's primary market – the suit market – suffered a significant decline in demand after the pandemic struck and people began working from home. Despite this, Numerion have demonstrated their workflow to a number of fashion companies and report that the initial feedback from both fashion and movie industry experts that have had access to an early preview has been very positive.

Volumetric Audio for AR (VASAR), Magic Beans Physical Audio (PIIC)

The Volumetric Audio for AR (VASAR) project empowers sound engineers to be able to produce '6-degrees of freedom' (6DOF) audio content more easily and quickly by providing them with new tools for audio capture and reproduction.

Magic Beans noted that the significant amount of equipment, specialist hardware and set-up has been a limiting factor in spatial audio. They sought to address this through their AotF project with the innovation of a mechanism that delivers immersive audio experiences using standard consumer hardware and internet protocols.

As the project developed, Magic Beans' felt there was more need and potential for technology that creates and delivers an immersive experience out of a recording – including normal, off-the-shelf recordings – which represented a shift away from their initial focus on large-scale audio capture, such as an orchestra. Their project moved to develop a way to take any legacy material or modern material and convert it and deliver it to audiences.

New revenue streams from new customers

Magic Beans are already using the technology developed through the project in commercial products and are in conversations about further commercial opportunities. One of their ongoing projects is with Highways England: Magic Beans have created an immersive audio simulation of a motorway. While this is not an area the company had foreseen themselves as working in, the project has been so successful that they have been invited to produce another product for Highways England which simulates a large construction programme.

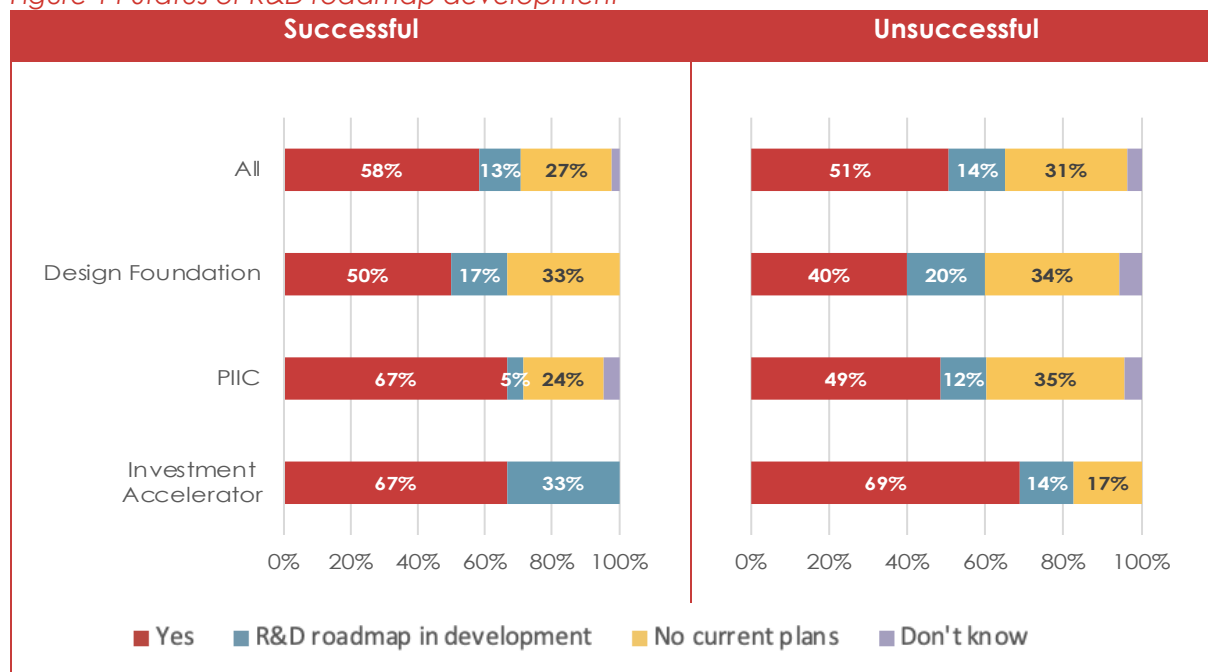
They have also showcased their product at the IBC (International Broadcasting Convention) in December 2021, which is the major broadcast innovation show, as part of a group looking at immersive audio. Magic Beans had produced content for both Audible and the BBC and although this was a non-commercial piece of work, it enabled them to show their work publicly and helped them to engage in conversations with other companies at the IBC, some of which are ongoing.

Overall, the programme has had a profound impact on the company, who reported that their whole product line-up is now based on the technology they developed through AotF.

3.4.5.4 R&D roadmaps

Out of 48 participants, 58% had developed a R&D roadmap for creative immersive technologies, and a further 13% indicated that they are in the process of doing so. In comparison, of the 132 unsuccessful applicants, around half had developed a R&D roadmap, with a further 14% in the process of development. This indicates an intention to further keep on investing in the development of creative immersive technologies and (an intended) direction of travel. Figure 14 shows that PIIC and Investment Accelerator participants are slightly more likely than Design Foundations participants to report that they had developed an R&D roadmap. Participants in these two strands are also less likely to state that they have no plans to make progress in that respect in the future.

Figure 14 Status of R&D roadmap development



Source: Technopolis analysis using longitudinal survey. Base PIIC: 21 successful and 68 unsuccessful; Base IA: 3 successful and 29 unsuccessful; Base Design Foundation: 24 successful and 35 unsuccessful.

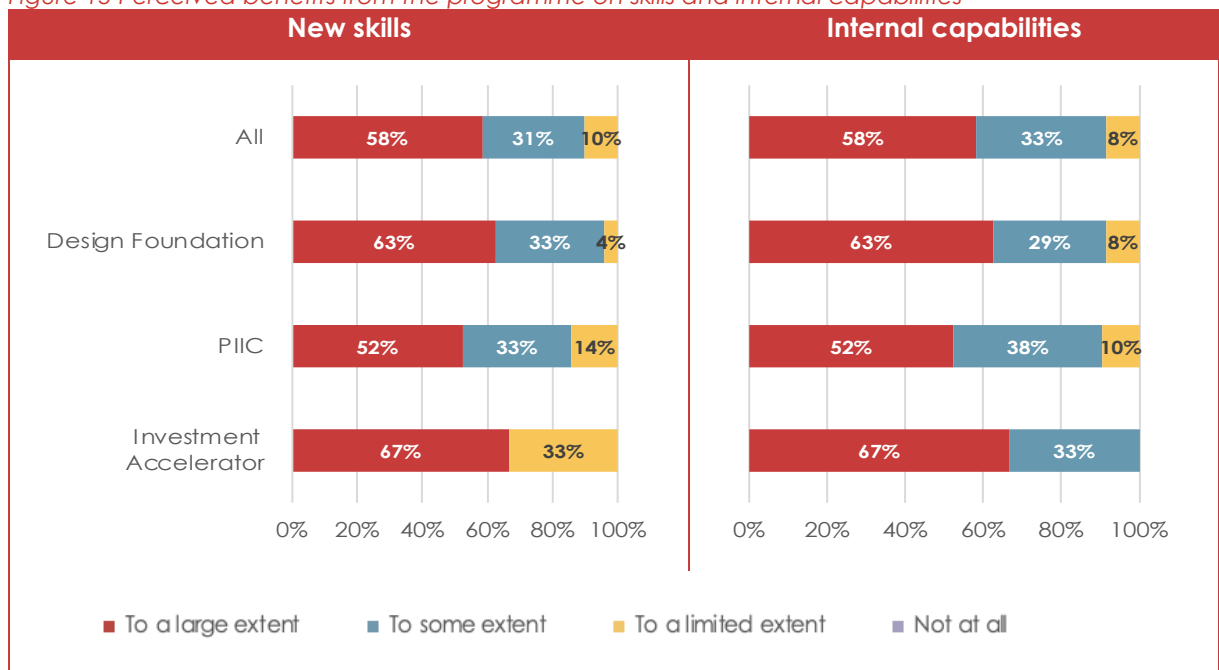
3.4.5.5 Capacity building

Evidence collected from the survey shows **a good uptake of programme learning**.

Figure 15 shows to what extent participants feel they have gained new skills and internal capabilities because of their involvement in the programme. From the 48 participants, 89% reported their organisation's involvement in the programme had led to new skills among staff (with most saying this had happened to a large extent).

Similarly, 91% stated that their involvement had improved internal capabilities within their organisation/research group, with most saying this had happened to a large extent. The programme's impact is visible across all three strands, with most respondents indicating some or large impact. This refers to, for example, a company's capability to bid for and deliver R&D projects or utilise design methodologies.

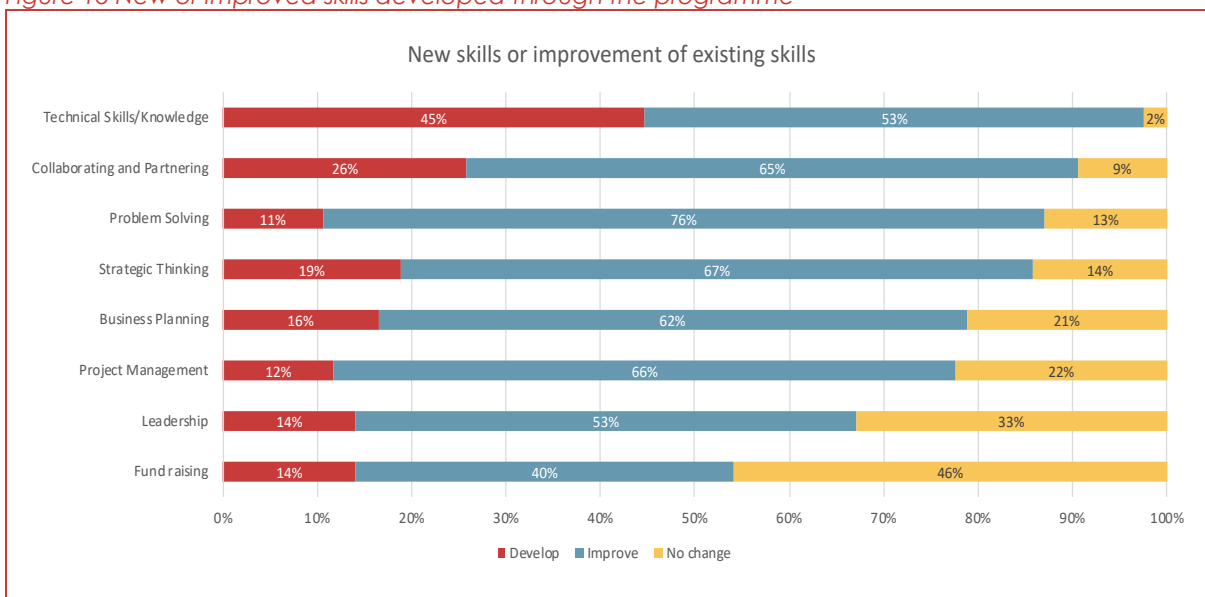
Figure 15 Perceived benefits from the programme on skills and internal capabilities



Source: Technopolis analysis using longitudinal survey. Base: 21 PIIC, 3 IA, and 24 Design Foundations

The Project Completion Forms (submitted by participants up to 3 months after completion of the projects) delve into the different types of skills developed or improved within the participants' workforce (see Figure 16). Almost all participant organisations developed or improved their technical skills/knowledge, with significant benefits to and collaborating and partnering, and skills in problem solving and strategic thinking. By contrast, almost half participants saw no change in their fund-raising skills (45%).

Figure 16 New or improved skills developed through the programme



Source: Project Completion Forms. Base: 32 PIIC, 5 IA, 48 Design Foundations

The 12 academic participants in Grants & Investments projects who completed their PCFs at project end had produced a total of seven7 publications, with a further 12 planned after the end of the project.

Immersive Studio, Immersive Interactive (IA)

Immersive Interactive is a tech company enabling shared multi-sensory immersive experiences for groups of learners. The company's offer is built around a core product (and associated support services) targeting schools and education providers.

The system consists of a series of projectors, audio and sensory equipment which allow classrooms to become interactive spaces by projecting an immersive 360° scene overlaid with interactive elements. Since these spaces do not require the use of glasses or a headset, the system enables shared multi-sensory immersive experiences for groups of learners. The company mostly focuses on software and on the development of content. Immersive interactive's clients are primary schools, special needs schools, and providers for simulation-based medical education.

New business models

The AotF programme has enabled Immersive Interactive to radically develop their business model from hardware and service-based installation commissioning to focus on IP and SAAS (Software as a Service) that targets international markets through resellers. It has allowed them to overhaul their approach to the technology – something which, without the grant, they would have had to have done much more gradually. Immersive Interactive credit the programme with enabling them to update their software to align with market expectations.

Skills and productivity

They have also been able to improve their productivity by implementing new project management systems and deploying new tools, developing their code base in a much more efficient way into packages and specific libraries. As a company, they have also been able to develop their skills using these technologies and through their work with expert agencies and developers.

3.4.6 Economic (outcome area 3)

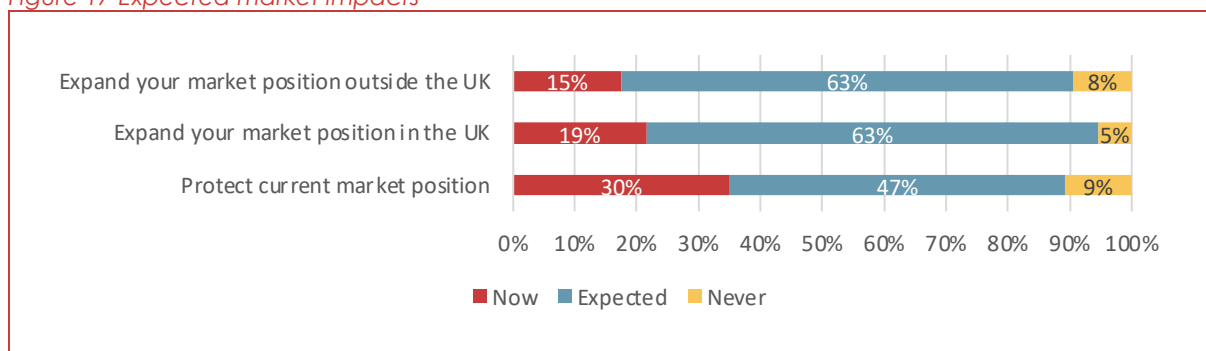
3.4.6.1 Turnover

At the close of their AotF projects, **the majority of participants in the Grants and Investments strands reported they had or expected to protect or expand their market positions** both within the UK and beyond the UK (see figure below).

Even at their project end, a third of respondents reported that the project had already contributed to protecting their current market position, with a further 47% indicating they expected this in future.

A fifth of participants had expanded their position within the UK, whilst 63% expected this in future. Only 5% of participants did not expect their AotF to have an impact on their capacity to expand their market position in the UK. Similarly, the majority of respondents also expected to expand their market position outside of the UK, with 15% reporting they had done so already.

Figure 17 Expected market impacts



Source: Project Completion Forms. Base: 32 PIIC, 5 IA, 48 Design Foundations

Evidence collected as part of this evaluation shows that **programme participants had gained a much larger absolute increase in the median turnover than unsuccessful applicants** (£128k vs £20k respectively). Table 17 shows that programme participants reported a median turnover of £200k, a significant increase from the baseline position of £72k. In comparison, unsuccessful applicants reported a more modest increase in median turnover from £50k to £70k. The average percentage increase in turnover is much higher for participants (175%) compared to unsuccessful applicants (75%).

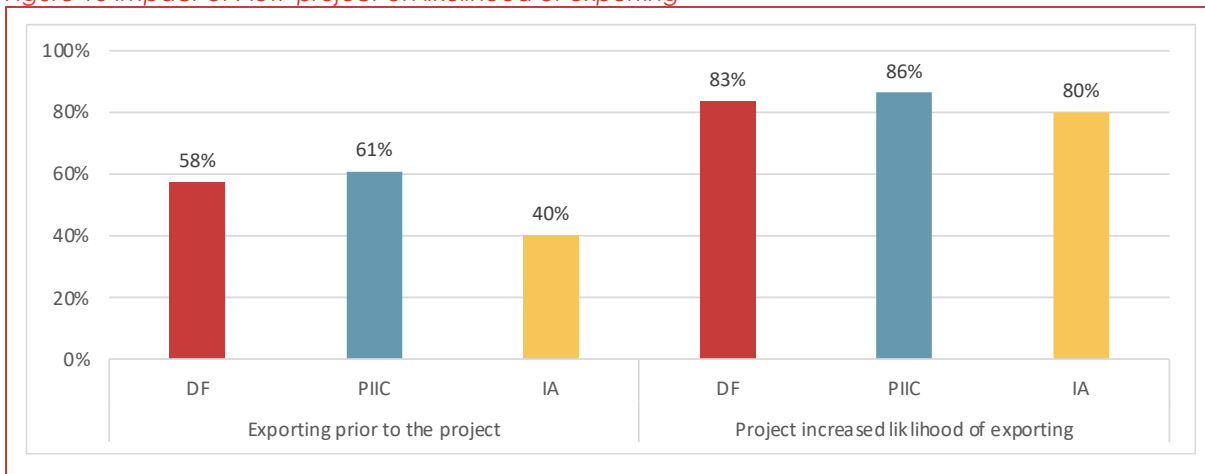
The **absolute increase in median turnover derived from immersive content or technologies was greater for programme participants than unsuccessful applicants** (£62.5k vs £20k). Programme participants reported a median value of £62.5k, a significant improvement from the baseline position of zero. While unsuccessful applicants had a higher starting position at the baseline, they have experienced a much lower absolute increase (from £10k to £30k, median).

For participants, the median value of **turnover in immersive content or technology attributable to exports** has stayed the same, at zero. Unsuccessful applicants, on the other hand, have reported an increase to £2,438 from the baseline position of zero.

That is not mean to say that participants are not active in international markets. For consistency, and due to small sample sizes, we have presented the median values across all indicators. When looking at the mean in value of exports we find that, for participants, the average has increased from £145k in the baseline to £304k (but this includes an 'outlier' with a value of £3m). For unsuccessful applicants, the average has increase from £21k to £76k. In fact, 15% of respondents reported on their PCF submissions, that at this time of their project end, they had already expanded their position outside of the UK, whilst a further 63% expected this in future

(see figure below). Just over half PCF submissions (54%) also indicated that the project has increased the likelihood of exporting goods and services. As such, results in terms of exports need to be taken with caution.

Figure 18 Impact of AotF project on likelihood of exporting



Source: Project Completion Forms. Base: 28 PIIC, 5 IA, 42 Design Foundations

Table 17 Turnover and exports, businesses (median)

| Indicator | Successful | | Unsuccessful | |
|---|------------|------------|--------------|-----------|
| | Baseline | Post-exit | Baseline | Post-exit |
| Business and organisation turnover † | £72,000 | £200,000 ▲ | £50,000 | £70,000 ▲ |
| Turnover derived from products or services in immersive content or technology † | £0 | £62,500 ▲ | £10,000 | £30,000 ▲ |
| Turnover in immersive content or technology attributable to exports † | £0 | £0 ■ | £0 | £2,438 ▲ |
| Annual spending on external suppliers for activities related to immersive content or technologies | £0 | £25,000 ▲ | £5,000 | £10,000 ▲ |

Source: Technopolis analysis using longitudinal survey. Base: 22 - 24 successful and 42 - 57 unsuccessful. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and FTE of 7,000 and two successful companies: one reporting turnover of £138m and another which split into two.

3.4.6.2 Employment

One of the intended objectives of the programme is to support increased employment within the creative immersive sector.

The AotF programme has supported participating companies to maintain their numbers of full-time employees since the programme baseline year (FY 2017/18). For programme participants, **the median of the average number of full-time employees has stayed the same since the baseline**, at 3 employees. However, for unsuccessful applicants, the median number has decreased, from 4 to 2 employees. The average percentage increase in employment is much higher for participants (18%) compared to unsuccessful applicants (8%).







The median of the average number of full-time freelancers/contractors employed in immersive content or technology has stayed the same for both groups: 2 for participants and 1 for unsuccessful applicants.

As presented above in the Sector Analysis, we estimated that 37% of the workforce in the Immersive Creative Content sector is open to new opportunities, a substantial increase in comparison to the baseline (when the figure was 19%). In addition to wider trends (i.e., 'the

great resignation'), the findings above indicate that AotF participants have been better able to retain talent than the unsuccessful applicant cohort.

Table 18 shows that **programme participants have experienced a larger absolute increase in average annual gross salaries than unsuccessful applicants** (£7.5k vs £6k respectively). For participants, the median of the average salary of employees was £35k, up from £27.5k at the baseline stage. Unsuccessful applicants reported a slightly smaller increase to £31k, from £25k at the baseline stage.

Table 18 Employment, business, and academia (median)





| Indicator | Successful | | Unsuccessful | |
|---|------------|---|--------------|---|
| | Baseline | Post-exit | Baseline | Post-exit |
| Number of full-time equivalent employees † | 3.0 | 3.0  | 4.0 | 2  |
| Number of freelancers/ contractors (FTE) employed in immersive, businesses only | 2 | 2  | 1 | 1  |
| Average salary of employees | £27,500 | £35,000  | £25,000 | £31,000  |

Source: Technopolis analysis using longitudinal survey. Base: 25 - 31 successful and 65 - 95 unsuccessful. †Excluding one successful applicant with 1,100 FTE and two unsuccessful applicant outliers: one with FTE of 7,000 and another academic research group with 2,500 FTE.

Reflecting the increase in turnover, **participants reported an increase in the median value of Gross Value Added (GVA)** from ~£36k to £100k. In comparison, unsuccessful applicants reported a much smaller absolute increase, from ~£25k to £35k. The average percentage increase in GVA is 183% for participants and 52% for unsuccessful applicants.

Similarly, the absolute increase in productivity for participants is more than double that of unsuccessful applicants (~£25k vs £10k respectively).

Table 19 GVA and productivity, businesses (median)

| Indicator | Successful | | Unsuccessful | |
|---|------------|--|--------------|---|
| | Baseline | Post-exit | Baseline | Post-exit |
| GVA (as calculated by applying an average ratio of turnover to GVA for the creative industries) ¹⁸ † | £36,395 | £100,400  | £25,100 | £35,140  |
| Productivity (GVA per FTE) ¹⁹ † | £12,550 | £37,650  | £9,852 | £20,080  |

Source: Technopolis analysis using longitudinal survey. Base: 21 - 22 successful and 57 unsuccessful. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and one successful outlier reporting turnover of £138m.

¹⁸ GVA calculated by applying a ratio of Turnover to GVA of 0.502. The ratio was calculated using the Annual Business Survey 2017 (released May 2019) and is the average ratio of Total Turnover to Approximate GVA for SIC codes aligned with the Creative Industries according to DCMS's SIC Code categorisation.

¹⁹ Where companies reporting turnover have also reported the number of employed persons as '0' for the financial year, number of employees has been assumed to be 1 (i.e. one person company).

3.4.7 Investment (outcome area 4)





3.4.7.1 Spend and funding sources for R&D for immersive

One of the expected outcomes of the programme is to leverage extra investment into R&D for creative immersive products and experiences. Applicants were asked to report the amount their company invested in R&D annually prior to the programme, and to date.

The **median value of R&D investment in immersive content or technologies** had stayed the same for participant, at £25k. Over the same period, however, that of unsuccessful applicants had doubled from £10k to £20k. Since investment in R&D has remained constant among, once could conclude that, at this point in time, the programme has not stimulated further R&D investment beyond the activity that already existed at the start of the programme participation.

For most applicants, all their R&D investment was self-financed (median). 11 out of 17 participating businesses had used self-finance to fund all their R&D spending, and 5 other businesses had used a mixture of self-finance and other sources (mainly grants)²⁰.

Table 20 R&D investment, businesses (median)

| Indicator | Successful | | Unsuccessful | |
|--|---|---|---|---|
| | Baseline | Post-exit | Baseline | Post-exit |
| Value of R&D investment in immersive content or technologies | £25,000 | £25,000  | £10,000 | £20,000  |
| Sources of R&D investment in immersive content or technologies | Self-financed:100% Loan: 0% Equity: 0% Grant: 0% | Self-financed:100%  Loan: 0% Equity: 0% Grant: 0% | Self-financed:100% Loan: 0% Equity: 0% Grant: 0% | Self-financed:100%  Loan: 0% Equity: 0% Grant: 0% |

Source: Technopolis analysis using longitudinal survey. Base: 17 - 26 successful and 35 - 51 unsuccessful. † Excluding one successful applicant outlier reporting turnover of over £10m

Immersive, highly detailed model for urban planning visualisation, Wagstaff design/VU.CITY Projects (PIIC)

VU.CITY's AotF project aimed to create an accessible, highly accurate immersive VR representation of the City of London to inform planning and development issues within the City. The product was initially designed to be accessed through a VR headset, but following the pandemic shift to homeworking, VU.CITY are now working to develop their product for desktop / screen environment rather than VR-ready environment. Despite these challenges, the team has achieved a significant amount (around 80%) of what they originally set out to build.

Investment

The work produced through AotF has helped the team to attract investment that is supporting the development of their core product. The company report that it has been a hugely valuable tool for VU.CITY to engage partners, investors and potential in the concept of using highly-detailed 3D models to be able to look at and demonstrate changes to the built environment.

They are also currently in discussions with a number of real estate businesses regarding the use of this technology on major projects. While the product was initially developed predominantly for the real estate and planning market, the team have started to realise that the models they are developing can also address challenges in other verticals, such as security and telecommunications infrastructure.

²⁰ We have also aimed at calculating R&D intensity. However, the lack of sufficient data points from respondents providing consistent information on both, R&D investment and turnover, means that we obtain contradictory results for R&D intensity (calculated as R&D investment as a proportion of turnover), and consequently this data is not presented here.

Since their AotF project finished, the Metropolitan Police are using the highly detailed models developed by VU.CITY as a test case for different uses.

3.4.7.2 Additional investment

As a result of their participation in their G&I project, 25% of participants reported in their PCFs that they were able to raise further funds (in addition to the matched funding) (22/86). This includes organisations that had secured funds from Venture Capital (6/22), existing investors (5/22) as well other sources of public funding including CreativeXR, the South West Creative Technology Network, Arts Council England, BFI, British Council, and Future Screens NI. Over a third of respondents indicated this additional investment was for further R&D on the same project (10/22) or to support market testing / launch related to this project (8/22).

The majority of businesses participants who submitted their PCF forms at their end of their Grants & Investment projects, 80% (59/74) planned to conduct further R&D to commercially exploit their projects. 11 of the 12 academic partners also planned on conducting further R&D to commercially exploit their AotF projects.

At the end of their projects, almost half (47%) of the Grants & Investment participants (40/74) planned to finance these future R&D projects with support from Innovate UK, and just under a third were planning on seeking other UK public support. A third of participants were going to use their own business funds (28/74). The median additional funding participants expect to spend on R&D was £50,000 for a period of two years.

3.5 The National Centre for Immersive Storytelling (StoryFutures Academy)

This section presents findings from the Audience of the Future Programme's investment in the National Centre for Immersive Storytelling (NCIS), called the StoryFutures Academy (henceforth SFA). SFA is an industry-academia collaboration led by the National Film & Television School and Royal Holloway, University of London which aims to develop the storytelling techniques and languages that will shape the future of immersive storytelling.

SFA seeks to generate training and research programmes to provide talent for the emerging sector with the skills and creative capacity to meeting industrial demand in immersive production.

3.5.1 Activities

Across four workstreams, SFA delivered the following between September 2018 (when the contract was signed) and September 2021 (AotF project end). These are summarised in the table below:

Table 21 SFA workstreams

| | |
|--|--|
| 48 Experimental R&D production Labs | Introductory Labs |
| | Experimental Labs – introductory courses to key technical areas of immersive content creation with a focus on photogrammetry and volumetric capture |
| | Bootcamps - Intensive training sessions covering topics such as game engines for creatives, 360 filming practice, audience behaviour insights and immersive sound design |
| | Writers Rooms (x 9)– training sessions for writers and content creators |
| | Masterclasses |

| | |
|--|--|
| 27 Embedded Placements | On immersive productions, for professionals to acquire experience on set |
| 29 Collaborative Co-productions | <p>To co-fund immersive challenges and commissions. These include:</p> <p>Kickstart funding - supporting early-stage project research and development and the creation of immersive proof of concepts across AR, VR, and MR platforms. This opportunity is for professionals who participated to NCIS training programmes (up to £10,000 per project)</p> <p>Production Booster Funding - supporting advanced projects that are entering or already in production, which already have significant project funding/resource attached to them, and which offer significant learning opportunities which can be fed back into NCIS programme (up to £20,000 per project)</p> <p>Immersive Game commissions – upskilling and funding the creation of story-based immersive games. This strand is delivered with InGAME (Dundee Games CICP Cluster)</p> |
| Developmental Training | <p>Course development</p> <p>Train the Trainer programme, which enabled 225 researchers and teachers in UK higher education to receive funding for 14 projects centred around research and teaching development in immersive storytelling, benefitting more than 50 courses and nearly 3000 students.</p> |

3.5.2 Implementation

SFA was originally due to complete in August 2021 but secured AHRC funding which has allowed this strand of the programme to be extended until March 2023 – the end date for the StoryFutures Cluster under which the Academy is housed.

At the end of its original timeline, the StoryFutures Academy had a significant underspend of £900,393 (£465,453 of which were un-committed costs).

There were several factors which contributed to this underspend, largely relating to the Covid-19 pandemic. New models for delivering training and facilitating collaboration, both on-line and using VR tools, as well as shelved plans for showcases, international exchanges and industry placements during the pandemic restrictions all resulted in reduced costs.

The AHRC funding and extension means that the Academy continued to fund some activities from the underspend of the AotF budget, despite the official completion of the AotF programme. Legacy projects – i.e. projects funded from committed costs from the AotF budget beyond the funding period - are listed below.

The remaining un-committed underspend has been rolled into the £2.1 million AHRC award and will fund activity across the SFA portfolio rather than individually identifiable projects.

Legacy projects funded from the AotF budget include: 'Laika' co-production, UK-Canada Immersive Exchange Programme, Industry placements, NFTS Bridges to Industry student awards, Coventry City of Cultures co-production 'Positive Realities', BBC3 co-production, Production Booster Funding, Kickstart Development Funding, BFI Immersive Short Animation Fund (50%) and Train The Trainer 2.

All but one of these projects concluded by Spring 2022. The final legacy project will conclude in Autumn 2022. As these projects have been funded through the original AotF award, they have been included in the scope of this evaluation.

3.5.3 Methodology

The findings in this section are based on the following data sources:

- Review of quarterly performance indicators (KPIs) and monitoring information
- Survey of all participants of the SFA activities that was prepared by Technopolis and distributed by SFA in February 2022, base: 49
- Mixed-method case studies of SFA beneficiaries based on SFA internal reporting and supplementary interviews undertaken in July 2020 and in June 2022, base: 5
- Focus groups with researchers and academics who took part in of the SFA's Train the Trainer programme (conducted in February 2022, base: 7)
- Focus group conducted with the SFA senior team in June 2022

An overview of the survey respondent profile is presented in Appendix D D.2 and list of focus group attendees is presented in Appendix D - D.5.

3.5.3.1 Outcomes overview

SFA **achieved its objective to support the development of new skills**. The survey results show a **significant majority of participants** (across the different workstreams) have **improved their knowledge of creative immersive production processes and of opportunities and challenges of creative immersive production**. The programmes also developed technical skills, with over half of participants reporting increased skills in development with real time game engines (53%); creative art direction (57%) and writing for Immersive experiences (57%).

In terms of embedding knowledge and capacity, **78 educational/skills programmes and courses** were developed or modified because of SFA activity, which includes **50 courses developed through the Trainer the Trainer (TTT)** project.

For delivery partners Royal Holloway (RHUL) and National Film & Television School (NFTS), the experience and approaches to talent development in immersive have also become **institutionally embedded** in ways that will last beyond the lifespan of SFA, including immersive within the core course portfolio at NFTS and a new research catalyst on digital storytelling at RHUL.

Although not a direct objective of the programme, TTT participants also reported changing attitudes and recognition of immersive at an institutional level as a result of their participation in the programme.

SFA had a positive impact on attitudes towards immersive: **92% programme participants** said their SFA involvement made them **convinced or enthusiastic about the future of immersive storytelling** (SFA Annual Report, 20/21).

Participants in different programmes reported increased understanding of the opportunities - and limitations - of immersive technology, especially among those who had less prior experience in this field.

These findings are presented in further detail in the sections below.

3.5.3.2 Progress against objectives and delivery targets

The evaluation team analysed progress against the expected outcomes and indicators as set in the AotF Evaluation Framework (see Table 22 below). SFA also had a list of key performance indicator targets and performance against these KPIs was reported to AHRC quarterly (See C.4, Table 22).

At the end of final reporting quarter in September 2021, **SFA had exceeded all its original targets**.

SFA also pledged that 50% of the people engaged through the programme would be female and at least 20% from BAME backgrounds. SFA consistently met these targets throughout the programme, reaching **52% female participants and 23% BAME participants**.

SFA also monitored to what extent they were engaging with stakeholders outside of London, ultimately delivering 7 workstreams elsewhere than the capital (Target 6). In total, **35% participants were from outside London**.

The demographic make-up of the SFA beneficiary cohort is shares some similarities to that of ScreenSkills beneficiaries. (ScreenSkills is the industry-led skills body for the screen industries which offers career development courses and support in film).

Across all of their courses in 2019/20, 17% Screenskills participants were from BAME backgrounds, 58% were female and 55% were based outside London.²¹ If this participant data is used as a benchmark for SFA, the Academy exceeds Screenskills in terms of proportion of BAME participants but underperforms on national spread. This may be in part due to the London/South East location of the two delivery partners.

Table 22 SFA Impact Indicators

| Indicator | Results by end September 2021 | |
|---|---|------------------------------|
| Outputs | | |
| £ match investment into project activity and source (private, public) | £4,588,875 | |
| Number of new partnerships for participating enterprises, organisation and researchers | New | Enterprises: 39% (13/33) (*) |
| | Improved | Academics: 21% (7/33) (*) |
| Number of partnerships including cross sectoral business/academic, across large/small businesses. Analysis by business type (small, young, large, well established) | 69 Academia-Industry collaborations reported as part of TTT | |
| Number of people from enterprise who participated in training activity | 770 | |
| Number of researchers who participated in training activity | 225 | |
| Number of placements | 27 Industry and 6 Early Career Researcher placements | |
| Number of new educational/skills programmes/courses developed [as a result of the funding] | 78 | |
| Evidence of new courses being developed by HE participants, including any supporting documentation | 50 new courses and 2680 students benefitting from new teaching or courses (TTT monitoring data) | |
| Number of experimental labs delivered | 48 Experimental/Intro/Tier 2 Labs & Bootcamps | |
| Number of organisations reporting new or improved production methods or working processes related to immersive content | New | 17% (6/38) (*) |
| | Improved | 22% (8/36) (*) |
| Examples of new or improved working processes within participant organisations | See TTT focus group | |
| Number of co-productions | 29 | |
| Number of people employed by universities engaged with programme to deliver project activity | 14 headcount, 10.65 FTE | |

²¹ ScreenSkills (2020) TRUSTEES' REPORT and FINANCIAL STATEMENTS For the year ending 31 March 2020. This year was selected as a benchmark as the following year ScreenSkills expanded digital access to their user community, adding an additional 50,000 users whose experience was less comparable to that of the SFA participants.

| Indicator | Results by end September 2021 |
|---|--|
| Average salary for those working on AotF project | £52,000 p.a. |
| Outcomes | |
| Number of peer-reviewed papers published by participating academics projects/research in the area of immersive content or technology. Analysis to identify if interdisciplinary | 10 peer reviewed papers published by RHUL. No data on peer-reviewed papers from SFA beneficiaries. |
| Examples of knowledge such as articles, presentations | See TTT focus groups |
| Examples of improved understanding between industry and academia, and potential future collaborations | See TTT focus groups |
| Academics' experience of understanding of commercial immersive sector trends increased | Yes, see TTT focus groups |
| Number of IP and/or exploitable trade secrets developed | Yes: 11% (4/35) (*) Expect to in future: 29% (10/35) (*) |
| Examples of IP and/or exploitable trade secrets developed | See in text Case Studies (Laika, UK-Canada immersive exchange) and Case Studies in Appendix B.3 |
| Change in employment that can be attributed to the programme [New and saved jobs evidence for NCIS commissioned survey] | 463 (Y3 Annual Report) |
| Number of professionals which indicate they have developed new skills | See 2.3.5 for skills development breakdown; 44% said their involvement with SFA had led to development of new skills among staff (16/36) (*) |
| Change in attitude to immersive | 92% programme participants said their SFA involvement made them convinced or enthusiastic about the future of immersive storytelling (Annual report 20/21) |
| Change in attitude to innovation and innovation process (professionals trained) | See SFA leads focus group |
| Evidence of influence on attitudes and approaches of researchers to innovation and enterprise | See TTT focus groups & SFA leads focus group |
| Examples of evidence base informing policy | See SFA leads focus group |

Sources: Train the Trainer Focus Groups, SFA KPIs, (*) SFA participant survey, SFA Participant case studies, SFA leads focus group

3.5.4 SFA participant survey

The findings presented in this section are based on survey of participants in SFA programmes conducted in February 2022. The survey questionnaire was prepared by Technopolis and distributed by SFA to all participants of the SFA activities, including participants of labs, masterclasses, Bootcamps, Co-productions, development projects, placements, and the Train the Trainer (TTT) programme. The survey received 49 responses to the survey, which represents c.6% of the participants of all SFA activities.

The majority of respondents were from micro companies (20%) or freelancers (26%) or from Universities or Public research organisations (16%). 41% of respondents were from micro-companies (0-9 FTE employees) or freelancers (27%) or from academia (16%) (base: 49). Most respondents were from the creative sector, with just 8% from the non-creative sector.

In terms of events or programmes attended, over half respondents had attended a Lab (55%) most of the Introductory Labs (31%). Only 7 respondents had participated in either the development projects or kickstart projects (14%) and only participants from the co-productions.

An overview of the respondent profile is presented in Appendix D - D.2.

3.5.4.1 New skills and knowledge developed

One of the primary objectives of the SFA programme is to support the development of new skills and a talent pipeline.

Qualitative research (case studies and focus group) conducted in summer 2020 as part of the SFANCIS standalone report indicated that participants felt their experience with the StoryFutures Academy helped them to develop their 'sectoral knowledge'. This included a deeper understanding of the main approaches and trends within the immersive sector.

The survey supports this, showing that a majority of participants developed their knowledge of creative immersive production processes (86% total and 32% to a large extent)(base: 41) and the opportunities and challenges of creative immersive production (80% total and 35% to a large extent) (base: 40).

UK- Canada Immersive Exchange – Fred Deakin and Company Limited / Fred Deakin

Fred Deakin and Company Limited is a Micro company in the Creative sector. Fred took part in the UK-Canada Immersive Exchange, which aims to better prepare creative companies and individuals to work together on international collaborations; accessing talent, financial support, audiences and business opportunities across borders.

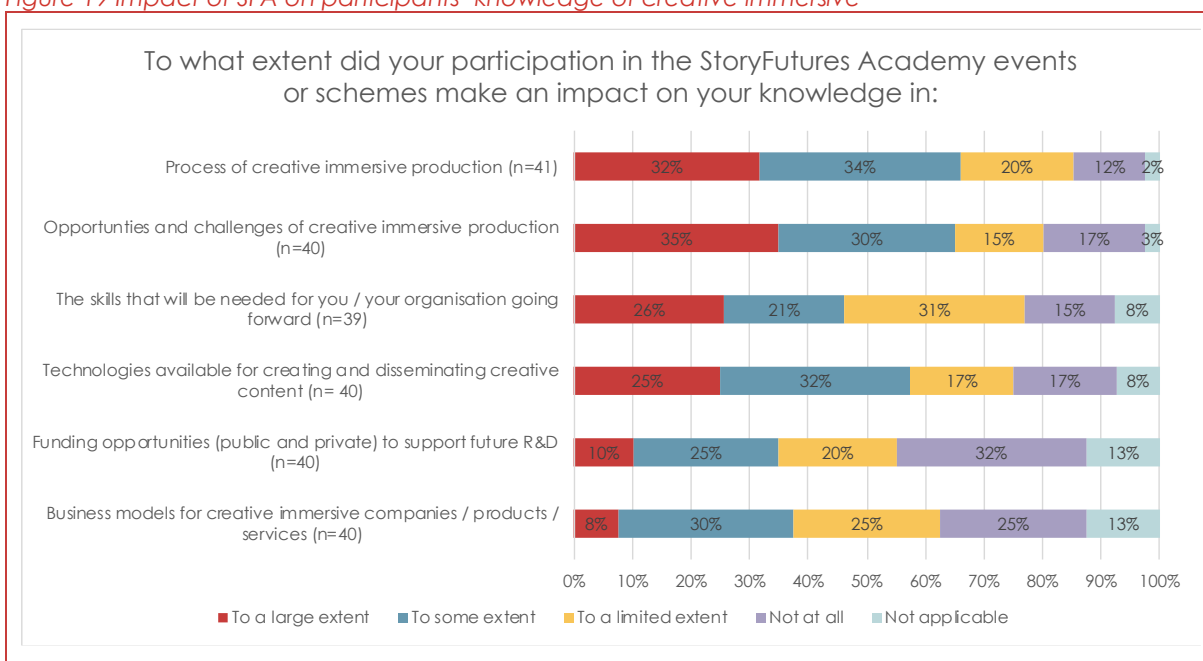
Fred reported improved skills in Business models for creative immersive companies, products and services, and funding opportunities, public and private to support future R&D. His participation has also made an impact on the development of new skills among his staff and improved the internal capabilities within his company.

Fred feels there is a high probability that the new skills that he has acquired will lead to further grant funding and commercial research in immersive content and technology. Additionally, as a result of participating in the exchange he has been able to identify new commercial leads, new career opportunities and public and private funding opportunities.

Fred Deakin and company have been able to improved existing production methods and working processes, create new creative immersive products and trial new business models for the company. Fred expects they will secure new revenue streams from these new products, services and customers in the future.

Participation in the UK-Canada Exchange has helped Fred to substantially increased his network, securing him new partners and collaborators. He is now partnering with Canadian company Flipside XR on "The Galaxicle Implosions" project and will be continuing to work on developing projects with them. This opportunity to develop new content and IP without excessively restrictive commercial constraints would not have been possible without StoryFutures. "The Galaxicle Implosions" project featured as part of a showcase at SXSW 2022, and completed a set of 5 performances as part of its inaugural "season" of shows.

Figure 19 Impact of SFA on participants' knowledge of creative immersive



Source: Technopolis and BOP Consulting: Survey data analysis

In terms of technical capacity, the most commonly reported skills developed were Development with real time game engines (53% in total, 13% to a large extent) (base: 39); Creative art direction (57% in total, 10% to large extent) (base: 40) and Writing for Immersive experiences (57% in total, 10% to a large extent)(base: 41).

1 in 10 respondents had already used the skills and knowledge they'd acquired through the SFA programme to secure further grants or commercial contracts. A further 38% of the 40 respondents thought that it was likely or highly likely that the skills and knowledge will lead to further grant funding or commercial research in immersive content or technology.

There is also evidence of some participants skill-sharing with staff and colleagues at their place of work (44% in total and 8% to a large extent) (base: 36).

“Valuable way to capture latest thinking e.g., in Virtual Production and develop research projects”

“Thanks to StoryFutures events, I had the opportunity to apply and get a place in the first Virtual Production course at NFTS. It is giving me the change to improve my skills and knowledge. Consequently, to develop my career to the next level and at the same time, increasing the chances of employment in the sector.”

“Thanks for kick-starting a path towards learning how to use Unity as an artist. It has set off a path of discovery into software that will undoubtedly change the way I create artistic work in the future.”

“Thank you, StoryFutures Academy - you continue to have an enormous impact on my career. I am now about to enter the virtual production industry, thanks to you!”

“It was an incredibly rare mix of the inspiring and the practical.”

"I am the founder and artistic director of my production company/charity we use a range of tools to deliver across a wide group of projects. The knowledge gained has given me the confidence to a) pitch b) turn down opportunities knowing they were ill thought through or deliverable and c) to plan for longer term future project that will involve XR. Due to the impact of the pandemic on the live theatre sector I also feel I have knowledge that could improve freelance opportunities."

"From a professional development point of view, it has widened my understanding of skills needed in the future, as well as knowledge of current technologies. I also mentor people and have shared events and programs led by you with graduates and aspiring filmmakers so they have awareness of new opportunities, and avenues beyond traditional old school film routes."

Writers' Room – Imperial War Museums, Rachel Donnelly

Imperial War Museums (IWM) participated in an ambitious training-in-action programme with the StoryFutures Academy (SFA), which enabled writers to produce new works using binaural sound design as part of a Second World War and Holocaust sound installation. The installation was launched at the opening of the Second World War and The Holocaust Galleries at IWM London in October 2021. The installation is touring different regions across the UK in 2022 and 2023 via the 8 cultural heritage organisations across the UK who form the Second World War and Holocaust Partnership Programme (SWWHPP), led by IWM.

The partnership with SFA arose after the SWWHPP were looking for new, ambitious and creative ways to engage audiences across the UK with lesser-known stories about the Holocaust and the Second World War. Project manager Rachel Donnelly was introduced to the SFA through a colleague and together they came up with the idea of commissioning a group of writers to respond creatively to the collections or research areas of each of the partners. The SFA then recorded these stories and created an installation with SWWHPP and creative designers Joi Polloi using innovative binaural sound technology to provide a unique, immersive sound experience.

Knowledge of creative immersive production

The IWM feel that their engagement with SFA brought a new perspective to the installation and that without their input, they would not have considered using binaural sound. Working with SFA has also given the IWM better understanding of what is needed to develop a technologically complex project - especially in terms of capacity, which was at times a challenge for the project delivery team. Project learnings will be shared both within the museum and across the wider SWWHPP partnership.

Although it will not finish touring until 2023, initial feedback has shown that visitors are really engaging with the installation and the opportunity to hear stories and accents from the length and breadth of the UK. It has also resulted in some 'spin off' projects: for example, a digital intern at the National Holocaust Centre and Museum has created a digital animation based on their story in the installation. The IWM plan to use this experience to assess how and where they might want to undertake similar projects in the future.

3.5.4.2 New and improved processes, content and products

SFA is first and foremost intended as a skills intervention to build capacity within the sector. Despite this, participant case studies show examples of content and processes being created or improved as a result of participation in SFA programmes.

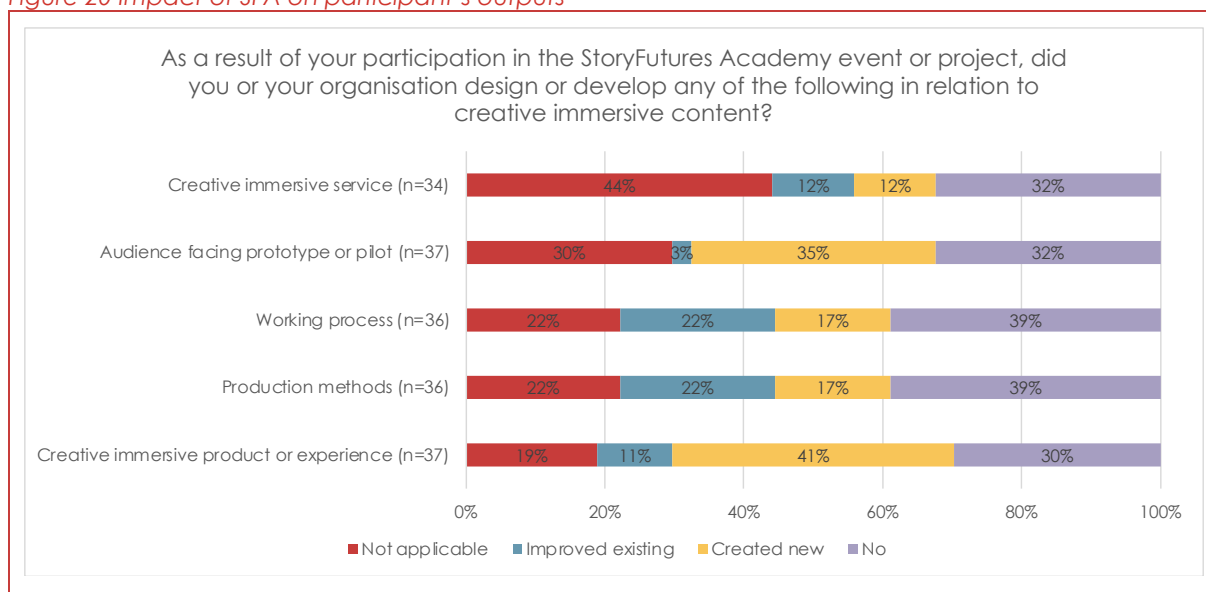
While this indicator was not applicable across the full diversity of SFA participants and programmes, the survey findings show that the SFA did contribute to a wider AotF objective to

develop new and improved production methods, prototypes, working processes, and products and services.

Of 38 respondents, 17% said they had **developed new production methods and working processes**, and 22% reported having improved methods and processes.

The most frequently reported output from the SFA programmes were new or improved creative immersive products and experiences. Over two-fifths (41%) respondents said that they had **developed a new creative immersive products or experience** and a further 11% (base: 37) had **improved an existing product or experience**. This is followed by audience facing prototypes or pilots, developed by 35% of respondents (base: 37).

Figure 20 Impact of SFA on participant's outputs



Source: Technopolis survey data analysis, base: 34-37

3.5.4.3 Outputs and revenue streams

Just over one in ten participants said they had produced **new IP and/or exploitable trade secrets** with a further 29% (base: 35) indicating that they expected to in the future. The same proportion **trialled or demonstrated new business models** and 28% (base: 36) expected to do so in the future.

Participant case studies also show evidence that new IP had been created as a result of participation in SFA programmes. As before, while this was not a primary objective of SFA activities, the survey shows evidence of impact in outputs and revenue streams.

The most frequently reported output was the development of **new immersive platforms**, reported by 17% of respondents (base: 36) with an additional 8% expected to develop this in the future.

There is little evidence that new products and services developed through SFA have led to new revenue streams or customers at this point in time, although 31% respondents said they expected this to happen in the future (base: 35).

3.5.4.4 Improved collaboration between academia and industry

Stronger links between academia and industry was a key objective of the SFA and a third of organisations collaborated with other organisations as part of their SFA participation. Over a

fifth (21%, base: 33) survey respondents **secured new partners and collaborators** as a result of the programme, with a further 39% having identified new partners for the future.

SFA has also had a positive impact on academic's understanding of commercial research in immersive content and technologies, with 5 of the 7 survey respondents to the survey that were from an academic background reporting improved understanding.

The following quotes demonstrate the breadth of these connections and collaborations developed because of their participation in SFA.

"I very much enjoyed taking part and made excellent connections while I was there ... it was a really positive experience."

"Now partnering with Canadian company on our SFA funded project and will be continuing to work on developing projects with them."

"Built a relationship with the National Gallery"

"Our network has been substantially increased as a result of our participation in these events and schemes."

"Increased understanding of how to work on creative projects with academics and cultural institutions"

3.5.5 Train the trainer

In this section we present the findings on the outcomes of the StoryFutures Academy Train the Trainer (TTT) workstream. The workstream was designed to enable researchers and teachers in UK higher education to develop their skills and experience of immersive storytelling by delivering research and teaching development projects. It aimed to build capacity of UK higher education to create a talent pipeline for immersive production.

It has been delivered in two cohorts, each of which funded seven projects. Across the two cohorts which have completed their activities, the 14 project teams have trained over **225 academics** and trainers and engaged **462 students**.

Findings are based on two focus groups with a total of seven project team members, which were conducted by BOP in February 2022. The full deep-dive can be found in Appendix C.3.

3.5.5.1 Outcomes of the workstream

New skills and knowledge developed. Participants reported different levels of knowledge of immersive prior to TTT. Accordingly, the skills and knowledge developed reported by focus group participants, but included:

- **Competency using hardware and software** relating to immersive technologies and acquiring and learning how to use cutting edge technology within academic institutions
- **Better understanding of the budget, timeline, and other project management considerations** for immersive productions.
- **Better understanding of the opportunities or limitations of integrating technology** within the creative process.
- **Developing a common language** across disciplines as part of a project team to overcome the challenge of a not having a 'locked down' language for immersive

"It was a massive creative lesson for me."

New or improved courses, modules, content, and teaching methods. The programme has resulted in **50 new or modified courses** and **2680 students benefiting** from new teaching or courses (Train the Trainer cohorts 1 and 2).

Examples of knowledge outputs such as articles, presentations:

- **Conferences:** Over half of the focus group participants (base: 4) have presented their projects externally at conferences and academic festivals.
- **Industry engagement:** including demonstrations of work; industry-facing media, and industry-wide steering groups.
- **Institutional knowledge:** internal symposia and other channels to share within participants' own institutions.

Improved understanding between industry and academia. Many collaborations are either likely to or already continued beyond the project lifespan. However, several of the focus group participants already had a high base level of understanding of industry as they had either come from an industry background or in some cases worked in both HEIs and industry simultaneously, therefore the TTT programme had little impact on their overall understanding.

Change in attitude to immersive. Participants reported developing their attitudes to the role of storytelling through technology as well as their confidence assessing the potential of immersive tech projects and career paths.

"We came into the project thinking it was all about the technology, but our mentor told us to focus on the story, which was really helpful."

Institutional change: Participants felt the project gave them 'leverage', 'permission' or 'authority' to dedicate their time to immersive and to have conversations with senior management about future projects. In one case, the **TTT programme has directly resulted in a project team** from the Department of Electronic Engineering and the Department of Computer Science at Royal Holloway **securing further funding from their institution** to build on this work.

3.5.5.2 Process

Knowledge frameworks in immersive. Feedback on the industry speakers and masterclasses was mixed. For participants who had more direct experience and knowledge of immersive tech – both from academia and for some, from their time in industry – felt that it would have been more beneficial for the sessions to be pitched as a knowledge-exchange opportunity rather than a hierarchical knowledge transfer (e.g. a peer-to-peer learning rather than a teacher to student model).

Networking and collaboration. Participants appreciated the opportunity to meet peers from other institutions and learn about what each project team was working on and are keen to continue to stay in contact with others in their cohort and other TTT participants. It was suggested that SFA invests in sustaining a community of practice or alumni network, which could include a face-to-face meet up/symposia to share projects, learnings and scope out any future collaborations.

“For me, a big, big plus of TTT is the opportunity to have peer to peer engagements -especially extra institutional.”

What next? Over half of the projects have either secured or are exploring future funding opportunities to develop their TTT project further. Participants said they would appreciate the opportunity to apply for future funding from SFA to continue and progress their projects.

3.5.6 Legacy and lessons learned

3.5.6.1 Lessons learned

The SFA leadership identified the following lessons when it comes to developing talent in immersive.

Production-led approaches are an effective way to facilitate professional training and R&D. SFA leads – specifically partners at RHUL - noted the challenge of taking the research-focused, R&D approaches that are typical within a research institute to the fast-moving demands of professional development training in an innovative space such as immersive storytelling.

The leadership team described a ‘production-led’ approach as a successful solution to marrying the training and R&D elements of SFA support, with productions – from large scale productions to tiny projects – acting as vehicles for both R&D and professional training. The team use the example of the work they did with Maze Theory, who were looking for writers to work on a Peaky Blinders VR project. In supporting this production, SFA were teaching young writers about how to work with VR technology while simultaneously training Maze Theory technologists about developing solutions for television storytelling.

Academics who took part in the SFA Train the Trainer programme also noted how beneficial the opportunity to work on real-life productions was for their students’ development.

Laika’, Collaborative Co-production – Katie Grayson, Passion Pictures

Passion started working with the StoryFutures Academy (SFA) on the VR production *Laika* which was created for London Film Festival 2021. *Laika* is a 20-minute animated VR short directed by Asif Kapadia and is an adaptation of a graphic novel of the same name. The project was part of SFA’s ambitions to engage established film talent with immersive technologies.

Production-led R&D

Passion had prior experience of working on other immersive, interactive and real-time projects, which form an important part of their R&D portfolio that runs alongside their commercial and long-form animation work. Strategically, the company value having a foot in the immersive space. *Laika* was an opportunity to upskill internal teams, to retain and build out the crew working with Unreal as well as giving some members of the senior leadership team who hadn’t work on similar projects in the past an opportunity to work on a VR project for the first time.

The experience of producing *Laika* has given the company the confidence and know-how to consider similar real-time projects in future, despite their technically challenging nature. Passion are currently making a complete short film entirely in Unreal and bringing more crew members onto real time workflows. The production has been credited with shifting attitudes towards Unreal from ‘that sounds hard’ to ‘that sounds interesting – let’s do more’.

In addition to technical learnings, working with SFA on *Laika* proved an important learning curve for Passion when it comes to the financing of VR projects. The company noted that established film financing and contacting models don’t quite fit when it comes to VR projects, leading to additional challenges for the production team. However, with the help of SFA, the producers were able to overcome these challenges and share this learning across the company, meaning Passion is now better equipped to tackle similar projects in future.

Laika has also helped Passion to keep the team together to work on other projects. In addition to StoryFutures Academy funding, the company also received a MegaGrant from Epic Games for the production. This experience helped them to apply for a successful follow up grant from Epic to work on the next R&D project.

Virtual Production Introductory Labs – 3WitchesXR Productions Ltd / Hester Schofield

- StoryFutures Academy's Virtual Production Introductory Labs are designed to help participants understand how Virtual Production technologies are deployed to tell compelling stories, and how they might affect their practice in future. Labs are run in small groups are intended to provide a forum for discussion and debate about Virtual Production techniques; develop new thinking and grow a community of practice. The key areas covered include a comprehensive overview of the Virtual Production landscape, and the technology enabling this content.
- 3WitchesXR Productions Ltd, is a Micro company, which primarily works in the creative sector. Hester Schofield attended the Motion Capture and Fundraising work streams. Hester gained knowledge in creative art direction, development and real time game engines, motion and volumetric capture, writing for immersive experiences, funding opportunities, public and private, to support future R&D.
- As a result of her participation, Hester has been able to identify new partners and collaborators, new commercial leads, and public and private funding opportunities. Additionally, Hester's involvement with SFA has had an impact on the development of new skills among her staff, and the internal capabilities with his organisation. In particular, Hester has adapted IP content through technical workshops, and is now more aware of prototype requirements to raise funding.
- Hester believes that there it is probable that the skills and knowledge he's learnt will lead to further grant funding and/or commercial research in immersive content or technology. Moreover, due to her participation in SFA, Hester expects to trial new business models, produce new IP, develop new immersive platforms, and secure new revenue streams from new products, services and new customers in the future.

There is growing demand for skills in the area of virtual production. Following the establishment of SFA, the leadership team noted that there was growing demand and interest from the screen industry around virtual production technologies - and the use of game engines - as they became more widely adopted. This led to a skills gap which SFA has endeavoured to help overcome – despite the fact that the term 'virtual production' wasn't a major focus for the Academy at its inception.

A stakeholder external to AotF shared this view, noting that from their perspective SFA had made significant progress in upskilling the sector in the fast-moving area of virtual production.

“Virtual production is moving quite quickly in the UK. It has been pushed forward by AotF and the brilliant SFA. The skills development in our space as a result of public funding has been really significant.” – External stakeholder

Interdisciplinarity is key to successful training in the immersive space. SFA leadership identified the collaborative and inter-disciplinary structure of the workstreams as a key enabler for bringing the UK's research infrastructure together to share knowledge in a way that had not been done before.

For NFTS, the interdisciplinarity that has been a key part of SFA has proven so effective it has prompted the school to consider ways to adopt a less-siloed approach to talent development across their portfolio. RHUL report that the interdisciplinary approach of SFA has catalysed a step-change in the way the Universities both sets up and shares research.

3.5.6.2 Legacy

Organisational change. NFTS are currently reviewing their portfolio of course and exploring ways to embed the experiences and knowledge gained through SFA into their core offer, acknowledging the significant influence the programme has had on their approach. In particular, the NFTS will seek to meet the growing demand for skills in virtual production techniques that has been uncovered through their delivery of SFA.

SFA has also helped NFTS to raise their profile internationally when it comes to their work in immersive. They report **significant interest from international counterparts** in SFA, with Zoom conversations with interested international counterparts taking place as often as every three weeks.

RHUL also reports a step-change in the way they teach immersive, especially in terms of the interdisciplinary structures that have been created. This has informed the set-up of four interdisciplinary research catalysts at RHUL which emulate the relationship SFA research had to the wider world. One of these, the Catalyst on Digital futures in the creative and cultural industries, led by Professor James Bennett, will build on the success of SFA and ensure it has a life beyond the grants.

RHUL has also launched an undergraduate games programme which sits alongside the film department and looks at virtual production scenarios.

Funding for immersive. The BFI recently put out their first ever funding call with immersive as a priority – the BFI Animation Fund²² – which was developed in collaboration with SFA. This is considered a key success by SFA leadership as it is evidence on the influence the Academy has had on the broader funding environment for immersive productions.

Collaboration. RHUL and NFTS reported a continued commitment to collaborate once SFA comes to an end. The two institutions are already looking at things they might bid for in future.

²² <https://www.bfi.org.uk/get-funding-support/create-films-tv-or-new-formats-storytelling/short-form-animation-funding-immersive-projects>

3.6 The Digital Catapult

The Digital Catapult was contracted to support the delivery of the AotF Demonstrator Programme. The four areas of work that it was initially envisaged that this role would cover are outlined below, although the Digital Catapult pivoted some of their planned activities – both adapting existing plans and undertaking new activities - as the programme evolved to maximise the benefit of their support.

1. Convening across the Demonstrators to share learning and facilitate co-working
2. Identification and provision/sourcing of technical support to the Demonstrators
3. Engaging start-up and scale ups in the opportunities provided by the Demonstrators
4. Dissemination of learning and showcasing outcomes arising from the Demonstrators.

Work that the Digital Catapult could usefully deliver for the Demonstrator programme and the wider sector changed over the course of time – to fit with how the programme evolved, the needs of companies and individuals within it, and to respond to wider events (principally the pandemic) The major changes took place with regard to work areas 1 and 3 above.

3.6.1 Digital Catapult Support for the Demonstrators

In terms of convening the Demonstrators to share learning and facilitate co-working, the tech lead for each Demonstrator was envisaged to join each of the monthly forums. In practice, attendance at the forums was more varied – some were consistent in attendance, others less so. In large part, this was because the leads from the consortium partners organically organised a separate means of keeping in touch with each other and sharing challenges and solutions among themselves, in the form of a weekly call. The result was that both interim and post-exit interviews with Demonstrator leads and lead partners revealed little engagement with the Digital Catapult, and limited understanding of their role. Sometimes this was expressed as the Catapult duplicating something that they were already doing (“I never had a clear sense of what their role was – for instance, they have research, but we have research in our consortium”), and sometimes this lack of awareness was part of a wider lack of understanding as to the Catapult’s role as an institution more generally (“I’m never quite sure what they do... Are they about evaluation and White Papers?”).

However, on the occasions when project leads did attend a convening, some certainly reported positive experiences: “I have been to a couple of the convenings – all of the Demonstrators and some of the PIC grantees – and that was really interesting, particularly the small grants as I didn’t know about them. More exposure to what’s going on in with the small grants would have been good.²³ I made loads of notes and met some great people and got lots of cards. And when they produce White Papers we always read them.”

Getting the Catapult’s network of immersive start-ups to be a key part of the environment supporting the technical elements of Demonstrators did not materialise. This was because the assumption underpinning this work area proved incorrect. Specifically, it was initially assumed that the Demonstrators would need to contract out a lot of technical / production work to third parties and would therefore need help identifying the most relevant suppliers and partners. However, through a combination of existing in-house resources and new hires – which in some cases (e.g. the Visitor Experience Demonstrator) were extensive – the Demonstrators kept the large majority of the work in-house. As a result, this strand of activity (involving start-ups and

²³ While the Digital Catapult would have liked to have worked more with the organisations in receipt of the smaller AotF grants, they reported that there was not enough time / resource to do this.

scale-ups in the Demonstrator projects) did not happen at all while others changed in emphasis and make-up (e.g. the provision of technical support).

The Catapult team also acknowledged that their role in the Demonstrator programme, “was potentially a bit confusing for the Demonstrators.” In part, this was attributed to a structural cause: “We didn’t really have any power in the project. The Demonstrators had to report back to UKRI, and they might not all have wanted to have to share the details of their work with us; some of the Demonstrators were a bit secretive and we couldn’t force people. Some Demonstrators did feel that they were getting something back from the research, so some opened up a bit more.”

Additionally, the team also felt that some of this distance from the Demonstrators had been exacerbated by the pandemic as pre-Covid, the team had been visiting the Demonstrators regularly but keeping in touch became more difficult once in-person visits were no longer possible. What is more, as outlined elsewhere, many of the Demonstrators went into ‘survival mode’ during the pandemic and had to expend a lot of resource replanning or pivoting their projects. This reduced their capacity to engage with the Digital Catapult.

3.6.2 Digital Catapult Showcasing and Dissemination

It had initially been envisaged that the Digital Catapult would programme a showcasing event in a physical location to show the development and outcomes arising from the Demonstrator projects. However, as the projects approached their conclusions, the Digital Catapult felt that an event focused on the Demonstrators, in a museum-style exhibition or symposium format, that had been planned was no longer the best option to pursue. There were three main reasons for this:

- The Covid-related delays to the Demonstrators created uncertainty as to when / if the Demonstrators would actually complete their projects.
- Given less engagement with the Demonstrators than planned, the Digital Catapult did not have the material nor data from the Demonstrators that they had envisaged they would have.
- The Demonstrator experiences used such different platforms, with more digital and fewer physical outcomes than anticipated (as a result of the pandemic), that it would have been difficult to recreate these experiences in a physical space in a useful or coherent manner. A virtual platform was unachievable within time and cost restraints.

3.6.3 Immersive Arcade

In response, the Digital Catapult chose to pivot their project plans to programme a major immersive sector showcase called the Immersive Arcade, broadening their reach with the sector as well as with audiences.

The project was conceived as a national collection of UK immersive content – the first of its kind - showcasing 20 years of British works incorporating VR, AR and XR. This was then used as a tool to engage with the wider sector, with a particular view to engage more women aged 18-25 (due to their low presence in the industry workforce). The mentoring within the project focused exclusively on this age group, but also this demographic was strongly reflected in the branding of the Arcade and in the work that was chosen to include within it. The outputs of the project were a website, a virtual reality showcase and a physical tour of the showcase.

Immersive Arcade showcase was toured to around 14 different UK locations alongside a wraparound mentoring programme. Before the end of its licensing period, over 14,000 users had engaged with the VR showcase, with downloads of products in excess of 16,500, well beyond the initial target of 1,000, and over 40,000 page views of the website, against a target

of 12,000. Audience feedback was also strongly positive: the showcase products received 88% user approval on the Steam platform and of the 81 demo users that were asked to rate their experience of Immersive Arcade at the North East Tees Valley tour venue, all scores were either 5/5 (outstanding) or 4/5 (very good).

OmBeond, a creative immersive studio who worked on the production of the Immersive Arcade, highlighted the successful collaboration between companies and producers who worked on the project:

The collaboration [on Immersive Arcade] has worked really well. I hope it will be looked at as a landmark project for collaboration.

Another creative digital company, Megaverse, who worked on Immersive Arcade, highlighted the connections and visibility they gained through taking part in the project:

Immersive Arcade got us moving in the right circles again and has been some good visibility for us.

The Digital Catapult believe that the Immersive Arcade is the first national collection of its type and note that France and Canada have since launched their own versions of a national showcase. The involvement of a Canadian supplier, the Museum of Other Realities (MoR), in helping to producing key parts of the Immersive Arcade was unexpectedly beneficial in promoting the UK work internationally as MoR were able to provide support for launch events and publicity. It is likely that this helped significantly in achieving not just a bigger audience, but a more international audience – for instance, 27% of traffic to the website came from outside of the UK, mostly from the US.

From the Digital Catapult's perspective, the Immersive Arcade has been a learning experience as well as a success. The associated programme of mentoring did not go as well as expected, but the Catapult was otherwise satisfied with how the Immersive Arcade had engaged the target female demographic. Much has also been learnt about the challenges of licensing historic immersive content. As so much of the work to-date has been produced by individual project-based consortiums, and as there is as yet no real secondary rights market in immersive content, identifying rights holders of immersive experiences years after release proved challenging in many cases. However, once the content was acquired, the partnership with venues around the UK – who showed an appetite to platform immersive creators – was a particularly successful outcome of the Immersive Arcade as it has enabled Digital Catapult to disseminate content across the country, beyond metropolitan hotspots, in a cost-effective manner. The Catapult report that they are likely to use this model again in future. Similarly, the experience of the Immersive Arcade also fed into the Show and Tell talks and the publication series (see below).

3.6.4 Research and knowledge sharing

In addition to the showcasing event pivot, the research part of Digital Catapult's activities, which had initially been assumed to be a relatively small part of the work, became much more significant. This was because over the course of the AotF programme it became apparent that certain areas of knowledge within the immersive ecosystem (business and educational) were either incomplete or not systematised.

Digital Catapult saw an opportunity to embrace these areas and generate reports and tools that represent codification of these areas and in some areas moved the state of the art forward with new ideas. The reports focussed on the following areas:

- Audience and audience journey
- Business models
- Production, distribution, licensing and archiving

Four reports have been produced:

- 'The Immersive Audience Journey', which brings insights from customer journey mapping and other service design processes to bear on immersive creative content and experiences.
- 'The UK Creative Immersive Landscape', which looks at the business model and scale-up challenges facing small immersive creative producers.
- 'Home Audiences and Immersive Content', a study of the current XR market in the UK.
- 'The creative immersive content lifecycle: from distribution to restoration' which considers the challenges facing immersive technologies throughout the lifecycle of immersive content from finding funding at the pre-production phase through to post premiere.

The reports, videos and associated tools have been downloaded in excess of 2,900 times.²⁴

The Digital Catapult also hosted four Show and Tell knowledge sharing sessions on topics such as archiving and licensing, hosting speakers from different parts of the immersive 'value chain'. These were open to the Demonstrators and the wider sector, although as before, the level of engagement from the Demonstrators varied depending on their needs and availability. They reached a total of 115 attendees, and recordings are available via YouTube.

The Digital Catapult report that these workshops and session were productive and well received. No formal evaluation was undertaken with attendees.

²⁴ Figure excludes downloads of 'The creative immersive content lifecycle: from distribution to restoration' as these were not available at the time of writing

4 Conclusions

Overall, AotF has largely met its intended goals and objectives. This is particularly true of the Grants and Investments strand, which supported the creation of new immersive products and services, and the Story Futures Academy (SFA) strand, which succeeded in upskilling its participants and embedding knowledge and capacity across the sector.

The picture of success is more mixed across the Demonstrators. The investments in the four consortia have always been the riskiest element of the programme, given the size of the investment across such a small spread, and the level of ambition that the Demonstrators were tasked with achieving. It must also be recognised that the delivery of AotF, particularly the Demonstrators, coincided with the Covid pandemic. The resilience and resourcefulness of the beneficiaries, coupled with the flexibility and care extended to them by UKRI, is notable.

Across the wider industry, the programme has enjoyed significant reach and interest across the UK's creative immersive sector, with stakeholders attesting to the contribution that it has made to the positive state of the sector, including its international standing.

Grants and Investments

We find that the **Grants and Investments strand** have delivered across its main objectives.

The programme has provided a good platform to enhance existing partnerships and to build new ones. Most participants had collaborated with at-least one new partner, with more than half stating they had established a new partnership with a micro business. Almost all respondents agreed the programme played a big role in enhancing these partnerships.

Most participants had developed at least one new creative immersive product (79%) and/or service (56%) because of their Audience of the Future project. A significant share had also improved their existing offering(s). The majority of participants had progressed at least one level and a third had progressed from Feasibility (TRL 1 – 2) to Commercialisation (TRL 9). As a result, close to half of participants reported that they had already generated revenue from new product/services or customers, and another 40% stated they expected to achieve this in the future. This is in stark contrast to unsuccessful applicants, most of whom had not progressed the TRL of their project or had not continued with their project at all.

This seems to have translated into additional sources of income. Based on survey results, we find **that turnover has improved substantially for programme participants, in particular, the value of turnover derived from immersive content or technologies.** As the number of employees has remained the same, the levels of (labour) productivity for participating businesses (Gross Value Added per employee) has increased.

Around half participating businesses had not generated turnover from exports, suggesting that there is scope for further growth if this option is successfully explored in the future.

StoryFutures Academy

At the end of final reporting quarter in September 2021, the **SFA had exceeded all its original targets.** SFA also pledged that 50% of the people engaged through the programme would be female and at least 20% from BAME backgrounds. SFA consistently met these targets throughout the programme, reaching **52% female participants and 23% BAME participants.**

This includes objectives to support the development of new skills within the creative immersive sector: survey results show a significant majority of participants (across the different workstreams) have improved their knowledge of creative immersive production processes and of opportunities and challenges of creative immersive production. The programmes also developed technical skills, with over half of participants reporting increased skills in

development with real time game engines (53%); creative art direction (57%) and writing for Immersive experiences (57%).

In terms of embedding knowledge and capacity, 78 educational/skills programmes and courses across UK Universities were developed or modified as a result of SFA activity, which includes 50 courses developed through the Trainer the Trainer (TTT) project.

For delivery partners Royal Holloway (RHUL) and National Film & Television School (NFTS), the experience and approaches to talent development in immersive have also become institutionally embedded in ways that will last beyond the lifespan of SFA, including an increased focus on immersive within the core course portfolio at NFTS and a new research catalyst on digital storytelling at RHUL. Academics who participated in the Train the Trainer workstream also reported changing attitudes towards and greater recognition for immersive within their institutions as a result of their participation in the programme.

SFA had a positive impact on attitudes towards immersive among participants: **92%** said their SFA involvement made them **convinced or enthusiastic about the future of immersive storytelling** (SFA Annual Report, 20/21).

External stakeholders from the immersive sector (investors, industry professionals, trade bodies and other higher education institutes) recognised the level of demand for skills development in the creative immersive vertical and praised the impact SFA has had in meeting this need.

The Demonstrators

The last eighteen months (since we reported on progress at the Interim stage) have allowed projects to fulfil their Covid-adjusted plans and ambitions, in particular with respect to the Location Based Experiences (LBEs) that were delayed by the pandemic. This last period has also enabled organisations to test different business models and (to some degree) test commercial viability, as well as think about building upon their projects.

At the end of the project, 100% of the participants reported that their projects would not have gone ahead without the UKRI funding (base: 24, Project Completion Form data), indicating strong additionality for the Demonstrator investment.

Outputs from across the Demonstrators have typically generated significant industry traction and met with critical acclaim. Meeting the audience target of 100,000 for each Demonstrator has been more difficult. In particular, this was a challenge for the two Demonstrators that were originally planned as LBEs and then pivoted to at-home, app-based experiences during the pandemic. Both experienced the challenges of driving volume on the app stores without significant marketing budgets.

Nevertheless, two of the four Demonstrators (eSports and Immersive Performance) met this target and overall audience engagement across the four consortia still amounted to just under 2.4m, driven principally by the eSports Demonstrator.

Two of the four Demonstrators – the eSports and Moving Image Demonstrators – have attracted follow-on interest and investment. In both cases, the investment has come from trade sources (in this case larger companies) rather than external investors, as is typical of creative industries investment.

The following observations can be made about the experiences of the Demonstrators:

- **A strong and positive involvement with the knowledge base** (in three of the four Demonstrators, eSports, Performance and Visitor Experience) with examples of further collaboration, both with existing and new academic partners.
- **Shifts to wholly digital products and services, accelerated due to Covid restrictions meant the development of outcomes that were more technologically mature and better aligned**

with broader market trends towards in-home entertainment, cloud-based platforms and Web3 technologies.

- **The overhead on collaboration within the largest consortium**, the Immersive Performance Demonstrator, **was considerable**, leading to organisations having to sometimes curb their collaboration with partners in order to get things done. However, overall 68% of respondents reported being either satisfied or very satisfied with the effectiveness of the consortium in project delivery, with just 13% saying they were unsatisfied or very unsatisfied (the remaining 14% said they were indifferent). (base: 29, PCF data).
- **There are clear benefits of setting up consortia with organisations that share similar characteristics** (in terms of size, public or private, sectoral background, and their degree of existing knowledge and experience in digital media and tech). The Interim findings suggested that having partners that share similar structural organisational characteristics means that it is also likely that they share similar ways of working, decision-making processes and attitudes to risk, as well as having the skills to engage as peers. The positive aspects of this were again shown in relation to the rollout of the Visitor Experience and Moving Image LBEs.
- **For the audience-facing consortia partners, there was often a tension between engaging audiences in innovative ways vs reputational risk.** The ambition in Audience of the Future to engage audiences was both highly valued and also, for some consortium members, the source of considerable challenges. For the eSports Demonstrator, the emphasis on engaging audiences was what made the programme distinctive and attractive and helped them to maintain an experience-led approach to innovation. However, in the Visitor Experience and Immersive Performance Demonstrators, the cultural partners struggled with what they felt was a tension between creating something novel and technically innovative, while also creating something that met the quality and production values they expect to deliver to their audiences. In the Moving Image Demonstrator, internal company reservations from the rightsholder were overcome through the experience of the discovery journey, and the insights this gave them about the relevance of their IP and core competences in the immersive space.
- **This tension, allied with the challenge of working with partners with different organisational characteristics, underpinned many of the collaboration challenges experienced in the consortia.** The consortia provide differing ways in which the input and participation of rightsholders was structured. Where cultural organisations have been core partners within the consortia, it was not entirely successful. This is most apparent with regard to the national museum partners within the Visitor Experience Demonstrator, who left the consortium once the apps had been delivered. In large part, this was related to the two points above: differences in size, outlook and experience between the consortium partners (in this case the two museums and the two remaining project partners); as well as the tension that the museums felt trying to innovate and experiment, while avoiding reputational damage in the eyes of audiences and the media.
- When the rightsholder was not a core partner, as with the Moving Image demonstrator (instead providing a license to the IP for the core partners) some internal doubts about the process were kept at 'arms-length' from the core consortium and production process.
- **Structuring deals for uncertain IP and fluid circumstances also proved difficult across the Demonstrators**, with different approaches undertaken. For instance, the Moving Image Demonstrator structured their new company (Fictioneers) as the asset holding entity from the outset of the project, but still found themselves having to unwind the arrangements towards the end of the project, to reflect changed aspirations of the partners. eSports took the alternative approach – as the IP was too uncertain at the outset to try and structure an agreement – but still found that the negotiations and arrangements to structure the IP were

difficult, even at this later stage once the IP became knowable, particularly given that legal costs could not be covered by the AotF grants.

- **All four Demonstrators trialled new business models and explored the commercial viability of their projects, and the results suggest that not much has changed in the marketplace regarding the ways to make commercial returns from immersive creative content.** The pivot to apps was one way that two of the Demonstrators could keep their projects alive during a time when LBEs were not possible. But in doing so, the projects ran into the same issues that other app and games developers face: a congested market with distribution gatekeepers that means marketing spend is a necessary (if not sufficient) condition of driving downloads. However, unlike other developers, AotF projects were not allowed to spend their grants on marketing (which caused some tensions in consortia as they struggled to meet the audience KPIs previously set for their projects). Equally, the Moving Image Demonstrator also found that app-based revenues (e.g. 'in-game' / in-experience purchases) are weak without a high volume of downloads. In terms of the commercial viability of immersive LBEs, partners in the Immersive Performance Demonstrator report that the cost implications of the technology and infrastructure remain prohibitively high so constrain commercial returns (and therefore also private investment). However, the Visitor Experience LBE did manage to show in its short, paid-for run that – had there been a different venue solution with no hire costs – the experience could have run on commercial lines.
- In contrast to the Demonstrators focused on unique experiences tied into specific IP, **the two Demonstrators that focused more on creating reusable assets and scalable processes have both attracted follow-on interest and investment.** Both the eSports and Moving Image Demonstrators have seen the main assets created through AotF be effectively acquired by larger companies, either through an existing relationship as the parent company to one of the consortia partners (Moving Image), or as part of an acquisition deal (eSports) in which WEAVR has become a key innovation asset that the overseas acquiring entity wants to build on.

The work that was contracted from the Digital Catapult that was originally intended to support the Demonstrators had to change significantly. The Demonstrators needed less technical and knowledge sharing support than was originally envisaged, and the pandemic made this support and plans for dissemination to the sector harder to provide. As a result, there was some confusion among the Demonstrators as to what the role of the Catapult was. Working with UKRI, Digital Catapult re-scoped their work and pivoted to focus more on the wider sector, with a greater emphasis on a series of publications focused on immersive content and experiences, as well as a new initiative: the 'Immersive Arcade', a first ever national collection of UK immersive content that showcased 20 years of British works incorporating VR, AR and XR. The showcase was well received by audiences and partners and the initiative and website created international interest that further helped to promote the UK's reputation as a leader in creative immersive content.

Progress towards achievement of high-level objectives

The table below summarises our key findings vis-à-vis the programme's three high-level objectives, based on the evidence presented above.

| AotF high-level objectives | Conclusion and summary evidence |
|--|--|
| <p>1. The UK will be a world leader for immersive creative content in terms of reputation, specialist skills and investment ecosystem</p> | <p>The programme has contributed to enhancing the UK's global position in Creative Immersive Content, by:</p> <ul style="list-style-type: none"> • supporting the development of specialist skills (mostly via the StoryFutures Academy, SFA), with the equivalent of 21% of the estimated skilled workforce in the Creative Immersive Content benefiting from courses developed by the programme (=2,680 students/12,617 skilled workforce in Creative Immersive Content) • supporting the development of new curricula that would continue to underpin skills development going forward (with 78 educational/skills programmes and courses developed or modified as a result of SFA activity) • funding a relatively high proportion of companies operating in the Creative Immersive Content sector in the UK (~9 out of 100 companies), a percentage of which (~40%) are already generating income from new product/services or customers develop under the programme • funding innovative projects and ideas that would not have gone ahead without the programme, some of which have now attracted further private investment (including notable examples such as VU.City and Tiny Rebel Games). <p>UK's reputation in the Creative immersive Content sector was already high at the outset of the programme, and there is no evidence to suggest this has changed. There was consensus among external stakeholders (investors and industry representatives) interviewed for this research that the UK is internationally recognised for its content creation, specifically its ability to take new technologies and develop attractive content.</p> |
| <p>2. The UK has an increased skilled workforce to create immersive content, will lead to the UK becoming the number 1 destination in Europe for investment in immersive content production</p> | <p>All the evidence above (for Objective 1) supports the achievement of this objective. Additionally, the sectoral analysis reveals that:</p> <ul style="list-style-type: none"> • there has been an increase in skill levels across the UK Creative Immersive Content sector workforce in comparison with the baseline (73% increase in number of 'tech skilled' people in the sector) • the UK continues to perform better than comparator European countries in terms of private investment in the Creative Immersive sector (e.g., over x6 higher investment than France), although this was also the case at baseline (when the UK was actually attracting x11 more investment than France). <p>These results cannot be fully attributed to the programme, but high penetration of the programme, to both workforce and companies, and better performance of AotF participant companies in comparison with the control group, suggest that programme's contribution is high.</p> |
| <p>3. Increased private investment in immersive technology, so that UK will double its share of global investment in immersive technologies.</p> | <p>Again, the evidence above (for Objectives 1 and 2) supports the achievement of this objective. Additionally, the sectoral analysis reveals that the amount of private investment the Creative Immersive sector has increased by 51% in comparison with the baseline (although the global share is unknown).</p> <ul style="list-style-type: none"> • For the reasons given above, we also conclude that programme has contributed to these results. • Note that despite the UK's strengths in content creation, stakeholders (investors and industry representatives) characterised the global market as very competitive, with challenges from the US, Japan, China, France, and Israel. |

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Appendix A Impact indicators: Final update

| Impact | Indicator | Activity strands | Data source | Figure on baseline | Figure at interim | Figure at final update |
|---|---|----------------------|--|-------------------------------------|--|--|
| Impact 1: Increased R&D capacity and capability | Number and % of firms reporting that participating in programme has led to an increase in internal capabilities | G&I | G&I programme survey - successful and unsuccessful | Baseline zero | | 90% (43/48) reported that the programme helped development of new skills among their staff and 92% (42/48) reported that the programme helped improve the internal capabilities within their organisation / research group |
| | Number/ % of firms reporting that participating in the programme has led to an increase in their R&D intensity | G&I | G&I programme survey - successful and unsuccessful | Successful: 14% Unsuccessful: 5% | | Successful: 22% Unsuccessful: 20% |
| | Evidence of change in absorptive capacity within organisations | G&I and Demonstrator | G&I case studies and Demonstrator interviews | Baseline zero | See Evaluation of ISCF Audience of the Future Interim Report, Table 11 and Table 12 for an overview of interim position (Demonstrators only) | See Immersive Interactive case study. Demonstrators: see Visitor Experience, Immersive Performance case studies. |
| | Evidence of organisational change including reduced rigidities and constraints to innovation (longer-term) | | G&I | G&I interviews/case studies | Baseline zero | |
| Demonstrators | | | Demonstrator interviews | Baseline zero | See Evaluation of ISCF Audience of the Future Interim Report, Table 11 and Table 12 | See Section 3.3.5 for overview of final position. See Section |

| | | | | | | |
|---|--|--|--|--|--|---|
| | | | | | for an overview of interim position | 3.3.7 for summary of Demonstrator case studies or Appendix B.1 for full length case studies of final position. |
| Impact 2: Increased income and productivity | Increase in turnover of supported businesses | G&I | G&I programme survey - successful and unsuccessful | Successful: mean=£334,545 median=£72,500 Unsuccessful: mean=£461,237 median=£50,000 | | Successful: mean=£551,818 median=£200,000 Unsuccessful: mean=£643,517 median=£70,000 |
| | | Demonstrators | Demonstrator quantitative instrument | (n= 18) Median = £4,072,110; Mean = £38,840,292 | | (n = 6*) Median = £7,200,000; Mean = £26,713,250 *Low response rates mean this data is not representative of Demonstrator cohort |
| | Increase in GVA of supported businesses | G&I | G&I programme survey - successful and unsuccessful | Successful: mean=£167,942 median=£36,395 Unsuccessful: mean=£231,541 median=£25,100 | | Successful: mean=£277,013 median=£100,400 Unsuccessful: mean=£323,045 median=£35,140 |
| | | Demonstrators | Demonstrator quantitative instrument | Total = £350,960,879 Median = £1,255,000, Mean = £17,548,044 | | No data |
| Change in number of FTE employees in supported businesses | G&I | G&I programme survey - successful and unsuccessful | Successful: mean=6.1 median=3.0 Unsuccessful: | | Successful: mean=10.3 median=3.0 | |

| | | | | | | |
|-----------------------------|---|---------------|--|---|---|--|
| | | | | mean=8.7 median=4.0 | | Unsuccessful: mean=8.2 median=2.0 |
| | | Demonstrators | Demonstrator quantitative instrument | (n= 18) Median = 66 Mean = 493 | | (n = 6*) Median = 35 Mean = 346 *Low response rates mean this data is not representative of Demonstrator cohort |
| | Calculated productivity (GVA per FTE) in supported businesses | G&I | Calculated | Successful: mean=£16,496 median=£12,550 Unsuccessful: mean=£20,499 median=£9,852 | | Successful: mean=£39,132 median=£37,650 Unsuccessful: mean=£26,431 median=£20,080 |
| | | Demonstrators | Demonstrator quantitative instrument | Total = £667,856, Median = 35,050, Mean = £33,393 | | No data |
| | Examples of productivity improvements | G&I | G&I interviews/case studies | Baseline zero | | See Framestore case study. |
| | | Demonstrators | Demonstrator interviews/case studies | Baseline zero | See Evaluation of ISCF Audience of the Future Interim Report, Table 11 and Table 12 for an overview of interim position | See Section 3.3.7 for summary of Demonstrator case studies or Appendix B.1 for full length case studies of final position. |
| Impact 3: Increased exports | Increase volume/value of exports | G&I | G&I programme survey - successful and unsuccessful | Successful: Mean=£144,727 median=£0 Unsuccessful: Mean=£21,286 median=£0 | | Successful: Mean=£303,750 median=£0 Unsuccessful: Mean=£75,759 median=£2,438 |

| | | Demonstrators | Demonstrator quantitative instrument | (n=5) Median = n/a Mean = £151,550 | | (n=2) Median = n/a Mean = £970,000 |
|--|--|---------------|--------------------------------------|---|---|--|
| Impact 4: Increased R&D investment in creative immersive technology (UK and abroad) | Change in private investment in immersive creative content | All | Sector Analysis (private investment) | UK: \$120,997,465 EU (minus UK): \$75,583,688 RoW: \$3,478,418,587 UK as proportion of EU (EU+UK): 62% | UK: \$ 99,783,741 EU (minus UK): \$168,655,034 RoW: \$3,367,792,920 UK as proportion of EU (EU+UK): 37% | UK: \$183,304,934 EU (minus UK): \$269,296,782 RoW: \$4,289,657,866 UK as proportion of EU (EU+UK): 37% |
| | Change in public investment in immersive creative content | All | Sector Analysis (public investment) | 29 projects and £5.6 funds (yearly average of June 2016-June 2019) | 30 projects and £5.6 funds | 41 projects and £5.5 funds (excluding one project supported by £35.4m) |
| | Perception of the investment environment for immersive content | All | Stakeholder consultation | Limited evidence from stakeholder consultations, however lack of scale of investment going into early-stage businesses was identified as a challenge | See Evaluation of ISCF Audience of the Future Interim Report, Section 3.3.3. 'Perception of the investment environment for immersive content'. | XX |
| Impact 5: Increased skilled workforce | Change in the job function and experience level in the UK | All | Sector Analysis | Experience level UK - 0-5 years 24%, 5-10 years 28% and 10+ years 49%; Top five roles in immersive (all sectors) Arts and Design (17 Business Development (15), Engineering (11%), Media and Communication (8%) and Information Technology (7%) | Experience level UK - 0-5 years 19%, 5-10 years 26% and 10+ years 55%; Top five roles in immersive (all sectors) Arts and Design (17%), Business Development (14%), Engineering (12%), Media and Communication (8%) and Information Technology (7%) | Experience level UK - 0-5 years 18%, 5-10 years 26% and 10+ years 56%; Top five roles in immersive (all sectors) Arts and Design (16%), Business Development (14%), Engineering (12%), Media and Communication (7%). |
| | Change in the UK proportion of workforce in the EU | All | Sector Analysis | EU total immersive 92,107 incl. 21,294 technical. UK total immersive 28,211, incl 7,281 technical). UK as proportion of EU 31% | EU total immersive 130,176 incl. 33,597 technical. UK total immersive 36,258, incl 10,716 technical). UK as proportion of EU | EU total immersive 157,909 incl. 39,769 technical. UK total immersive 43,158, incl 12,617 technical). UK as proportion of EU 27% |

| | | | | | | |
|--|--|-----|------------------------|---|--|--|
| | | | | total and 34% of technical | 28% total and 32% of technical | total and 31% of technical |
| Impact 6: Reputation of the UK creative immersive content industry is raised | Number of awards won by British firms | All | Wider market analysis | Between January 2017 and August 2019, 169 awards were made to creative immersive productions during this period by the events in the sample (32 awards and festivals analysed). Of these awards, 13 (7.7%) were produced or co-produced by companies based in the UK. For comparison, companies based in the US won 91 awards (54% of those available). | | In the approximately two and a half years between September 2019 and May 2022, 194 awards were made to creative immersive productions of which 18 (9.3%) were produced or co-produced by companies based in the UK. For comparison, companies based in the US won 73 awards (37.6% of those available) from September 2019 – May 2022, |
| | Stakeholder assessment of reputation of UK creative immersive content industry | All | Stakeholder interviews | From small number of interviews carried out to date there is some evidence that UK based stakeholders feel there is a potential for UK to be a leader in creative content (but not hardware development). The appearance is that creative content production is developing positively and there are some good firms emerging, although it is still too early to assess the extent to which this will continue to be the case. | See Evaluation of ISCF Audience of the Future Interim Report, Section 3.3.4 'Stakeholder assessment of the reputation of the UK creative immersive content industry' | See Wider Market Analysis: Stakeholder analysis of UK market position, Section 2.2.3 |
| Impact 8: UK's relative position for immersive | UK proportion of EU and North America investment in immersive creative content at beginning of AotF and post-programme | All | Sector Analysis | UK investment \$121m, EU \$75.6m | UK investment \$100m, EU \$169m | UK investment \$183m, EU \$269m |

| | | | | | | |
|---|---|----------------|-----------------------------|---|---|--|
| investment improves | | | | | | |
| Impact 9: Cross fertilisation across industries | Examples of creative immersive content/solutions developed as part of the programme applied to other industries | G&I programmes | G&I interviews/case studies | - | | See VU.CITY and Magic Beans case studies. |
| | | Demonstrators | Demonstrator interviews | - | See Evaluation of ISCF Audience of the Future Interim Report, Table 11 and Table 12 for an overview of interim position | See Section 3.3.7 for summary of Demonstrator case studies or Appendix B.1 for full length case studies of final position. |

Appendix B Case studies

B.1 Demonstrators

B.1.1 Case study - WEAVR: Immersive Cross-Reality Experiences in Esports

The main consortium partners we spoke to for this report are Dock10, York University and ESL (the lead partner). The project aimed to produce a platform called Weavr that leverages the data-rich environment of esports to transform the way esports and, further down the line, physical sports - are experienced by remote audiences.

By the end of the project, Weavr had reached large audiences across the globe with personalised, mixed-reality experiences that were broadcast from virtual facilities. The Demonstrator changed course during the pandemic, side lining planned in-venue experiences and bringing forward deliverables related to online experiences, something that all of the consortium members agreed had been a positive development

As part of Weavr's emphasis on remote and digital working, the consortium was able to develop a new cloud-based platform and more efficient production workflow. Consortium members were also able to develop a comprehensive understanding of the way users and audiences prefer to engage with narratives and storyline through the large-scale audience data collected as part of the deliverables.

Reflecting on the project set-up, the consortium felt that the audience KPIs were a real driver of innovation right from the project inception – and was something that makes Audience of the Future distinctive from other research grants.

'The research is really cutting edge - TRL 123 research - all the way up to a large-scale demonstration with, in the end, millions of people. It's the volume, it's the ambition [...] that was really, really brilliant for us.' UoY

Project outcomes

All consortium partners regard the project as a success and are positive about the impact it has had on their business / organisation. For ESL, the cloud-based technology has helped the company to overcome some of the recruitment challenges identified in the earlier stages of the project, as they were able to access a talent pool beyond those who could physically travel to the studio. The technology and workflow pioneered through Weavr is now by used by the University of York to teach students from the institution's new on-site television studio. The new studio is credited as '100% a result' of the Demonstrator project.

For Dock10, the broadcast partner within the consortium, the Demonstrator programme has accelerated a significant shift in their business model: at the point of application, the studio was not doing any virtual production. By 2021, virtual production made up 25% of the studio's revenues, with the company still being approached with new opportunities from the entertainment and media industries alongside eSports.

'If they had brought [opportunities like this] to us three years ago, I think we wouldn't have even looked at it. And now we're saying we could probably turn it around in six to eight weeks.' Dock10

While Dock10 feel that they were likely to have ended up moving into virtual production without the Audience of the Future programme, they acknowledge that it would have taken much longer to make this shift without Weavr. The project has also resulted in a growth in number the number of people at the company working on virtual production, including in-house and an expanded pool of freelancers.

For the University, the research undertaken through Weavr has had a significant influence on the research agenda of the academics involved, as well as the way the department approaches and invests in digital creativity. The virtual production techniques developed have through Audience of the Future have now become 'bread and butter' of their eSports work.

Weavr as a flagship project is now central to my research agenda and that of the wider group I'm embedded in and the department [...] It takes us into a broader immersive landscape that will become increasingly important. UoY

Collaboration between industry and academia:

The partnership between the academic (University of York) and industry partners has been a particularly successful element of the Demonstrator. Multiple projects and collaborations have arisen from Weavr, and the partnerships look set to continue well beyond the Audience of the Future programme.

'Being able to have an industry collaboration that has scope beyond a year or two – that's what has been facilitated by our participation in the Demonstrator. It completely changes the game'. UoY

ESL say they look at academia and KTNs in 'a whole different light' following their participation and acknowledged the 'bi-directional' and mutually beneficial ways industry and academic partners can work together: with industry bringing context and innovation to academic research, in turn applying that research back into the commercial space. This sentiment is echoed by Dock10, who report that the Demonstrator has 'opened their eyes' to the opportunities that exist within academia, some of which they are already pursuing with other institutions.

From an academic perspective, the University of York feel that Weavr has given them credentials and made it easier to make contacts and find new opportunities. For example, Dock10, are now contracting freelance researchers from the University of York on other projects.

Knowledge sharing:

The project has resulted in four peer-reviewed papers published by the University of York (with a further three currently under review). ESL have also engaged in disseminating the project results, most significantly as part of the IBC conference.

In addition to speaking at the conference, ESL/Weavr participated in another consortium for a location-based 5G cross-reality project as part of an IBC Media Innovation accelerator. The project was awarded the top prize at the conference and ESL/Weavr hope to demonstrate the results at the Commonwealth Games this year. They have also been invited back to participate in this year's accelerator.

Reflecting on opportunities to share the project with the wider industry, ESL would have liked to have been able to formally dedicate time and resource to marketing throughout the project,

noting that where they had put time and effort into this themselves it has had massive benefits in terms of generating opportunities to collaborate and driving conversations forward.

'We're just setting that agenda' ESL

Consortium partners reported significant interest from broadcasters, universities, advertisers and tech companies from around the world. For the University of York, the level of interest was such that two of the individuals working on the project established a spin-out consultancy to advise companies on how the learnings of Weavr can be applied within their own projects.

In addition to conferences and academic papers, the University have disseminated the outcomes of Weavr through a dedicated eSports research website and an industry-facing newsletter sharing the key learnings from the academic publications. Weavr has also directly informed the development of a new Masters' course in creative AI.

IP:

Consortium partners acknowledged a strong desire to jointly commercialise the project outputs. It was not clear how this might work at the beginning of the project, as the IP pool had not yet been generated, so towards the end of the project a process was developed. These negotiations were challenging at times, with one partner describing the process as time-consuming and laborious, noting that legal costs were not covered by the grant.

Next steps

Consortium lead ESL changed ownership over the course of the Demonstrator programme and merged with UK eSports business Face It. At the time of writing, the new owners, Savvy Gaming Group (SGG), are likely to make UK entity, ESL Face It Group, the main technology and innovation hub for the entire global conglomerate. ESL believe their experience on the Audience of the Future programme have made the UK the 'obvious choice' to become the Group's innovation arm.

"In Weavr, we were five years ahead of the time. A lot of the thinking that we had within Weavr is now becoming quite apt for the overall innovation direction that the Group is taking. So it's kind of like a 'told you so' moment."
ESL

After originally planning to go to market to seek investment for Weavr, ESL is now pitching the project internally rather than externally as new owners SGG are investing more in innovation than the previous owners (a media rights group). ESL are aiming to use the organisational restructure as an opportunity to incorporate the learnings and IP from Weavr into the overall structure and strategy of the business.

Following the Demonstrator project, Dock10 have secured a contract to deliver the PlayStation GranTurismo World Championships for Japanese games company Polyphony, bringing this work to the UK for the first time (beating an incumbent company based in Canada). Dock10 describe Weavr as being pivotal to the success of their tender. The work that they had produced through the Demonstrator, alongside their understanding of what the eSports community want in terms of narrative and storyline, played a major role in the pitch.

Consortium partners The University of York and Magnopus (formerly Rewind) are seeking to continue their collaboration and have recently submitted a Prosperity Partnership application to support this.

Beyond eSports, the consortium sees a cross-sector relevance to the technologies they developed, particularly across the wider broadcast and entertainment sector and within traditional sports broadcasting.

B.1.2 Case study – Immersive performances of the future

The consortium partners we spoke to for this report are Punchdrunk International, Marshmallow Laser Feast, De Montfort University's (DMU) Institute of Creative Technologies and the Royal Shakespeare Company (RSC) (the administrative lead).

The project aimed to investigate new ways to incorporate immersive technologies into location-based live performance. The initial project design was entirely location-based, which meant the consortium had to shift of focus towards virtual production environments when the pandemic struck.

A live component to the project was however retained, albeit with a completely digital delivery. In March 2021, the RSC live-streamed *Dream: 11* shows set in a virtual forest and using real-time motion capture of live actors performing digital avatars, that people could see on a bespoke platform on their desktop, mobile and tablet. There was also an element of interactivity enabled: audiences could become fireflies and interact with the performance.

Dream reached over 65,000 people, 40% of whom were 'Gen Y or Gen Z' (under 40s) and 76% of whom had not previously booked shows with the RSC. The performance was seen in 92 countries. The livestreams were highlighted by multiple stakeholders external to Audience of the Future as a high-quality, cutting-edge output of the programme – evidence of external validation for the project outputs.

The project was also a success from a technical perspective: the performances were streamed without any down time despite a complex technical infrastructure that was being iterated right up until the last minute.

Across all audience-facing project outputs, the Demonstrator reached 160,000 people. Alongside these, the consortium developed prototypes exploring how the assets of cultural organisations – such as orchestral pieces - could be performed and interacted with in the digital realm.

Despite the challenges of Covid, some consortium members felt that the constraints that were a result of the pandemic restrictions made the Demonstrator more innovative – and that the project benefitted from the need for a more structured, less open approach. For one of the partners, the opportunity to apply directly to UKRI for the remaining 30% of the grant – a Covid measure – also took away the risk and, the company say, allowed them to innovate with less internal scrutiny.

The revised project approach meant that partners undertook a large amount of audience research upfront. They felt this pivot really paid dividends when it came to creating audience-facing project outputs and overcoming the challenge of balancing the R&D aspects of the project with its audience KPIs.

“There are challenges around R&D going into an audience setting. I don't think people had really thought about how challenging it is. Because whatever you say, audiences don't care whether it's research, development, they care wherever it works and it's a success.”

Organisational change

Marshmallow Laser Feast said that the digital pivot pushed them to think differently about the potential of AR and creating digital-physical experiences using devices, as much of their prior work had focused on location-based experience. This new approach has ultimately changed the organisation's strategy and the projects they want to explore in the future.

In some ways, one partner reported that the pandemic restrictions had helped to demonstrate the significance of technology - and the work the consortium were undertaking to the creative sector, parts of which may have been previously slow to embrace or take up digital opportunities.

New immersive products

Through their participation in the Demonstrator, Punchdrunk International developed and trademarked a live action games engine platform which enables theatre makers to incorporate responsive mobile tech into immersive theatre pieces. The company have the intention to undertake further R&D to build out the prototype and are currently seeking grant funding which would enable them to develop this business model while protecting their IP.

Punchdrunk International believe that, with further investment, the prototype they developed has significant commercial potential - which could even have application outside of the creative industries.

Upskilling the creative workforce

Through the Demonstrator, consortium partners have significantly increased their understanding of the commercial viability of immersive performance projects – both in terms of the kind of budgets involved and what and how much audiences are willing to pay.

The consortium placed significant emphasis on sharing these and other learnings across the sector, including with small and micro-organisations. Moreover, several freelancers who worked on the Demonstrator have benefitted from the experience and profile they gained and some have gone on to start their own businesses. One of these freelancers, George Simons, set up the company Ruleo following his work on the Performance Demonstrator and has since been awarded funding through UKRI's Design Foundations 2 competition (a successor to the Audience of the Future Design Foundations strand).

"I think that the legacy of this project is that it has turbocharged a huge amount of people within the sector to create their own work and build, it's diversified the sector. And I think that's something we're all really, really proud of."

Knowledge Dissemination:

Consortium partners Marshmallow Laser Feast created a website called Findings of Future Live to share learnings (design schematics, creative process) from the project. Nesta, another consortium partner, also created a site to share interviews about innovation and investment and the impact on creative culture, making the case for UK PLC to continue to invest in R&D for creative immersive.

Alongside digital sharing, individuals who delivered the project have given tens of talks and presentations for industry and academia all over the world. For example, the RSC's Sarah Ellis recently presented the project at MIT and Harvard.

DMU have proposed a special edition journal focused on live performance in digital environments that will share, among other things, the learnings from the Demonstrator

(although this would not be published until 2024 – what the university refer to as the 'long tail' of the project').

DMU has recently rewritten its undergraduate programmes, which has been an opportunity for the Institute to feed in lessons from Audience of the Future, especially in terms of a multidisciplinary approach to programming and performance. The Institute are also rewriting Masters programmes to reflect the project learnings and have taken on a couple of PhD students to work in the creative immersive field. The Institute is also now offering sector-facing training in performance in digital environments.

Collaboration between industry and academia:

One of the consortium's academic partners noted that, while they had had connections with culture sector partners lasting years, they had not had the opportunity to bring any R&D projects to fruition until the Audience of the Future programme came along. The partner describes all three universities as being 'woven in' to the project with lots of examples of successful collaborations between academia and the cultural sector.

"It was great that the cultural partners were fully engaged in the research that we were doing as well."

Following the project end, the RSC have become the first performing arts organisation to have been awarded Independent Research Organisation (IRO) status by the Arts and Humanities Research Council (AHRC) – something they attribute to their participation in the Audience of the Future project.

Challenges:

The number of consortium partners in the Immersive Performance Demonstrator – and their different sizes, working pace, processes and priorities – posed challenges to achieving a coherent and shared ambition – something that was exacerbated by the pandemic and the fact that partners were unable to work together physically. One partner also described the significant amount of resource it took to keep the collaboration aligned and on track and others acknowledge their work packages were 'compartmentalised' and not integrated with the wider Demonstrator project.

Reflecting on the project, the RSC noted that the lack of diversity within the tech workforce risks replicating existing inequalities within the creative workforce in the immersive space, which in turn threatens the quality of the UK's creative immersive offer.

Next steps:

The success of the project and the 'unprecedented' press coverage have led to their experience on the Demonstrator becoming 'completely embedded' in RSC's organisational strategy. The company now has a new digital development structure which includes an R&D lab and Sarah Ellis, the project lead is now a member of the RSC's senior leadership. The company also report that there are projects in the pipeline for the RSC's core programme that will build on the learnings from the Demonstrator.

Following the Audience of the Future programme, DMU have funded an 'XR audio lab' which brings together people making audio-led immersive works. The Institute credits this to the Demonstrator project, as it created an opportunity for the University to see how such a lab works in practice and how highly the space to experiment is valued by the sector. The Institute has since been approached by more and more performance companies looking for support

with R&D and use of the Institute's resources and expertise. DMU has also been written into three different Arts Council England NPO applications.

Marshmallow Laser Feast have been able to have 'completely different' conversations with commercial investors and partner organisations as a result of their participation in the development of 'crystal clear' prototypes through the Demonstrator. One of the prototypes they produced as part of the Demonstrator project – which MLF showcased at Sundance and Digital Passport in New York – will be going into production later this year as a feature-length product, funded by a mix of commercial investment, non-commercial grants and internal R&D funding.

B.1.3 Case study – Visitor Experience: Dinosaurs and Robots

The consortium partners we spoke to for this report are the Natural History Museum (NHM), Science Museum, Almeida and Factory42 (the lead partner). The Visitor Experience Demonstrator consortium aimed to create a new genre of participatory MR experience to broaden audiences and seek new commercial opportunities ('immersive theatre meets highly interactive museum exhibit').

Initial plans to create location-based experiences (LBEs) to be run in the Natural History Museum and the Science Museum had to be shelved during the pandemic restrictions, and by the time the museums reopened it was not possible to find the time and space to host the experiences. Consequently, the consortium refocused additional resources towards the development of two augmented reality learning mobile apps for children using content from each museum that were developed and launched in 2020.

As restrictions eased, consortium members Factory42 and Almeida with Sky started to look once again at creating a location-based visitor experience that would explore the relationship between the digital and the physical. The resulting *Lost Origin* ran for six weeks in Autumn 2021 and combined theatre and mixed-reality technologies. Audiences joined a narrative journey in which they were part of a 'mission' to investigate illegally trafficked dinosaur bones which had ended up in the experience venue, a warehouse in Hoxton. The experience was able to repurpose digital assets that had been created pre-pandemic for the planned museum-based LBE.

Lost Origin received critical acclaim and has been identified by stakeholders external to AotF as a stand-out output. The experience was ambitious in scale and turned around in under twelve months – including some months that were subject to lockdowns. Both Factory42 and Almeida noted the extraordinary challenges – both technical and creative - of putting something together that was a high-quality, cutting-edge, audience-facing output in such a short timeline.

In total, the project outputs reached 60,000 audiences and users in total: 3,000 of which were on location and the remaining 57,000 of which were online and/or digital audiences.

Project outcomes:

Lost Origin:

For Almeida, the experience of creating *Lost Origin* highlighted the different challenges and considerations of creating an immersive theatre piece. These include challenges relating to batching (the process of sending audience groups through the experience to a particular time schedule), the need to make sure the technology was synchronized in such a way that the audience experienced narrative moments collectively; to finding creative ways of onboarding audiences to the Magic Leap glasses without disrupting the narrative journey.

“What I bring individually back to the Almeida is huge. My skills development is enormous. And certainly, if we do an immersive show at the Almeida, which I’m sure we will at some point, my knowledge of how to do that will support us enormously.”

In order to manage the challenges that arose trying to balance what was feasible (and practical) from a technological perspective with the need to make the experience creatively fulfilling for audiences, Factory42 established a set of core principles at the project inception that the team could return to when issues came up. This included the principle that the technology must always be in service to the storytelling. These foundational agreements helped the two organisations to push each other to get the most out of the collaboration while maintaining a strong working relationship – which they hope to maintain in case opportunities to work together in the future arise.

In terms of the commercial viability of the experience, the team found that the cost of hiring the warehouse venue for the LBE prohibited them from extending the run beyond two weeks. However, the Almeida feel that under different circumstances – and without the burden of venue costs, which were not originally factored in when the LBEs were due to take place in the museums – there is potential for a production like *Lost Origin* to operate with a similar model to a commercial theatre piece.

Although they were not directly involved in the creation of the LBE, *Lost Origin* was an opportunity for the Science Museum to undertake further research into the audience potential of immersive experiences linked to museum collections, both from an audience experience perspective and in terms of business models, price points and volume of engagement.

Museum apps:

To date, the Science Museum app has received around 16,000 downloads. The museum noted the lack of dedicated marketing budget was a significant barrier to reaching a wider audience with the app, as they could not do any paid promotion.

The organisation are currently deploying the learnings from their AotF app in the development of a new, outdoor AR app. The product is being developed by Niantic – developers of Pokemon Go – and aims to give users opportunities to encounter scientific phenomena in the outside world. Thanks to the Demonstrator project, the team have been much more confident about the kinds of questions they need to ask of the technology, the size of team they will need to have, and they have a much better understanding of what audience expectations will be.

Following their participation in AotF, NHM report that they have received an increasing number of approaches about immersive experiences, from large-scale productions to full VR. The organisation is continuing to explore the different ways they could build on their project experience and incorporate new technologies into their work. Following AotF, they hired an external consultant to look specifically at the different business models that exist for immersive experiences. NHM also undertook their own evaluation of the Demonstrator project, the learnings of which have been shared and embedded across the organisation.

Challenges:

Cultural organisations in the consortium described a tension between producing outputs that were technologically innovative and experimental and the need to maintain the standard and quality of the visitor experience – and in the case of the Science Museum, the scientific rigour - that their audiences expect. Ambitions to create something that was (or would be) commercially viable, also added to that perceived tension.

NHM also noted that there is a tension around the sustainability of providing certain kinds of immersive experiences for their visitors, especially those involving specialist hardware. This includes concerns about the financial sustainability of upfront investment in hardware that may quickly go out of date, alongside the need to balance the use of technology with the organisation's efforts to reduce its carbon footprint.

Collaboration:

Factory42 worked with three different departments of the University of Exeter over the course of the project – the first time the company has collaborated with an academic partner. This has been a valuable learning experience for Factory42, who say they have worked out how to derive mutual value from the partnership.

The company are now undertaking another R&D project with the University of Nottingham and the StoryFutures Creative Cluster. Research partnerships and funding had not been on Factory42's radar prior to the project, but they now describe this kind of collaboration as 'incredibly important' to the development of the company. In total, Factory42 collaborated with ten organisations (academic, cultural and commercial) for the first time through the Demonstrator project.

Next steps

Factory42 credit *Lost Origin* with allowing them to build the capacity of the team working on location-based experiences to be globally competitive, which has since provided the basis for a successful bid to DCMS for *Green Planet*, a 5G project. *Green Planet*, which premiered in Spring 2022, has since won two awards and been shortlisted for a further five industry awards.

"In terms of the depth of pipeline, the quality of customers, we are competing on a global scale now and that wasn't the case at the start of the project."

While the Almeida does not currently have an immersive project in the pipeline, the organisation believe they are likely to take part in similar projects in future. They also reported that digital has a significant role in the three-year business plan the organisation is currently putting together for the next Arts Council England NPO round.

B.1.4 Case study – Moving Image: *The Big Fix Up / Fix Up the City*

The consortium partners we spoke to for this report are Sugar Creative and the Project Manager (employed via Potato), representing two of the three partners in Fictioneers (the start-up company that owns and ran the project). We also spoke with Aardman Animations, who – while not officially part of the Demonstrator - provided the IP, worked on the narrative, and took a close interest in the project throughout.

The Demonstrator was initially designed to be an immersive, cross media adventure for the Wallace and Gromit characters that would play out across AR, print and YouTube and end with a ticketed LBE in Bristol, the home of Aardman. However, the pandemic meant that the project pivoted to delivering a narrative-based app experience during 2020 (*The Big Fix Up*), reaching a far larger territory than originally envisaged, and then returning to a location-based LBE (*Fix Up the City*) in 2021, which ran in three cities across the UK and the US.

The Big Fix Up app launched in January 2021. Initially, it was released only in the UK, Canada and the US, but later in the year the territory restraint was removed so it became available globally, except China (as the distribution platform required signing up to an ad model that Fictioneers did not want) and Singapore (where there are very specific data privacy laws that

would have required a lawyer to hire and navigate). The app has continued to run on the app stores for both Android and iOS since then.

Work on the LBE, *Fix Up the City*, began in January 2021 and Ficioneers launched it in the summer in Cardiff Bay and Bristol, before also delivering a cutdown demonstration version of the experience in San Francisco, timed to coincide with the major AWE XR conference in November and sited close to the Unity offices (which was used for as the main development platform for the project and Unity were an enthusiastic backer of the project). The LBEs closed in Bristol and San Francisco in December and in January 2022 in Cardiff.

While a high-profile brand and IP with national and international recognition was integral to the project, the overall goal of the Moving Image Demonstrator was to create an IP agnostic platform and back end for handling immersive projects. Ficioneers were successful in creating the first implemented of what they have named the MUST (Multi User Story Telling) platform.

The development of the project has been technically and creatively complex. It became clear early on in the project that the genre of narrative-based AR experiences did not really exist. In addition to the technical production challenges that this threw up, it also led to challenges at the distribution stage and in audience expectations.

That Ficioneers were largely successful in meeting these challenges, can be seen in the interest and praise that the experiences and the MUST platform have drawn from the industry, including a number of accolades and awards that the project has won. These include:

- BIMA's Top 10 for 2021
- Qld XR Festival Awards: Best in the World (Across All Categories)
- Bloo Loop Innovation Awards 2021 Winner: Digital
- Shortlisted in TIGA 2021 Game Industry Awards
- Creative Industries Council top 100 companies to watch
- The project was also shortlisted for the following:
- The Drum Awards for the Digital Industries
- Best in Location based entertainment (2021 Auggie Awards)
- Fast Company Innovation By Design Awards 2021

Project outcomes / learning

The Big Fix Up

“What we learnt was that there were no prior examples – real time narrative experiences in the digital environment [that are not games] – and this meant that even the app stores didn't know how to categorise us once we had a product. Was it a game? Was it entertainment? But it also meant that the stories also couldn't be tested and validated in the app in their standard way, because how do you do that over 22 days?”

After getting the app onto the app stores, Ficioneers learned a lot about their product through the experience of working with the functionality of the platforms and from users engaging with it, and were responsive in making changes to optimise it. This included:

- slicing the app into chunks in order to get around the maximum size limit of the app stores
- working out how to categorise the experience on the app stores, as games and entertainment are listed separately – the partners found that gamers wanted much quicker

gratification (which *The Big Fix Up* was not designed to produce) so it became obvious that it was 'entertainment'

- creating an introductory video at the beginning of the app as otherwise there was no way of describing and explaining what the experience was going to be like
- experimenting with the running time for the app experience – initially it was based on a real-time story that ran over 22 days, but this was varied afterwards to shorter run times (6-11 days).

However, one thing that could not be optimised was a key creative element of the experience. Using the app stores analytics, Fictioneers found that users liked the passages where they had agency, but where the experience delivered less was in terms of creating, *“a sense of jeopardy at the end of each day – there was no page turner, no sense of danger – that would have helped keep more people going through it.”*

The Big Fix Up reached c.68,000 users by the time of interview.

Fix Up the City

The biggest learning and outcome concerning the LBE, for both the partners in Fictioneers and Aardman, was the extent to which the experience needed to be more 'managed'. Firstly, the AR experience interacted with the real world and this sometimes led to problems. In particular, the launch in Bristol had to be delayed as one building that was used to anchor the experience in Bristol (using scanning technology) was unexpectedly covered in scaffolding for a film production, so there was a three-week delay until the shoot had completed. Secondly, people responded to the AR as if it was real (e.g., they reacted and moved backwards), so the team quickly realised how conscious they had to be regarding Health and Safety and traffic flow, etc. Thirdly, the partners also found that not having explained to other people in the same public space that there was an AR experience going on was an oversight, as some non-users clearly felt uncomfortable – this could have been easily sorted with signage but putting this up in a public space was not easy (even though both Bristol and Cardiff Councils were backers of the LBE). Reflecting on all of this, Aardman concluded that, *“essentially it becomes something that's driven as much as a managed experience, rather than a self-directed experience... you need to build that more managed experience, otherwise things can go wrong.”*

Partners also found that just the physicality of users holding their phones up for a long time was tiring, so shorter bursts of this would have been better.

In terms of the development of the MUST platform, at the Interim Evaluation stage, Fictioneers were actively looking for external investment in order to further develop and commercialise this asset. Fictioneers have subsequently been successful in attracting further investment, but not from an external source. Rather, the parent company of the larger consortium partner, WPP, the marketing communications multinational, has invested in MUST and as a result, the shareholding and rights shares within Fictioneers changed as a result (see 'Collaboration' and 'Next steps' below).

The only version of the experience that Fictioneers failed to implement was an idea that arose during the production process about the possibility for developing bespoke 'B2B' versions of the app for corporate clients. In particular, the consortium had serious negotiations with a cruise liner operator, but ultimately the negotiations came to nothing, due to a combination of some slight budgetary restraints and the lack of a working demo of the app at the time.

Overall, all partners in Fictioneers felt that the experience of the Demonstrator had been very positive for them as organisations. They experienced what they described as *“a huge degree of creative freedom”*, because of the AotF grant not requiring them to show a commercial return, and this was cited as a major positive factor in the success of the Demonstrator. The Covid pandemic had a serendipitous impact on the project too as it made the consortium,

“move away from a city-based experience and into the digital ‘at home’ realm – and then return to the LBE – this meant that we learnt a lot more.”

Aardman were also very positive about the experience and cited their participation as a major contributing factor in setting up, for the first time, a dedicated internal R&D policy and budget. Crucially, the project succeeded in overcoming some internal doubts in the company about the balance of risks of innovating in a new environment and format with much loved characters and IP:

*“There was an internal challenge all the way through. It took us a while to do this – it’s the first time we’ve done CGI for Wallace & Gromit and the first time putting them in the real world... We did also reach a point where we did have to make a couple of creative compromises – at some point we just had to go live with this product – and that was very challenging because this is Wallace & Gromit which usually has **no** compromises... We knew that there were a lot of risks for this IP in what we were doing – it may never have come to market, it might have been a dud... [But] we are more willing to understand now that it’s not the end of the world if things don’t quite work out... we have more of an open mind. It wasn’t massively commercially successful, but we took our most treasured IP and broke our own rules (“Wallace & Gromit must only be seen in their world”). But we found that our fans didn’t care; they loved it! It was just opening minds. It’s not necessarily about skills but more of a cultural shift, and a project like this just helped people to see that that the future is not so scary that you don’t go near it.”*

Challenges

Aside from some friction in the consortium (see Collaboration below), the biggest challenge encountered over the final period of the project lay in trialling ways to commercialise the experiences. The apps were free to download but there were opportunities to make in-app purchases, though these were small in number. Increasing these sales would have required a much larger installed app user base, but in practice this was not possible to achieve without significant marketing spend (which was not allowed within the terms of the AotF grant). In lieu of this, Fictioneers had hoped that the partners’ own promotion, as well as Aardman’s and that of technical partners such as Unity, together with the use of free websites would help drive sales, but this did not materialise:

“the social media didn’t really grow over the two years. The base that we tried to grow from just wasn’t that big. And it was a difficult subject to get over – people expected, and wanted it to be, a film. So there was a bit of education. The partnerships were supposed to help us with this, but this didn’t quite reach the numbers we needed, so the only thing we could resort to was traditional marketing – but we knew from the start that there was no marketing budget.”

Partners feel that this is a familiar story of the continuing state of the marketplace – particularly for innovative and relatively complicated AR experiences.

“At present, most of the LBEs on the market are taster, gimmicky experiences. There are very few narrative-driven experiences – they are instead short burst

experiences, rather than a narrative... The monetisation path still remains challenging – what are the commercial models? There is still a propensity for free to download, and so if you avoid the ad model, it's hard to work out how to monetise content. Equally, the ad model is difficult, because of data rules and consent, which are tougher for children."

Lastly, the nature and status of the technology was also mentioned as a continuing issue in slowly the expansion of the market. While the new smartphones do have significant AR capabilities, battery life is still a major issue to be addressed as AR experiences draw on a lot of power, and there were still, "a lot of disappointed users with old phones". More fundamentally, Aardman believe that the nature of the mobile phone handsets as the main experience device remains a constraining factor:

"The biggest drawback is where we are with devices. That will make the biggest difference. It would be such a better experience if you weren't trying to view it on your phone; it's just a massive barrier to get people to engage."

Collaboration

In general, and as documented in the two previous evaluation reports, the collaboration between the core partners in Fictioneers went very well. This also extended to Aardman's involvement:

"We were not just a licensed partner, but were involved in the development of the story and the assets. And there was a good bunch of people; the location really mattered in that we were only 40 miles from each other. And there was definitely a lot of respect on all sides. The project felt like a consortium of four."

Moving further afield, Fictioneers also developed a useful collaboration with the StoryFutures Cluster. This started with some of their Masters students interning on the project and then progressed onto employing some of the students to do testing, validation and customer service.

The one element of friction reported by partners arose in relation to the perceived necessity from UKRI for the Demonstrator to hit the audience KPI of 100,000 users. Firstly, consortium members reported mixed messages from UKRI about this – sometimes Fictioneers were led to understand that they were not to overly worry about it ("don't let it put you off"), while at other times the message was that the KPI remained in place and important. Secondly, there was then a difference of opinion across the consortium members in terms of how to respond to UKRI requests and try and drive more users. Specifically, the much larger consortium partner was prepared to invest their own capital in marketing spend, whereas the other two, much smaller, partners were unable to do so.

The different trajectories of the consortium partners that played out in relation to this issue have also played a part in a restructuring of Fictioneers. Specifically, Potato's parent company, WPP, had the desire and resources to invest in developing the MUST platform. In return, this has led to Fictioneers becoming wholly owned by Potato, with the other two companies no longer involved.

Next steps

As the restructuring of Fictioneers implies, Potato will invest in developing the MUST platform from now on:

“the bit we're focusing on from the MUST platform perspective will be about developing narrative journeys – yes in B2C, but also B2B and training; that's where the platform is going.”

For Sugar, the experience of AotF has grown their capacity and skills in AR and they have re-shaped their business to become more focused and specialised in this area; currently targeting entertainment brands that are looking for new ways to engage their customers, particularly those in TV, film and games. Tiny Rebel Games have returned to making games. Aardman want to continue to explore the further exploitation of the AR experiences but, at the time of interview, needed to talk separately to some of the consortium partners (“the hardest part to exploiting it is that the consortium partners have all gone their own way”). They also reported that they are also developing a healthcare project that they intend will embody similar innovations to the AotF project: *“it's not just an onscreen experience... we see this as being one of the sectors where VR and AR are going to disruptive tech.”*

B.2 Grants and Investments

4.1.1 Immersive, highly-detailed model for urban planning visualisation, VU.CITY

In short

The project: A VR representation of the City of London, including prediction modelling capabilities in order to visualise changes, to be made available both to the public and to paying commercial users.

Funding received: £440,739 (70% of total project costs)

Strand: PIIC

Partner organisations: City of London, GIA, MSA, Pipers

Progress: Feasibility [TRL 1-2] to Proof of concept [TRL 3-4]

VU.CITY

VU.CITY Projects is a start-up born from the experience of Wagstaff Design, an agency specialised in VR/AR technology for the built environment. Following the creation of the start-up, the company has enlarged its initial team from 12 to 58 people and is developing VU.CITY, the company's core product.

The main challenge addressed by the project

While the technology exists to create highly accurate, three-dimensional models of cities in virtual reality (VR), the amount of information processing involved to develop data and photo realistic images into a user-friendly 3D rendering is huge, and beyond the scope of most companies who would like to use it.

This means that most 3D VR models of cities are much more basic visualisations, that don't have the capabilities for realistic details such as street furniture and doorways, or visual

representations of what will happen with future developments, such as accurate representation of changes in traffic or pedestrian numbers.

To overcome this, VU.CITY's AotF project aimed to create an accessible, immersive VR representation of the City of London to inform planning and development issues within the City.

Process

After successes in the development of the initial product and over a quarter of the project complete, the pandemic arrived causing the team to change course. This is primarily due the way users access the VR, which was initially designed to run in a single location with a headset. The shift to homeworking challenged this model, as most people don't have the necessary headsets or computer capacity/equipment in their homes. The product also needed to be able to run on a cloud base as opposed to a local network, adding an additional layer of technical complexity for VU.CITY to overcome.

As a result, VU.CITY are now working to develop their product for desktop / screen environment rather than VR-ready environment. Despite these challenges, the team has achieved a significant amount (around 80%) of what they originally set out to build. While they haven't solved everything, the team report having unlocked and defined the challenges and complexities they face and have a much better understanding of what is needed to make the project viable at scale.

Results

The work produced through AotF has helped the team to attract investment that is supporting the development of their core product. While the product that has been developed through the project was not a VR-ready environment as originally planned, it has still been a hugely valuable tool for VU.CITY to engage partners, investors and potential in the concept of using highly-detailed 3D models to be able to look at and demonstrate changes to the built environment.

VU.CITY secured another round of investor funding in January 2020 which will help with some of the further R&D the company are looking to undertake. They are also currently in discussions with a number of real estate businesses regarding the use of this technology on major projects.

While the product was initially developed predominantly for real estate and planning, though the project the team have started to realise that the models they are developing can also address challenges in other verticals, such as security and telecommunications infrastructure. For example, since their AotF project finished, the Metropolitan Police are using the highly detailed models developed by VU.CITY as a test case for different uses.

Next steps

In the next few months, VU.CITY are planning a final round of investment that will target overseas investment. As with previous rounds, the team will use the product developed through AotF in discussions with potential investors.

In the long term, VU.CITY would like to expand the software, both to a wider area within London and to other cities/urban areas experiencing fast-paced urban-development, where levels of accurate visual scrutiny are needed.

4.1.2 FIRA Toolset: Fast Immersive Rigging and Animation, Framestore

In short

The project: Framestore in collaboration with Weightshift used the AotF funding to develop new tools for creating character animation in real-time environments with an improved efficiency and quality.

Funding received: £370,662 (50% of total project cost)

Strand: PIIC

Partner organisation: Weightshift

Progress: Proof of concept [TRL 3-4] to Commercialisation [TRL 9]

Framestore and Weightshift

Framestore is a world-leading VFX and CGI studio predominantly active in the film sector. The company is also involved in creative immersive projects, including location and headset-based experiences. Framestore has rapidly grown in the past years, and now employs a workforce of c.5,000 across its offices in the UK, US, Canada and India.

The partners for this project are Weightshift – a micro-enterprise employing two people offering technical support for animators with physics simulation expertise.

The main challenge addressed by the project

The project intended to tackle two barriers holding back growth in immersive animated content: the quality of character, creature and performance animation and the time it takes to create new work. Framestore needed funding to develop toolsets that would support their animators in their creative process reducing the time and effort necessary to produce their outputs while maintaining outstanding quality.

In addition, the team wanted to start a collaboration with the external micro-enterprise Weightshift and build on the untapped potential of a physics simulation system developed by them.

Process

Framestore used the AotF funding for two parallel projects. First, they developed a toolset using machine learning to accelerate character rig – that is the essential structure that forms characters in an animation (e.g., limbs movements or facial expressions). One of the main challenges for animators is having rigs within the animation scenes that operate fast enough for them to have interactive playback. The team created a much lighter and less computationally intensive version of these rigs that are visually more similar to the final product. This would help animators in producing engaging content faster.

Second, they worked with Weightshift, to transform their promising software into an artist-friendly tool that could be integrated into Framestore's pipeline. This would allow animators to work on high-quality outputs that accurately represent physical movements and characters interactions with their environments.

Results

The two companies agreed on the remarkable success of the intervention. Thanks to FIRA, the character rigging process runs between two and 500 times faster than before. The process is now semi-automated, and something that used to take weeks or months now only requires one or two days. The WeightShift user interface has been vastly improved as part of FIRA, therefore, removing the barrier to entry for animators, to the point that multiple projects and

departments within Framestore are picking it up and using it. Both systems have already been applied on multiple shows, including HBO's series His Dark Materials, and the assets have been proved crucial in business development and winning of new work. It is expected that FIRA will be soon used in the production of immersive experiences.

Equally, the project has been successful for WeightShift too. Thanks to the participation in the project, their product matured considerably over the year and a half of the project. The company was recently acquired by Epic Games. Framestore believes that the FIRA project and the use of WeightShift on Framestore's shows played a crucial role in the acquisition. Framestore and the team behind WeightShift now still collaborate on several projects, while under the Epic Games umbrella.

It was acknowledged that in the absence of the funding provided by the Audience of the Future programme, the company would have not proceeded with the project. Framestore reported that their AotF project represented one of their first R&D project supported via public funding.

Next steps

FIRA is still being used by the animator teams at Framestore.

After this successful project, the partnership made a successful funding application InnovateUK to develop a next-generation computer-generated crowd solution, although the project did not go ahead as Framestore were unable to find another partner in time following WeightShift's acquisition by Epic Games. Framestore are, however, currently undertaking an Agile Virtual Production project with InnovateUK at the moment, which they do not think would have come about without FIRA.

4.1.3 Emotion sensing for improved content creation and personalised immersive experiences, Emteq

In short

The project: Emteq used its AotF funding to specify the design of a software program that interprets and displays complex data captured with biosensors during emotion response detection in virtual or augmented reality.

Funding received: £31,098 (74% of the total project cost)

Strand: Design Foundations

Partner organisation: Bournemouth University

Progress: Feasibility [TRL 1-2] to Demonstration in real environment [TRL 7-8].

Emteq

Emteq is a technology spin-out company founded at the University of Sussex. At the end of their AotF project (2019-2020), the SME employed 6 permanent FTE staff, and 6 FTEs working on a freelance basis. This compares to 10 and 25 FTEs employed at baseline and before the beginning of the project.

The main challenge addressed by the project

Immersive productions require large investments to create powerful experiences. Content owners, media companies, brands, and creatives are today reticent to invest without a way to de-risk their efforts, measure usability results objectively and justify the higher production costs.

Emteq have been working for years in the development of a product to enable better insights into the emotional state of users in immersive experiences. The system consists of an emotion response tracker which registers and analyses facial expressions and emotional responses. The product can help animators to understand user preferences and could assist in the development of more user-friendly, personalised interactions, and therefore higher quality productions.

Emteq needed funding to research the potential market and quantify the commercial outcomes for this product, which is hoped will constitute the core offer of the company.

Process

Emteq used the AotF funding to test their system with almost 800 participants supporting the technical development of the product's design, as well as running interviews with key opinion leaders to assess the market appetite for such product. Emteq worked in collaboration with the University of Bournemouth to further design the technical aspects of this product. The Covid19 pandemic heavily impacted the project, as it prevented the team to run tests with users in a real-time setting. After pausing the project for some months, the team went back to their plans and completed the feasibility project.

Results

Emteq is now confident that a market for this product exists, based on the encouraging feedback received through face-to-face interviews with key opinion leaders and organisations active in immersive content development. The process also allowed them to identify their customer personas more clearly, and the pricing models they could apply, as well as allowing them to patent their technology. Furthermore, Emteq reported that the project has generated a pipeline of potential customers, some of which were keen to engage immediately in testing the technology.

The system has now been applied in various settings, including areas beyond the Creative Industries. For example, they recently collaborated with the British Red Cross, which are using this system to evaluate whether VR acts as a better medium to engage potential donors and increase empathy.

It was acknowledged that in the absence of the funding provided by the Audience of the Future programme, the company would have proceeded with similar plans, but with a longer timeframe allowed for progression. Emteq reported that their AotF project represented one of the first opportunities that gave them a chance to develop their offer from both a commercial and technical point of view.

Next steps

After testing the product's feasibility and market readiness, the team has secured further funding from a private investor to develop this technology further. In fact, Emteq has since moved from its relatively heavy VR system to a much lighter and less expensive untethered device, that does not require the computer and allows much more flexibility.

4.1.4 Volumetric Audio for AR (VASAR), Magic Beans Physical Audio

In short

The project: The Volumetric Audio for AR (VASAR) project aims to empower sound engineers to be able to produce '6-degrees of freedom' (6DOF) audio content more easily and quickly by providing them with new tools for audio capture and reproduction

Funding received: £326,299 (73% of the total project cost)

Strand: PIIC

Progress: Proof of concept [TRL 3-4] to Demonstration in real environment [TRL 7-8]

Magic Beans

Magic Beans is a tech company developing cutting edge immersive audio experiences and related technologies. The business works with a broad range of clients, from brand marketers to orchestras and musicians to produce and research on next generation immersive audio. Even though the company was formally founded in 2018, the two founders have been working in the film and music industry for about a decade. Magic Beans collaborates with a number of freelancers on a project-by-project basis.

The main challenge addressed by the project

The Volumetric Audio for AR (VASAR) project empowers sound engineers to be able to produce '6-degrees of freedom' (6DOF) audio content more easily and quickly by providing them with new tools for audio capture and reproduction.

Magic Beans noted that the significant amount of equipment, specialist hardware and set-up has been a limiting factor in spatial audio. They sought to address this through their AotF project with the innovation of a mechanism that delivers immersive audio experiences using standard consumer hardware and internet protocols.

Process

As the project developed, Magic Beans' understanding of the project they were trying to address changed. They felt there was more need and potential for technology that creates and delivers an immersive experience out of a recording – including normal, off-the-shelf recordings. This represented a shift away from their initial focus on large-scale audio capture, such as an orchestra.

Magic Beans had already begun to see the audio capture market as too small and niche and the arrival of Covid-19 accelerated their shift in focus as restrictions made large-scale capture difficult. Their project moved to develop a way to take any legacy material or modern material and convert it and deliver it to audiences.

Magic Beans had two partners on the project: Warner Brothers and Huddersfield University. They encountered some challenges working with the university that arose from fundamental difference in organisation purpose: Magic Beans felt unable to share some of the commercially sensitive innovations in their development with an academic institution, whose mission is to share and disseminate information, without it having a detrimental impact on their business. This stalled progress made through their collaboration.

They have since started a partnership with the Digital Signal Processing department at King's College London to explore possible utilisations of their product, including a recent project with Audible. Magic Beans feel this collaboration has been helped by the fact that the Department at King's have technology and expertise that complements their own.

Reflecting on their partnership with Warner Brothers, Magic Beans are grateful for the opportunity to understand how a company of that size operates, although didn't feel like the partnership was a good fit in the long-term. From a business perspective, at their current size the company felt that it is better to focus on where their market niche lies than try and work in a space being contested by larger companies such as Apple and Adobe and didn't feel like that mainstream licensed music – Warner's primary market- was the right focus for them.

Results

Magic Beans are already using the technology developed through the project in commercial products and are in conversations about further commercial opportunities. One of their ongoing projects is with Highways England: Magic Beans have created an immersive audio simulation of a motorway. While this is not an area the company had foreseen themselves as working in, the project has been so successful that they have been invited to produce another product for Highways England which simulates a large construction programme. They are also using parts of the technology with some of their other clients in the games industry.

They have also showcased their product at the IBC (International Broadcasting Convention) in December 2021, which is the major broadcast innovation show, as part of a group looking at immersive audio. Magic Beans had produced content for both Audible and the BBC and although this was a non-commercial piece of work, it enabled them to show their work publicly and helped them to engage in conversations with other companies at the IBC, some of which are ongoing.

Overall, the programme has had a profound impact on the company, who reported that their whole product line-up is now based on the technology they developed through AotF. Magic Beans say the funding helped

Next steps

Most of Magic Beans' current focus is on the commercialisation of their large-scale distribution system. The company are having conversations with a big brand about a potential mini campaign later in the year and they will be attending SXSW festival in Texas where they intend to promote their product as widely as possible.

They also plan to seek investment to support further R&D, which they are currently supporting through their commercial revenue.

4.1.5 Efficient workflow for real-time simulation of virtual garments, Numerion Software

In short

The project: To enable artists to efficiently deliver and deploy real-time simulation of virtual garments at a quality level suitable for fashion garment design, and promotion on the catwalk and on the web.

Funding received: £200,792 (70% of the total project cost)

Strand: PIIC

Partner organisation: On application there were three partners (Numerion Software, Change of Paradigm Ltd., Fydor Golan Limited), however two partners withdrew so the project was subsequently run uniquely by Numerion

Progress: Feasibility [TRL 1-2] to Demonstration for initial validation [TRL 5-6].

Numerion Software

Numerion Software is a software engineering business working on simulation software. They use mathematics to visually simulate objects and materials, such as fabrics and clothing, solids, liquids or squeezable objects.

The main challenge addressed by the project

Numerion set out to build a prototype workflow that enables artists to efficiently deliver real-time simulation of virtual garments at a quality level suitable for fashion garment design, and promotion on the virtual catwalk and on the web.

From a company perspective, their goal was to expand into the fashion industry – a new market which has been less influenced by digital technology than Numerion's existing client base in the film industry. Unlike the screen sector, the company felt that the fashion industry at times need encouragement to 'free up' money to invest in technological change that could have a positive impact on production and marketing processes.

Process

Reflecting on their AotF project, Numerion felt that they had delivered what they set out to do, albeit with some changes in the technologies they were using. The arrival of Covid-19 meant the project focus needed to move away from creating an initial public demonstration and towards the development of a product that would bring in revenue sooner, to make up for lost commercial revenue elsewhere that was a consequence of the pandemic.

As the project evolved, Numerion chose to focus on matching the workflow with a SAAS (Software as a service) delivery platform – which means their product can be accessed remotely with an internet connection. This was a new approach as their products had traditionally run on desktop. They consider this a positive change as SAAS allows customers to engage and deploy content much faster. Furthermore, Covid 19 has had a positive effect on the demand for web-based garment simulation experiences. It did however come with some technical challenges, such as dealing with live, real-time rendering, which is technologically challenging and not something the company held prior expertise in.

Numerion originally applied for the AotF programme as part of a three-partner consortium, however for different reasons the partners could not continue meaning Numerion was the sole business delivering the project.

Results

By the end of the project, Numerion had secured a customer who wanted to take the product forward. However, this was disrupted when the customer's primary market – the suit market – suffered a significant decline in demand after the pandemic struck and people began working from home.

Despite this, Numerion have demonstrated their workflow to a number of fashion companies and report that the initial feedback from both fashion and movie industry experts that have had access to an early preview has been very positive.

The wider impact of the programme for the business has been the opportunity to explore a new service-based 'pay-as-you-go' business model rather than upfront sale of their product, thanks to the technology that was developed. Numerion believe this is a good strategic move for the business as they see SAAS platforms as being 'the future' of tech services. They have also incorporated some of the technology developed, such as the garment sticking model, into other products, strengthening their existing commercial offer.

Next steps

Numerion are focused on getting a customer on board to act as a real use case and to take the business to the next stage and are currently in negotiations. As part of these discussions, Numerion are looking at producing some technical demonstrations which they hope will help a potential customer to raise the money needed to take the product on. In the long term, Numerion plan to continue working in the immersive vertical, which they say is 'exactly where they want to go'.

4.1.6 AI-driven narrative characters and immersive environments, Maze Theory

In short

The project: A new technology pipeline to create immersive artificially intelligent non-player agents in VR through machine learning

Funding received: £329,953 (70% of the total project cost)

Strand: PIIC

Partner organisations: Dream Reality Interactive, Goldsmiths University of London

Progress:

Proof of concept [TRL 3-4] to Commercialisation [TRL 9]

Maze Theory

Maze Theory is a tech company designing immersive experiences. Mixing skills from traditional console gaming and theatre, the team produces immersive storytelling a narrative-driven approach. Recent projects include productions of VR games using IP from TV series such as Peaky Blinders and Doctor Who.

The main challenge addressed by the project

Current generation VR experiences between human users and non-player characters within a virtual environment are limited to pre-determined scripted linear events. Maze Theory is working to develop a production system which will allow the creation of experiences within VR where the non-player characters that users encounter respond to a player's body and voice input socially and naturally, rather than just cycling through a set of pre-defined scripts.

The project objective was to produce a technical pipeline which will enable designers to easily script AI driven characters, and test the final outputs from a user perspective.

Process

Maze Theory completed a functioning prototype after the first eight months of their project, although they have not yet been able to deliver on all of the research they carried out. Some of the challenges have been creative, including the need to find the balance between performance of the characters in the game and the AI technology. As the team got further into development and started to implement the characters into the game alongside other components, Maze Theory were able to get a better understanding of what was needed commercially to make the characters entertaining. As it stands, Maze Theory are not yet at the point where those two systems are working simultaneously.

The other main barrier to completing this work has been time. The company are still in the process of working on and releasing the Peaky Blinders VR project which their research and

development into character interaction was working towards. The technology Maze Theory have developed is being used in different ways: some parts are being used as an enhancement to character performances, whereas other characters have more fully AI-orientated mechanics. These more complex AI elements are what the company plan to build on going forward.

Maze Theory worked on this project with two partners: the AR/VR studio Dream Reality Interactive and Goldsmiths University of London. It was the first time that they had collaborated with academia and Maze Theory credit the programme with giving them the opportunity to work with academic partners that, as a small developer, they otherwise couldn't afford. The partnership is ongoing and the company has hired two interns from Goldsmiths over this time – with one joining the team full time.

Results

From a company perspective, Maze Theory have developed a new creative strategy and vision as a result of the programme. They say it given them the ambition to drive character interaction in VR forward to become the studio's defining feature and believe that having this project in their portfolio will help them to stand out commercially. Maze Theory believe the project will be a foundation to move onto new titles.

The programme has also helped the company to formalise the way they evaluate the success or failures of innovations. These are processes developed during their AotF R&D which Maze Theory have carried through into their continual development.

They have already licensed new IP based on the characters and work created through the Peaky Blinders project. In terms of ways of working, they have also been able to initialise pipelines and processes around characters which did not exist before the project.

Next steps

The project has enabled Maze Theory to undertake user testing and usability testing, which they will do throughout the summer until the product is released. The company expects the programme to significantly increase their exports, as the largest part of the market for their product is in the US.

In the near future, Maze Theory are looking to move into more connected online connected experiences, where they believe the technology, and VR and AI driven characters, are going to become increasingly important.

4.1.7 Immersive broadcast content experience for inclusive audiences, Open Inclusion

In short

The project: Open Inclusion used the AotF funding to establish and share a knowledge base around immersive technologies and inclusion, positioning themselves a though leaders both in the UK and globally.

Funding received: £25,633 (70% of the total project cost)

Strand: Design Foundations

Partner organisation: Brunel University

Progress: Feasibility [TRL 1-2] to Demonstration for initial validation [TRL 5-6].

Open Inclusion

Open Inclusion is an inclusive research and solutions consultancy. They provide services in market research, user insight, innovation and service design. At the end of their AotF project (2019-2020), the SME employed 5.5 permanent FTE staff, and 6.5 FTEs working on a freelance basis. This compares to 5.7 FTE + 6.3 freelance at baseline and 2 FTE + 6 freelance at the time of application. The company have grown again since the end of their project and currently employ 7 FTE and 14 freelancers.

The main challenge addressed by the project

The project identified a lack of understanding in the way people, especially with diverse accessibility requirements, interact with emerging technologies and what inclusion challenges exist for immersive hardware.

Open Inclusion wanted to investigate the potential for publicly broadcast content to be more inclusive and better appreciated by audiences with specific access needs, including sensory, physical and cognitive impairments/disabilities and advanced age, through the use of immersive technologies.

From a company perspective, they were looking for a springboard which would give them the time, opportunity and 'permission' to move into the immersive tech space

Process

In collaboration with Brunel University and Channel 4, Open Inclusion used the AotF funding to establish a research base around the key hardware challenges for immersive and inclusion.

The relationships with both partners were good throughout the project. There were some initial challenges reconciling the differences in pace of work between Open Inclusion and their academic partner, who tended to work more slowly, although in the long run Open Inclusion felt this process had improved the quality of research. The timing of the project coincided with Channel 4 moving office, which limited the amount of capacity they could dedicate to the partnership. Overall, Open Inclusion see both partnerships as valuable to their business and likely to lead to new opportunities.

Results

Open Inclusion now have a new market proposition in immersive inclusion which has enabled them to win work they wouldn't otherwise have been able to. This includes a significant 3-year project as partner with Brunel University and Cambridge University looking at the barriers and design challenges for people with disabilities engaging with immersive content. This directly builds on the existing work and partnership established through AotF.

In addition, Open Inclusion have been commissioned by the StoryFutures Academy to deliver an inclusive accelerator in partnership with XR Access (a research consortium at Cornell Tech, in collaboration with Yahoo) that will disseminate the research and knowledge base that was developed through the programme.

Open Inclusion's partnership with XR Access was developed through Managing Director Christine Hemphill, who presented at the 2021 XR Access symposium. Christine credits the Audience of the Future programme as helping her to position herself globally as innovator in disability inclusive tech. She has recently been named as an 'entrepreneur-in-residence' for multinational telecommunications company Verizon and is shaping their Disability Innovation programme.

Next steps

Open Inclusion have applied for another 3-year project in partnership with Cambridge and Brunel universities, which will seek to develop some tools to address the design challenges identified in their current research.

While they plan to share some of their research as an open-source knowledge base, available in the public domain, Open Inclusion are considering licensing some IP for an 'inclusive immersive toolkit' product they plan to develop and market.

4.1.8 Immersive Studio, Immersive Interactive

In short

The project: A user-friendly web application that will allow teachers to create tailored immersive content for multi-sensory learning experiences.

Funding received: £200,067 (70% of the total project cost)

Strand: Investment Accelerator

Progress: Feasibility [TRL 1-2] to Commercialisation [TRL 9]

Immersive Interactive

Immersive Interactive is a tech company enabling shared multi-sensory immersive experiences for groups of learners. The company's offer is built around a core product (and associated support services) targeting schools and education providers.

The system consists of a series of projectors, audio and sensory equipment which allow classrooms to become interactive spaces by projecting an immersive 360° scene overlaid with interactive elements. Since these spaces do not require the use of glasses or a headset, the system enables shared multi-sensory immersive experiences for groups of learners. The company mostly focuses on software and on the development of content. Immersive interactive's clients are primary schools, special needs schools, and providers for simulation-based medical education.

The main challenge addressed by the project

Immersive Interactive aimed to build capacity for the development of a user-friendly web application that allows clients to create tailored environmental immersive content for their students. The software is a professional standard tool with a UX interface developed through user testing, meaning it is useable by non-technical educators.

From a business perspective, the company were looking to shift internal resources away from business support and content development to software development and business expansion.

Process

Immersive Interactive have more or less done what they set out to achieve at the start of the project. The process of transferring over existing content to their new platform has, however, taken longer than anticipated and has delayed the release of the product. This is because as more content has been added, the team subsequently deemed that it was necessary to add some features to the software that was beyond the original specification.

It has also been much more difficult than anticipated to convert legacy templates from their existing software – something that the company say if they ran the project again, they would avoid doing.

Results

Immersive Interactive have radically developed their business model from hardware and service-based installation commissioning to focus on IP and SAAS (Software as a Service) that targets international markets through resellers.

The programme has allowed them to overhaul their approach to the technology – something which, without the grant, they would have had to have done much more gradually. Immersive Interactive also credit the programme with enabling them to update their software to align with market expectations.

They have been able to improve their productivity by implementing new project management systems and deploying new tools, developing their code base in a much more efficient way into packages and specific libraries. As a company, they have also been able to develop their skills using these technologies and through their work with expert agencies and developers.

Next steps

Immersive Interactive are now focused on finishing the product, marketing, development and user testing. The company have received very positive feedback from market research they have undertaken with potential customers and have confidence in the commercial viability of their end product.

In this section we present two case studies undertaken in 2020 as part of a previous stage in the evaluation reporting (standalone SFA report, July 2020). Case studies are based on interviews and review of application documentation for 2 successful applicants to SFA support activities (1 Kickstart Funding project, 1 Production Booster funding).

B.3 SFA Participant case studies

In this section we present two case studies undertaken in 2020 as part of a previous stage in the evaluation reporting (standalone SFA report, July 2020). Case studies are based on interviews and review of application documentation for 2 successful applicants to SFA support activities (1 Kickstart Funding project, 1 Production Booster funding).

4.1.9 Case study: Kickstart funding: Shola Amoo & Violence VR

The project

Shola is a London-based filmmaker working in film and TV. His debut feature was a multimedia Film called *A Moving Image*, which received The Special Recognition Award at The Blackstar Film Festival in Philadelphia and premiered at The BFI London Film Festival 2016. Shola's second feature was the drama *The Last Tree* which premiered at Sundance 2019. This received The Best Screenplay Award from The Writers Guild of Great Britain and won two British Independent Film Awards. Before his application to the SFA Kickstart funding, Shola did not have any previous experience in working in immersive productions. After trying 360 and VR works at festivals (including Tribeca, Sundance, Sheffield DocFest and Cannes) he was interested in exploring black representation in this medium, which, he noticed, the sector particularly lacked.

SFA awarded Shola with Kickstart funding to direct *Violence*. The VR immersive experience was realised in collaboration with the producer Nell Whitley from Marshmallow Laser Feast, as well as with the director and choreographer Lanre Malalou, composer Finn McNicholas and interactive studio All Seeing Eye. *Violence* premiered at Tribeca Film Festival and was part of the Cannes XR Virtual at the Marché du film de Cannes, which was held online and in virtual

reality in late June 2020. In the experience “the audience explore the cathartic nature of rebellion by oppressed groups against draconian political and social systems. Through the user’s interaction, the audience are asked to examine perception and bias, interrogating the social death and dehumanisation of the marginalised and societal complicity”²⁵.

- *“It was great to get some funding from StoryFutures Academy to try and do my own thing knowing of their support. And that was the genesis of the project. In essence is a recontextualization of the word violence, looking at it from oppressed groups and state oppression”.*

SFA also ran a research project on audience response to the work. Shola thinks this process will be important to understand racial bias in the audience experiencing his work.

Successes and challenges

In this process, SFA was recognised as “the incubator” which allowed Shola to be introduced to immersive storytelling and to the rest of the team he collaborated with.

- *“StoryFutures was really kind of the incubator for both [Shola and the producer Nell] of us to collaborate together with the money they gave us. [...] working with her to have my first immersive piece was really useful as she's obviously got more experience in that space”*

The project has also enabled Shola to get some professional experience with VR, including how to direct VR productions, how the technology (and especially Motion Capture) works, and the medium can enhance audience experience. Looking back, Shola reported that the experience helped him to understand the potential of the technology and of immersive storytelling. He reported how he will try to translate some of his learning in this process in future work, especially when it comes to making films that aim to deeply engage the audience and make them feel part of the story.

However, Shola also articulates that VR is still in early development. He hopes the that the medium will keep challenging itself and will eventually allow a broader and more diverse array of people to engage with it. As the industry evolves and grows, according to Shola it is important that the sector acknowledges and addresses the clear barrier in access and representation present in it. He praises SFA’s commitment in this sense.

- *“As a tool it's got power, but still prohibitive. Still exclusive, which is deeply problematic, and it still has an output problem in a sense that most people cannot experience it unless they've got the headset, which is still quite expensive. I am not a fan of exclusionary arts forms, because I like art that engage with people, and has massive effects, so it's exclusionary if you do art that is only for a few. It's also boring, and doesn't have the social interesting element in it. So people have to be careful not to fall into that trap, which is very common. That's why Story Futures was important, for them to say 'okay you need to come in and utilise it in a different way'. Yeah, it's great, you know, we still are showing at Cannex XR next week, but we still need to know how to have this performed in the community, how to get regular people in the streets in communities using this technology, how to engage and I think that's still part of the battle.’*

4.1.10 Case study: Production Booster funding: NSC Creative & Fragments

The project

²⁵ <https://www.trebuchet-magazine.com/storyfutures-academy-shola-amoo-violence/>

NSC Creative is a studio with 20 years of experience in immersive media based in Leicester. The studio specialises in immersive experiences for theme parks, XR, domes, museums and science centres. They also work in animation, VFX, and live capture.

In early 2020, NSC Creative was awarded a Production Booster fund from SFA to facilitate the completion of their immersive documentary *Fragment*. This uses volumetric live capture to recreate the story of Lisa as she remembers her lost love, Erik. The experience evokes the fragments of their past memories and their life together. As the audience “navigates the space to explore these moments, new memories are triggered revealing new pathways through the story”. The users manipulate the virtual space with their hands influencing the narrative and creating an immersive experience.

This work stems from a previous production, called *Vestige*, which was based on the same IP and has been developed for VR. The work premiered at Tribeca Film Festival in 2018 and collected awards and positive reviews from the industry and the public.

The new work, *Fragments*, started one year later, in 2019, when the team was successfully awarded with a Magic Leap Independent Creator Grant to create a mixed-reality version of *Vestige* for the Magic Leap One headset. When the team was at about two thirds of the production process, NSC Creative successfully applied to the SFA Production Booster.

- *“We thought that was a great opportunity for us to inject a little bit more money to the production budget to allow us to explore some of the things which we wouldn't have been able to do in as much detail or been able to do as much previously”*

What the funding enabled

The Production Booster funding allowed the team at NSC Creative to expand their work and facilitated the creation of two versions of the product: a home release version which is available through Magic Leap World for anyone who has a Magic Leap headset, and a second one that can work as part of a full immersive installation for two people, intended for festivals and future licencing in public spaces such as museums and art galleries.

- *“This [creating a MR experience for two people] was something that we always wanted to explore. But the grant money from Magic Leap didn't quite cover the costs of us kind of figuring that out fully ...[This] allowed us to take it a step further and explore things that we wouldn't have otherwise been able to do.”*

The work was selected to premiere in SXSW, but because of Covid-19 the team never managed to present the location-based version.

Research and collaboration with academia

As in other co-productions, the SFA team collaborated with the production team to integrate academic research and study audience reaction to the immersive experience.

The testing of the location-based version of *Fragments* was not possible due to Covid-19 social distancing restrictions, the academic research team has not been able to run the primary research on users yet. Nevertheless, NSC Creative reported that the results will be useful for future productions, despite the initial doubts on the different working methods between industry and academia, generated by previous experiences working with universities.

- *“For anyone who works in production, the emphasis is very often on just trying to get the project finished, get it over the line on budget [...]. Introducing academia and research was initially a concern because we weren't quite sure what the level of expectation and work was for our side. We were already reasonably far down the line, there wasn't really a massive amount of scope for us to respond to that audience data. But at the end we were able to come up with a plan. This would help us as a studio moving forward; putting a bit*

more rigour and objectiveness on what we normally do instinctively in terms of what and why the audience like [...]. We were able to craft it [the collaboration] in such an effective way. It will be really valuable for us - as a studio who's constantly trying to develop our team professionally."

Appendix C Additional indicators

C.1 AotF portfolio per strand

C.1.1 Demonstrators

The AotF programme contributed around £17.7m, securing a further £8.3m from project participants in matched funding. This therefore does not include further funds raised for follow-on projects or any other aligned activities. Across the four Demonstrators, 30 unique organisations are involved. Predominantly involving business partners (22), the Demonstrators also include universities (6) and charities (2), as shown in the table below.

Table 23 Unique participating organisations in Demonstrators and funding

| Type | Number of unique participants | % | Total Investment | % | ISCF AotF Funding | % | Financial contribution |
|---|-------------------------------|----------------|--------------------|-------------|--------------------|-------------|------------------------|
| Business | 22 | a. 73% | £22,872,103 | 88% | £14,759,024 | 83% | £8,113,079.00 |
| Public Sector/ Registered Charity | 2 | b. 7% | £608,695 | 2% | £608,695 | 3% | -- |
| Academic | 6 | c. 20% | £2,428,495 | 10% | £2,428,495 | 14% | -- |
| Grand Total | 30 | d. 100% | £25,909,293 | 100% | £17,796,214 | 100% | £8,113,079.00 |

Source: Technopolis (2022) based on client data.

C.1.2 Grants and Investments

As of February 2020, 58 projects were awarded: 20 PIIC projects, commencing work in April 2019; 31 Design Foundations projects, commencing work between the end of 2018 and beginning of 2019; finally, 7 Investment Accelerator projects, commencing in January 2020.

These projects include a total of 106 unique participants, the majority of which are businesses (88, 83%).

C.1.2.1 PIIC

The total investment for all PIIC projects thus far is £10.7m, £7.6m of which comes from the AotF programme while £3.1m is leveraged from participating organisations. The average total investment per PIIC project is £537k.

Table 24 Unique participating organisations in PIIC and funding

| Type | Number of unique participants | % | Total Investment | % | ISCF AotF Funding | % | Financial contribution |
|---|-------------------------------|--------|------------------|------|-------------------|-------|------------------------|
| Business | 38 | e. 79% | £9,556,745 | 89% | £6,457,163 | 84.7% | £3,099,582.00 |
| Public Sector/ Registered Charity | 2 | f. 4% | £186,485 | 1.7% | £178,518 | 2.3% | £7,967.00 |
| Academic | 7 | g. 15% | £961,073 | 9% | £961,073 | 12.6% | -- |

| Type | Number of unique participants | % | Total Investment | % | ISCF AotF Funding | % | Financial contribution |
|--------------------|-------------------------------|----------------|--------------------|-------------|-------------------|-------------|------------------------|
| RTO | 1 | h. 2% | £27,712 | 0.3% | £27,712 | 0.4% | -- |
| Grand Total | 48 | i. 100% | £10,732,015 | 100% | £7,624,466 | 100% | £3,107,549.00 |

Source: Technopolis (2022) based on client data.

C.1.2.2 Design Foundations

The Design Foundations competitions were to run in two phases, the first of which was launched in May 2018 (DF1), with projects starting in October 2018. An additional Design Foundations competition was run in late 2021/early 2022, with projects due to complete in March 2022. Given the timing of this evaluation, the second Design Foundations competition (DF2) is being evaluated separately.

Design Foundations 1 received total £1.2m committed funds from AotF thus far, with a further £436k invested by project participants. Each project's total costs range between £20,000 and £60,000. The total indicative allocation to the Design Foundations strand of the AotF Challenge is £1.6m.

31 Design Foundations projects were selected and all have completed project activity. Most of the Design Foundations projects run for 6 months. Almost all businesses (42 of 43) involved in the Design Foundations strand are 'micro or small' in size

Table 25 Unique participating organisations in Design Foundations and funding

| Type | Number of unique participants | % | Total Investment | % | ISCF AotF Funding | % | Financial contribution |
|--------------------|-------------------------------|----------------|-------------------|-------------|-------------------|-------------|------------------------|
| Business | 43 | j. 84% | £1,446,462 | 91% | £1,010,368 | 88% | £436,094 |
| Academic | 8 | k. 16% | £142,129 | 9% | £142,129 | 12% | -- |
| Grand Total | 51 | l. 100% | £1,588,591 | 100% | £1,152,497 | 100% | £436,094 |

Source: Technopolis (2022) based on client data.

C.1.2.3 Investment Accelerator

The Investment Accelerator strand includes 7 projects carried out by 7 unique business participants. The total investment for this instrument is £2.1m, £1.5m of which is supported by the AotF programme. This does not include further funds raised for follow-on projects or any other aligned activities.

Table 26 Unique participating organisations in Investment Accelerator and funding

| Type | Number of unique participants | % | Total Investment | % | ISCF AotF Funding | % | Financial contribution |
|--------------------|-------------------------------|----------------|-------------------|-------------|-------------------|-------------|------------------------|
| Business | 7 | m. 100% | £2,151,600 | 100% | £1,506,120 | 100% | £645,480 |
| Grand Total | 7 | n. 100% | £2,151,600 | 100% | £1,506,120 | 100% | £645,480 |

Source: Technopolis (2022) based on client data.

C.1.3 Pivot funding

Due to the Covid-19 pandemic, AotF provided additional funding to pivot projects, namely “pivot funding” and the table below shows the amount of pivot funding per strand. 14 participants in the Demonstrators strand received a total of £3,567,353 of additional funding, while PIIC participants received £132,926 additional pivot funding. It is worth noting that Innovate UK also allocated funds to some AotF projects in response to COVID in the form of ‘continuity grants’ and ‘rapid response’ funds.

Table 27 Pivot funding from AotF

| Instrument/Strand | Number of participants who received pivot funding | Value of pivot funding |
|------------------------|---|--|
| Demonstrators | 2 – Performance Demonstrators | £1,043,342.90 |
| | 1 – Visitor Experience Demonstrator | £480,760 |
| | 7 – WEAVR | £1,178,251.40 |
| | 4 – Moving Image Demonstrators | £865,000 |
| Investment Accelerator | 5 | £105,000 (+ c. £27,556 TBC*) |
| PIIC | 9 | £83,372 (+ c. £49,554 TBC*) |
| <i>Total</i> | | £3,832,837 (including additional funds TBC*) |

Source: Technopolis (2022) based on client data. * Additional pivot funds to be confirmed.

C.2 Grants and investments survey indicators

Table 28 Grants and Investments, Turnover and exports indicators, businesses

| Indicator | Successful | | | Unsuccessful | | Assessment |
|---|------------|----------|------------|--------------|------------|------------|
| | | Baseline | Post-exit | Baseline | Post-exit | |
| Outcome area 3: Economic performance | | | | | | |
| Business and organisation turnover † | Mean | £334,545 | £551,818 ▲ | £461,237 | £643,517 ▲ | ▲ |
| | Median | £72,500 | £200,000 ▲ | £50,000 | £70,000 ▲ | |
| Turnover derived from products or services in immersive content or technology † | Mean | £245,625 | £445,167 ▲ | £101,958 | £233,190 ▲ | ▲ |
| | Median | £0 | £62,500 ▲ | £10,000 | £30,000 ▲ | |
| Turnover in immersive content or technology attributable to exports † | Mean | £144,727 | £303,750 ▲ | £21,286 | £75,759 ▲ | ▲ |
| | Median | £0 | £0 ■ | £0 | £2,438 ▲ | |
| Annual spending on external suppliers for activities related to immersive content or technologies | Mean | £13,800 | £35,151 ▲ | £19,364 | £30,822 ▲ | ▲ |
| | Median | £0 | £25,000 ▲ | £5,000 | £10,000 ▲ | |
| Number of full-time equivalent employees † | Mean | 6.1 | 10.3 ▲ | 8.7 | 8.2 ▼ | ▼ |
| | Median | 3.0 | 3.0 ■ | 4 | 2 | |
| | Mean | 3.5 | 2.9 ▼ | 3.0 | 2.8 ▼ | ▼ |

| | | | | | | | | |
|---|--------|--|---|---|--|--|---|--|
| Number of freelancers/ contractors (FTE) employed in immersive, businesses only | Median | 2.0 | 2.0 | ■ | 1.0 | 1.0 | ▲ | |
| Average salary of employees | Mean | £28,733 | £35,383 | ▲ | £23,305 | £27,147 | ■ | |
| | Median | £27,500 | £35,000 | ▲ | £25,000 | £31,000 | ■ | |
| GVA (as calculated by applying an average ratio of turnover to GVA for the creative industries) ²⁶ † | Mean | £167,942 | £277,013 | ▲ | £231,541 | £323,045 | ▲ | |
| | Median | £36,395 | £100,400 | ▲ | £25,100 | £35,140 | ▲ | |
| Productivity (GVA per FTE) ²⁷ † | Mean | £16,496 | £39,132 | ▲ | £20,499 | £26,431 | ▲ | |
| | Median | £12,550 | £37,650 | ▲ | £9,852 | £20,080 | ▲ | |
| Outcome area 4: Investment | | | | | | | | |
| Value of R&D investment in immersive content or technologies, businesses only | Mean | £66,618 | £61,923 | ▼ | £47,866 | £55,049 | ▲ | |
| | Median | £25,000 | £25,000 | ■ | £10,000 | £20,000 | ▲ | |
| R&D Intensity (Calculated as R&D investment as a proportion of turnover) ²⁸ | Mean | 23% | 33% | ▲ | 26% | 27% | ▲ | |
| | Median | 20% | 31% | ▲ | 5% | 20% | ▲ | |
| R&D investment in immersive by source, businesses only, % of R&D investment | Mean | Self-financed: 69% Loan: 6% Equity: 0% Grant: 12% Other: 12% | Self-financed: 76% Loan: 2% Equity: 1% Grant: 15% Other: 6% | | Self-financed: 77% Loan: 6% Equity: 1% Grant: 9% Other: 3% | Self-financed: 80% Loan: 6% Equity: 2% Grant: 8% Other: 4% | | |
| | Median | Self-financed: 100% Loan: 0% Equity: 0% Grant: 0% | Self-financed: 100% Loan: 0% Equity: 0% Grant: 0% | | Self-financed: 100% Loan: 0% Equity: 0% Grant: 0% | Self-financed: 100% Loan: 0% Equity: 0% Grant: 0% | | |

Source: Technopolis analysis using longitudinal survey. Base: 17 - 31 successful and 35 - 95 unsuccessful businesses. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and FTE of 7,000 and one unsuccessful academic research group with 2,500 FTE. Excluding one successful company with turnover of £138m and 1,100 FTE and one successful company which split into two.

C.3 Train the Trainer focus group

In this section we present a deep dive into the outcomes of the StoryFutures Academy Train the Trainer (TTT) workstream. Findings are based on two focus groups with a total of seven project team members, which were conducted by BOP in February 2020.

The workstream was designed to enable researchers and teachers in UK higher education to develop their skills and experience of immersive storytelling by delivering research and teaching development projects. It aimed to build capacity of UK higher education to create a talent pipeline for immersive production.

²⁶ GVA calculated by applying a ratio of Turnover to GVA of 0.502. The ratio was calculated using the Annual Business Survey 2017 (released May 2019) and is the average ratio of Total Turnover to Approximate GVA for SIC codes aligned with the Creative Industries according to DCMS's SIC Code categorisation.

²⁷ Where companies reporting turnover have also reported the number of employed persons as '0' for the 2017/18 financial year, number of employees has been assumed to be 1 (i.e., one person company).

²⁸ Responses that indicated R&D spending as more than their annual turnover for that financial year (i.e., R&D intensity of over 100%) have been assumed as 100%

C.3.1 Implementation

So far, this workstream has been delivered in two cohorts, each of which funded seven projects. Project teams are multidisciplinary but from the same HEIs and span a broad range of fields including film production, media arts, engineering, drama and music, games design, screenwriting, ethnographic documentary filmmaking, media communications, digital animation, creative computing, immersive journalism, VFX, music technology, audio technology and more.

Alongside project delivery, project leads received masterclasses and mentorship from industry professionals working in immersive.

The first cohort was announced in June 2020 with a second funding round running from January – July 2021. A third cohort, announced in March 2022, will fund five further projects and conclude in August 2022.

Across the two cohorts which have completed their activities, the 14 project teams have trained over **225 academics** and trainers and engaged **462 students**. The programme has resulted in **50 new courses** and **2680 students benefitting** from new teaching or courses.

C.3.1.1 Outcomes of the workstream

New skills and knowledge developed

Within the two focus groups there was a diverse range of specialisms and different levels of prior knowledge of the immersive vertical.

Some participants reported knowing 'almost nothing' about immersive production when they joined the programme whereas other participants had more experience - from both research and in industry - of the technologies and fields covered by the course.

"I didn't know anything about [immersive], other than sort of anecdotally and what I had read."

"I've been working in this in these sorts of fields for quite a long time."

Similarly, some participants joined the programme with clear technological aims, such as designing a new tool or getting to grips with a particular piece of hardware, whereas others felt more confident with the technology but wanted to understand more about how it could be applied to creative processes and storytelling, or better incorporated into course content and modules. Accordingly, the skills and knowledge developed reported by focus group participants, but included:

Competency using hardware and software: participants described the challenges to acquiring and learning how to use cutting edge technology within academic institutions, something they programme helped them to overcome.

Better understanding of the budget, timeline, and other project management considerations for immersive productions: for some participants, this was the first time they had undertaken an immersive project and therefore did not have a detailed understanding of what is required. The experience of the TTT development projects gave them experience that they can apply to future projects.

Better understanding of how technology can be integrated with into the creative process: participants described the way that the incorporation of immersive tech can lead to a whole new set of production considerations which can impact all parts of the creative process – and

how the TTT programme has helped them to understand both the opportunities and limitations it can bring.

"It was a massive creative lesson for me."

Developing a common language across disciplines: several focus group participants identified communication challenges when it comes to immersive, as the language has not yet been 'locked down'. The delivery of a project as part of a team demanded a common frame of reference and helped participants to overcome this challenge. For participants with less experience in the field, getting more familiar with the terminology through the programme gave them confidence to push ahead with their projects and partnerships

New or improved courses, modules, content, and teaching methods

Participants noted that the standard undergraduate degree only gets validated once every five years, beyond which time it is only possible to make minor changes because of quality assurance requirements. This is challenging when teaching a fast-moving field such as immersive. However, the Train the Trainer programme allowed teaching staff to 'leverage' new content into undergraduate modules and introduce them to new and emerging technology.

All focus group participants reported either improvements or innovations in their course content and approaches to teaching in the immersive vertical as a result of the programme. This includes the creation of new modules, new teaching frameworks, new content and updating existing models to make them available at higher level. One of the participants was working on the creation of a brand-new degree course which will have a major focus on virtual production, starting in September. Other improvements included:

Project-based learning: Participants felt the opportunity to engage in project-based applied learning as opposed to classroom-based learning has been really valuable for their students and that this approach was something they would like to continue to incorporate in their teaching now the programme is over.

"It made us realise how useful [project experience] was to the students as a way of learning".

Updated hardware: Two of the project teams described significant hardware barriers to teaching immersive prior to the TTT programme. The project funding allowed them to acquire the necessary hardware to keep their students engaged with the technological theory and gain real-world experience.

Examples of knowledge outputs such as articles, presentations

Conferences: Over half of the focus group participants (base: 4) have presented their projects externally at conferences and academic festivals, and some others plan to in the future.

Industry engagement: Focus group participants reported activities including: demonstrations of their work to industry partners and potential collaborators; appearing in industry-facing media such as podcasts, and sitting on industry-wide steering groups.

Institutional knowledge: Participants also reported having shared their projects within their institutions through internal symposia and other channels.

Change in employment that can be attributed to the programme

The imperative to teach students skills and knowledge that will increase their employability was noted by the focus group participants, who valued the opportunity to introduce students to new kinds of technologies and to bring an 'immersive' perspective in their education provision.

One participant spoke about being able to hire one of their MA students as a result of the programme, and another has been informing the development of six new PhD places in the immersive vertical.

Improved understanding between industry and academia

Industry collaboration: Focus group participants valued the opportunity to work with industry partners on their projects, with many collaborations either likely to or already continuing beyond the project lifespan. In other cases, the project content or results have stimulated new conversations with different industry partners.

Beyond teaching staff, some participants felt that their students had learned a lot about professional practice through the programme and the opportunity to work on a production alongside established professionals.

Several of the focus group participants already had a high base level of understanding of industry as they had either come from an industry background or in some cases worked in both HEIs and industry simultaneously, therefore the TTT programme had little impact on their overall understanding.

Change in attitude to immersive

Creative process: Participants developed their attitudes and understanding of immersive in different ways. For one participant, the emphasis placed on storytelling as well as technology was a uniquely valuable aspect of the programme.

"We came into the project thinking it was all about the technology, but our mentor told us to focus on the story, which was really helpful."

Potential of immersive: Other focus group participants reported a new perspective on the potential of immersive tech which they had developed through their experience of the programme and the application of the technology within a project. One participant has been inspired to scope out a more ambitious follow up project doing something they hadn't previously considered or realised was possible. Another felt more confident assessing the potential and limitations of different technologies in relation to their work.

Teaching staff also felt better equipped to embed immersive approaches within the career thinking of their students as a result of TTT.

"I just feel my eyes are even more open to the possibilities now".

Institutional change: Focus group participants appreciated the inter-disciplinary emphasis of the programme and the catalyst it provided to work with colleagues from other schools within their institutions. It was noted that HEIs can often be very siloed, with bureaucratic structures acting as barriers to multidisciplinary research. They said the programme allowed them to discover what knowledge was already held across their institution and to establish a common purpose and way of talking about immersive.

“One of the biggest learnings was that storytelling, and immersive means so many different things in different departments”.

The project was described by one participant as 'leverage' to gain recognition and profile for creative immersive within their institution and others felt it gave them the 'permission' or 'authority' to dedicate their time to immersive and to have conversations with senior management about future projects.

In one case, the **TTT programme has directly resulted in project teams securing further funding from their institutions** to build on this work.

C.3.1.2 Process

Knowledge frameworks in immersive

Feedback on the industry speakers and masterclasses was mixed. For participants who had more direct experience and knowledge of immersive tech – both from academia and for some, from their time in industry – felt that it would have been more beneficial for the sessions to be pitched as a knowledge-exchange opportunity rather than a hierarchical knowledge transfer.

This was in part because, as an emerging field, the approaches, methods and language in immersive production are not yet codified in the same way as more established technological fields. As a result, the hierarchical cascade of knowledge that is a central part of the train-the-trainer model - a commonly-used pedagogical framework- did not always feel relevant to these participants.

“I think some of the sort of commercial partners they brought in felt they knew more than academics. And lots of the people ~~on these~~ on these programmes have spent half their time in industry anyway.”

“There was a sense that the groups had come into it didn't know anything. I think it would be more useful been to have been engaged with it ~~as a~~ as more of a knowledge exchange”.

This does not represent the experience of all of the focus group participants.

Terminology

Even those with less prior experience of immersive, however, were at times challenged by the lack of a common language or framework in the field.

According to one participant, it became apparent that there were lots of different interpretations of what was meant by the immersive production within the cohort. Several participants referred to the immersive lexicon as a 'different' or 'foreign' language or described situations within project teams where members were using the same words but meaning different things.

“We are talking, we are using the same words, but they don't mean the same thing.”

Another, who described themselves as a 'novice' to the area, felt they would have benefitted from some explanation of the context and terminology early on in the programme.

Networking and collaboration

Given the challenges described above, focus group participants appreciated the opportunity to meet peers from other institutions and learn about what each project team was working on. For some, slightly more time for peer-to-peer discussion and for sharing project outcomes would have been appreciated, although it was recognised that there are challenges building this in online as opposed to in person.

"For me, a big, big plus of TTT is the opportunity to have peer to peer engagements -especially extra institutional."

Application and delivery:

Application process: Feedback on the application process was generally positive and the application form described as straightforward.

Grant structure: However, it was noted that the project grants were not very compatible with the way Higher Education Institutions receive grant funding. In some cases, universities were reluctant to sign off the grants and in another the grant is still being processed one year later. This was seen as a potential deterrent to HEIs approving similar grants in the future. It was also noted that the grants were fairly small given the ambition of the projects they were supporting, which added pressure on capacity and resource – although participants still felt the benefits they saw from the project made it 'worth it'.

Delivery: Focus group participants were very complimentary about the SFA delivery team and the level of support they received throughout the programme.

"The team behind it were excellent - very good to deal with."

C.3.1.3 What next?

Project development: Over half of the projects have either secured or are exploring future funding opportunities to develop their TTT project further. Participants said they would appreciate the opportunity to apply for future funding from SFA to continue and progress their projects.

TTT network: Participants were keen to continue to stay in contact with others in their cohort and other TTT participants. It was suggested that SFA invests in sustaining a community of practice or alumni network, which could include a face-to-face meet up/symposia to share projects, learnings and scope out any future collaborations.

"I think it'd be good to get a little bit more follow up - it just seems a bit scattergun."

C.4 SFA KPIs and progress

Table 29 SFA KPIs and progress by end September 2021

| Indicator | Target | Progress by end September 2021 | Reporting Mechanism |
|---|--|----------------------------------|------------------------------|
| Growth | | | |
| £ match investment into project activity and source (private, public) | £3,100,000 | £4,588,875 | Quarterly dashboard |
| Change in employment that can be attributed to the programme [New and saved jobs evidence for NCIS commissioned survey] | 80 (Original programme) 75 (Extension phase) | 463 | Y3 Annual Report |
| Skills | | | |
| Number of people from enterprise core screen talent who participated in training activity | 220 (Stretch Goal) 400 (Extension phase) | 770 | Zoho Survey & exit interview |
| Number of new educational/skills programmes/courses developed | 49 (Whole programme) | 78 | Quarterly dashboard |
| Number of researchers who participated in training activity | | | |
| Productivity | | | |
| Number of co-productions | 12 (Original programme) 15 (Extension phase) | 29 | Quarterly dashboard |
| Collaboration | | | |
| Number of placements | 25 Industry (Original programme) 4 Industry and 10 ECR placements (Extension phase) | 27 Industry and 6 ECR placements | Quarterly dashboard |

Appendix D Profile of respondents

D.1 Telephone Survey

Table 30 CATI Telephone survey sample size, by strand

| Strand | All | | Businesses | | Academia | |
|------------------------|------------|--------------|------------|--------------|------------|--------------|
| | Successful | Unsuccessful | Successful | Unsuccessful | Successful | Unsuccessful |
| Design Foundation | 24 | 35 | 21 | 32 | 3 | 3 |
| PIIC | 21 | 70 | 19 | 61 | 2 | 9 |
| Investment Accelerator | 3 | 29 | 3 | 29 | 0 | 0 |
| All | 48 | 134 | 43 | 122 | 5 | 12 |

Source: Technopolis analysis using longitudinal survey

D.2 StoryFutures Academy survey

Table 31 StoryFutures Academy survey respondent organisation type

| Organisation type | Response Percent | Response Count |
|---|------------------|----------------|
| Micro company (0-9 FTE employees) | 40.82% | 20 |
| Small company (10-49 FTE employees) | 8.16% | 4 |
| Medium company (50-249 FTE employees) | 2.04% | 1 |
| Large company (250+ FTE employees) | 2.04% | 1 |
| University / Public Research Organisation | 16.33% | 8 |
| Charity | 2.04% | 1 |
| N/A – I am a freelancer | 26.53% | 13 |
| N/A – I am currently unemployed | 0.00% | 0 |
| N/A – I am currently a student | 0.00% | 0 |
| Other (Please specify) | 2.04% | 1 |

Table 32 StoryFutures Academy survey, event or programmes attended

| StoryFutures Academy events or programmes | Response Percent | Response Count |
|--|------------------|----------------|
| Writers rooms | 0.00% | 0 |
| Train the Trainer | 6.12% | 3 |
| Experimental lab | 10.20% | 5 |
| Introductory lab | 30.61% | 15 |
| Game Engines Lab | 8.16% | 4 |
| Other Lab sessions (e.g., Unity Lab) | 14.29% | 7 |
| Co-productions | 8.16% | 4 |
| Development projects | 12.24% | 6 |
| Kickstart projects | 2.04% | 1 |
| Bootcamp | 12.24% | 6 |
| Placements | 0.00% | 0 |
| Masterclasses (event featuring guest speakers from industry) | 18.37% | 9 |
| Audience Insight Report Launch | 10.20% | 5 |
| Other (Please specify) | 20.41% | 10 |

D.3 Project Completion Forms

Table 33 Project Completion Form response rates

| Strand | Number of responses | % of participants | Number of projects | % of projects |
|------------------------|---------------------|-------------------|--------------------|---------------|
| Demonstrators | 23 | 79% | 4 | 100% |
| Design Foundations | 48 | 98% | 29 | 100% |
| Investment Accelerator | 6 | 86% | 6 | 86% |
| PIIC | 32 | 71% | 17 | 81% |
| Total | 109 | | 56 | |

D.4 Interviewees – Case Studies

Table 34 Grants and Investments case study interviewees

| Name | Organisation | Role |
|------------------|-------------------|-------------------|
| Jason Hawthorne | VU.CITY | Founding Director |
| Theo Jones | Framestore | VFX Supervisor |
| Dr Charles Nduka | Emteq | CEO |
| Gareth Llewellyn | Magic Beans | Co-Founder, CEO |
| Mike King | Numerion Software | CEO |

| | | |
|--------------------|-----------------------|-------------------|
| Russ Harding | Maze Theory | COO |
| Christine Hemphill | Open Inclusion | Managing Director |
| Chris Porter | Immersive Interactive | Director |

D.5 Interviewees – Demonstrators

Table 35 Demonstrator interviewees

| Demonstrator | Name | Organisation |
|---|------------------|---------------------------|
| WEAVR: Immersive Cross-Reality Experiences in Esports | Florian Block | York University |
| | James Dean | ESL, Turtle |
| | Richard Wormwell | Dock 10 |
| Immersive performances of the future | Sarah Ellis | Royal Shakespeare Company |
| | Rosalind Coleman | Punchdrunk international |
| | Nell Whitley | Marshmallow Laser Feast |
| | Sophy Smith | De Montford University |
| Visitor Experience: Dinosaurs and Robots | John Cassy | Factory 42 |
| | John Stack | Science Museum |
| | Dani Parr | The Almeida |
| | Alex Burch | National History Museum |
| Moving Image: The Big Fix Up / Fix Up the City | Dan Clemo | Sugar |
| | Richard Saggars | PotatoLondon |
| | Robert Goodchild | Aardman |

D.6 Interviewees – External stakeholders

Table 36 Wider stakeholder interviewees

| Name | Organisation |
|----------------------|--------------------------------|
| Jonathan Chippindale | Holition |
| Fabio La Franca | Blueverse Ventures |
| Patrick Bradley | Station12 |
| Asha Easton | Immerse UK |
| Richard Hurford | University of South Wales |
| Darren Cosker | Microsoft & University of Bath |
| Jon Zeff | Creative Industries Council |

D.7 Focus group attendees

Table 37 StoryFutures Academy leads focus group attendees

| Name | Organisation | Role |
|-------------------------|-------------------------------------|--|
| Amanda Murphy | StoryFutures Academy | SFA Executive Producer |
| Professor Adam Ganz | StoryFutures & StoryFutures Academy | Co-Investigator, StoryFutures & Head of Writers Room, StoryFutures Academy |
| Will Saunders | StoryFutures & StoryFutures Academy | Chief Creative Officer, StoryFutures and StoryFutures Academy |
| Professor James Bennett | StoryFutures Academy | NCIS Director |
| Dr Jon Wardle | StoryFutures Academy & NFTS | Nation Film and Theatre School Director, NCIS Co-Director |
| Sarah Smyth | StoryFutures Academy | Head of Delivery |
| Rebecca Gregory-Clarke | StoryFutures Academy | Head of Immersive |

Table 38 Train the Trainer Focus Group attendees

| Name | Organisation | Role |
|-------------------|-------------------------|--|
| Dinah Lammiman | UCL | Professor, Immersive Factual Storytelling |
| Jon Weinbren | University of Surrey | Director – Centre for Creative Arts and Technologies |
| Jodi Nelson-Tabor | University of Greenwich | Senior Lecturer Digital Film & TV Production |
| Lindsay Keith | University of Greenwich | Creative Research Fellow |
| Nuno Barreiro | RHUL | Senior Lecturer, Immersive Engineering |
| Klaus Kruse | Falmouth University | Senior Lecturer, Theatre |
| Heather MacRae | Venture Thinking | Director |

Appendix E Wider Context

E.1 Sector analysis

E.1.1 Sector analysis search terms

Table 39 Initial set of keywords for web scrape

| Type | Business | Workforce |
|-----------------------|------------------------|------------------------|
| Thematic search terms | Virtual Reality | Virtual Reality |
| | VR | VR |
| | Augmented Reality | Augmented Reality |
| | AR | AR |
| | Mixed Reality | Mixed Reality |
| | XR | Immersive Content |
| | Immersive content | Immersive Environments |
| | 360 video | 360 video |
| | 3d sound/ audio | 3d sound/ audio |
| Technology | Unity VR | Unity VR |
| | Oculus | Oculus |
| | Vive | Vive |
| | Google VR / GVR | Google VR / GVR |
| | Unreal VR | Unreal VR |
| | PlayStation VR / PS VR | PlayStation VR / PS VR |
| | Samsung VR | Samsung VR |
| | ARKit | ARKit |
| | ARCore | ARCore |
| | Vforia | Vforia |
| | HoloLens | HoloLens |
| | Magic Leap | Magic Leap |
| | StreamVR | StreamVR |

Table 40 List of LinkedIn industry categories related to DCMS Creative Industries sectors

| LinkedIn Code Number | LinkedIn industry category | DCMS CI sector grouping/ Tech Nation definition |
|----------------------|----------------------------|---|
| 3 | Computer Hardware | Tech Nation |

| | | |
|-----|-------------------------------------|---|
| 4 | Computer Software | IT, Software and Computer Services |
| 5 | Computer Networking | Tech Nation |
| 6 | Internet | IT, Software and Computer Services |
| 8 | Telecommunications | Tech Nation |
| 19 | Apparel & Fashion | Design: Product, graphic and Fashion Design |
| 28 | Entertainment | Music, performing and visual arts |
| 35 | Motion Pictures and Film | Film, TV, Video, Radio and Photography |
| 36 | Broadcast Media | Film, TV, Video, Radio and Photography |
| 37 | Museums and Institutions | Museums, Galleries and Libraries |
| 38 | Fine Art | Music, performing and visual arts |
| 39 | Performing Arts | Music, performing and visual arts |
| 50 | Architecture & Planning | Architecture |
| 60 | Textiles | Design: Product, graphic and Fashion Design |
| 81 | Newspapers | Publishing |
| 82 | Publishing | Publishing |
| 84 | Information Services | IT, Software and Computer Services |
| 85 | Libraries | Museums, Galleries and Libraries |
| 96 | Information Technology and Services | IT, Software and Computer Services |
| 99 | Design | Design: Product, graphic and Fashion Design |
| 100 | Non-Profit Organization Management | Museums, Galleries and Libraries |
| 103 | Writing and Editing | Publishing |
| 108 | Translation and Localization | Publishing |
| 109 | Computer Games | IT, Software and Computer Services |
| 111 | Arts and Crafts | Crafts |
| 112 | Electrical/Electronic Manufacturing | Tech Nation |
| 113 | Online Media | IT, Software and Computer Services |
| 115 | Music | Music, performing and visual arts |
| 118 | Computer & Network Security | Tech Nation |
| 119 | Wireless | Tech Nation |
| 126 | Media Production | Film, TV, Video, Radio and Photography |
| 127 | Animation | Film, TV, Video, Radio and Photography |

| | | |
|-----|--------------------------|---|
| 132 | E-Learning | IT, Software and Computer Services |
| 136 | Photography | Film, TV, Video, Radio and Photography |
| 140 | Graphic Design | Design: Product, graphic and Fashion Design |
| 143 | Luxury Goods & Jewellery | Crafts |

E.1.2 *List of top 23 UK cities*

- Belfast
- Birmingham
- Bournemouth
- Brighton & Hove
- Bristol & Bath
- Cambridge
- Coventry & Warwickshire
- Dundee
- Edinburgh
- Glasgow
- Hull
- Leeds
- Leicester
- Liverpool
- London (equates to NUTS 1 region)
- Manchester
- Newcastle
- Nottingham
- Oxford
- Sheffield
- South Wales
- Southampton & Portsmouth
- Thames Valley
- York

E.2 Wider market analysis

E.2.1 Industry Breakdown

This section provides a snapshot of the size and shape of the global immersive technologies industry, how this compares to the size and shape of the industry at the baseline phase and a summary of how the industry is projected to grow.

Table 41 Combined current and projected size of the AR and VR industries (\$ USD Bn.)

| Source | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | CARG (%) |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|----------|
| Mordor Intelligence | 17 | | | | | | 185* | | | | | |
| The Insight Partners | | 28 | | | | | | | 252 | | | 37 |
| Report Ocean | | 21 | | | | | | | | | 454 | |
| Allied Market Research | 15 | | | | | | | | | | 455 | |
| Industry Research | 25 | | | | | | 38* | | | | | |
| IndustryARC | | 17 | | | | | 140* | | | | | |
| Statista | | 28 | | | | | | | 250 | | | |
| Verified Market Research | 9 | | | | | | | | 81 | | | |
| Technavio | | | | | | | | | | | | 47 |
| Average | | 24 | | | | | | | 194 | | | |

Source: Various / Technopolis and BOP Consulting (2022)

Table 42 Compound Annual Growth Rate of the AR and VR industries (%)

| Source | CAGR | Years |
|--------------------------|------|------------|
| Mordor Intelligence | 34 | 2020-2027 |
| The Insight Partners | 37 | 2021-2028 |
| Report Ocean | | |
| Allied Market Research | 41 | 2020-2030 |
| IndustryARC | 39 | 2021-2026* |
| Statista | | |
| Verified Market Research | 32 | 2021-2028 |
| Technavio | 46 | 2020-2025 |
| Average | 38 | |

Source: Various / Technopolis and BOP Consulting (2022)

Table 43 Size of the AR industry (\$ USD Bn.)

| Source | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---------------------------|------|------|------|------|------|------|------|------|------|
| Markets and Markets | 15 | | | | | | 88 | | |
| Fortune Business Insights | 4 | 6 | | | | | | | 98 |
| Research and Markets | 15 | | | | | | 88 | | |
| KBV Research | 9 | | | | | | 89 | | |
| Expert Market Research | 15 | | | | | | 122 | | |
| Grand View Research | | 30 | | | | | | | 340 |
| Average | 12 | | | | | | 97 | | |

Source: Various / Technopolis and BOP Consulting (2022)

Table 44 Size of the VR industry (\$ USD Bn.)

| Source | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Grand View Research | | 22 | 28 | | | | | | | | 87 |
| Markets and Markets | 6 | | | | | 21 | | | | | |
| Statista | | 5 | | | 12 | | | | | | |
| Fortune Business Insights | 4 | | | | | | | | 84 | | |
| Million Insights | 16 | | | | | | | 62 | | | |
| Research and Markets | | 22 | | | | | | | 70 | | |
| Average | 9 | | | | | | | | 77 | | |

Source: Various / Technopolis and BOP Consulting (2022)

Global market growth since 2018 slower than envisaged

- Industry analysts have estimated the size of the combined AR/VR global market in 2021 at \$17bn to \$28bn (see Table X).
- It is estimated that 80% of AR and VR revenue is generated by gaming activity.²⁹
- Assuming a market size of \$12bn in 2018, this gives a compound annual growth rate (CAGR) between 12% and 32%.³⁰
- The \$17bn to \$28bn 2021 market valuation is considerably lower than the 2021 forecasts of \$55bn to \$108bn cited in the 2019 baseline analysis.
- Nevertheless industry analysts still envisage strong growth over the coming years, with the combined AR/VR global market projected to reach \$455bn in 2030.

²⁹ <https://pixelplex.io/blog/ar-and-vr-in-gaming/>

³⁰ no link - Statista value cited in 2019 baseline analysis

China: top market for XR

- China was estimated to account for almost 56% of global AR/VR spending in 2021.³¹
- The China AR/VR market is predicted to grow at 67.5% CAGR over the five years from 2021.³²

Global AR vs VR: AR forecast to show stronger growth

- Estimates for the value of the 2021 VR market vary from \$5bn to \$22bn, and the 2021 AR market from \$6bn to \$30bn. There is considerable overlap in these ranges, although the AR range tends to a higher valuation.
- There is agreement among current industry forecasts that AR will be subject to a higher rate of growth than VR over the coming years. Market projections place a valuation on the VR market at \$70bn to \$84bn by 2028, whereas it is estimated that the AR market will be worth \$88bn or more by the year 2026. This is consistent with the 2019 baseline analysis which also identified that AR was set to assume a bigger share of the XR industry, although growth has been slower than projected.

Platform: headsets forecast to overtake consoles; AR smartphone usage set to dominate

- Combined global shipments of AR and VR headsets are forecast to grow from 7m in 2020 to 70m in 2025.³³ Annual headset sales are forecast to reach 49m in 2024 - at which point they are expected to exceed sales of gaming consoles.³⁴
- Smartphone is a key delivery device within the XR market. It has been estimated that there were 802m mobile AR users in 2021, an increase of 34% compared with 2020.³⁵
- The number of mobile AR users is forecast to grow to 1.67bn by 2025, or roughly 24 times the number of predicted 2025 headset users.³⁶
- 2020 mobile AR revenues – for example from AR ad placement and in-app purchases – are estimated at \$6.9bn in 2020 and forecast to increase to \$26bn in 2025.³⁷

Investment: social media and XR converging through M&A activity

- Global AR/VR investment in 2021 has been estimated at \$14.7bn, and is forecast to increase to \$74.7 billion in 2026.³⁸
- It is also estimated that China accounted for \$2bn or about 14% of global XR investment, and this is set to increase to \$13bn in 2026.³⁹

³¹ <https://nexttrendsasia.org/glimpse-into-chinas-vr-ar-world/>

³² <http://global.chinadaily.com.cn/a/202109/02/WS61302575a310efa1bd66cc2c.html>

³³ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

³⁴ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

³⁵ <https://mobidev.biz/blog/augmented-reality-trends-future-ar-technologies>

³⁶ <https://arinsider.co/2021/07/01/mobile-ar-users-approach-800-million/>

³⁷ <https://www.thevrara.com/blog2/category/ARtillry>

³⁸ <https://pandaily.com/idc-predicts-chinas-AR/VR-market-to-exceed-13b-in-2026/>

³⁹ <https://pandaily.com/idc-predicts-chinas-AR/VR-market-to-exceed-13b-in-2026/>

- Six major (\$75m or over) M&A deals took place in the eighteen-month period ending June 2022 involving immersive technology target companies for a total of \$4.6bn.⁴⁰
- Of these six deals, three deals for a total of \$3.3bn relate to social networks, such as Match Group's \$2bn acquisition of Hyperconnect. The 2019 baseline analysis identified that social media platforms were integrating AR features, and these three major acquisitions fit with a trend of alignment between social and XR.
- It is less clear that investment is moving away from VR as was the case at the time of the original baseline analysis with the \$770m sale of VR headset manufacturer Pico and \$670m sale of VR enterprise software provider EON Reality. In addition, Apple acquired a VR live streaming operator for an undisclosed fee in 2020.
- 2021 was a strong year for venture capital investment into VR and AR start-ups, with funding raised of \$3.9bn. This was more than the combined total of the previous two years.⁴¹
- In addition to start-up investment and M&As, Meta – another social network – announced in 2021 internal investment of \$10bn into its inhouse XR business.⁴²

Covid: potentially significant but not a prevalent theme within sector commentary

- Sector commentary inevitably refers to the pandemic, although it is by no means a strong theme.
- Forbes has reported that the pandemic prompted workplaces to start using VR platforms for collaborative working.⁴³ A study by Forrester Research found that 34% of surveyed organisations currently using XR did not do so prior the pandemic.⁴⁴
- Ofcom data shows that 5% of UK households owned a VR headset in 2019.⁴⁵ This increased to 8% in 2021. ⁴⁶It is plausible that this growth can be attributed - at least in some part - to lockdown.
- It has been claimed that "virtual worlds and XR technology gained an increasing install base and social mindshare, as shelter-in-place, physical distancing, and remote connectivity became the norm."⁴⁷
- On the other hand, a technology analyst writing in 2020 said: "we're all locked up at home, video calls have become a huge consumer phenomenon, but VR has been not. This should have been a VR moment, and it isn't."⁴⁸
- Covid had a different effect on the location-based experience sector; it has been reported that the pandemic inflicted heavy damage to the US VR arcade industry although its best-known brand - VOID – may yet return to the market.⁴⁹

⁴⁰ <https://techmonitor.ai/technology/emerging-technology/metaverse-mergers-acquisitions-investing-virtual>

⁴¹ <https://news.crunchbase.com/startups/metaverse-augmented-reality-virtual-reality-investment/>

⁴² <https://uk.pcmag.com/vr-1/136537/facebook-to-spend-10-billion-on-vr-business>

⁴³ <https://www.forbes.com/sites/forbestechcouncil/2021/09/14/augmented-and-virtual-reality-after-Covid-19/?sh=21e8007e2d97>

⁴⁴ <https://www.skillnetireland.ie/wp-content/uploads/2022/04/The-Irish-Immersive-Economy-report.pdf>

⁴⁵ https://www.ofcom.org.uk/__data/assets/pdf_file/0026/143981/technology-tracker-2019-uk-data-tables.pdf

⁴⁶ https://www.ofcom.org.uk/__data/assets/pdf_file/0015/219102/technology-tracker-2021-data-tables.pdf

⁴⁷ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁴⁸ <https://www.ben-evans.com/benedictevans/2020/5/8/the-vr-winter>

⁴⁹ <https://techcrunch.com/2020/08/25/the-pandemic-has-probably-killed-vr-arcades-for-good/> and <https://uploadvr.com/the-void-promises-big-return/>

E.2.2 Market Drivers

Quest 2: an industry growth engine

- In late 2020, Meta launched its Quest 2 VR headset. The Quest 2 has been described as “a main driver of higher adoption of VR in 2021.”⁵⁰
- Estimates place total Quest 2 sales from launch to end of 2021 at around 10m units.⁵¹ May 2022 data showed that Quest 2 was the most popular VR headset among users on the Steam distribution platform, with a 50% share of its monthly total VR headset customer base.⁵² According to Counterpoint Research, the Quest 2 was the most popular headset of 2021, reaching a market share of 80% by Q4.⁵³
- The Quest content store (Meta's VR distribution platform) has benefited from a strong uplift in revenue since the launch of Quest 2. It generated around \$850m of platform sales in 18 months, indicating that Quest 2 has become a growth engine within the sector.⁵⁴ To place this \$850m figure in context, the total 2021 VR content sales have been estimated at \$1.8bn (see section E above).
- This uplift in content sales has benefited content producers; the number of games developers earning more than \$1m on Meta's Quest store doubled in the six-month period ending Feb 2021.⁵⁵ A 2021 survey among 3,000 VR developers showed that a 50% were working on a release for Quest.⁵⁶
- As an untethered, standalone unit, the Quest 2 offers significant benefits over the sector norm of VR headsets which require connection to gaming hardware.⁵⁷
- The success of Quest 2 is also attributed to its price.⁵⁸ It is assumed that Meta subsidised the device price in order to promote sales. Mark Zuckerberg says Meta will “continue to either subsidize our devices or sell them at cost to make them available to more people.”⁵⁹

Top tech brands are committing to the XR hardware market

- It can be anticipated that we are now entering a phase of product launches that will bring XR hardware into the mainstream. This wave commenced with Meta's release of the Quest 2 in 2020. It is widely assumed that development of an XR headset is in progress at Apple.⁶⁰

⁵⁰ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁵¹ <https://omdia.tech.informa.com/pr/2021-dec/omdia-research-reveals-12m-consumer-vr-headsets-sold-in-2021-with-content-spend-exceeding-2bn> and <https://www.theverge.com/2021/7/27/22596076/facebook-oculus-quest-2-storage-upgrade-foam-face-mask-recall>

⁵² <https://store.steampowered.com/hwsurvey/Steam-Hardware-Software-Survey-Welcome-to-Steam>

⁵³ <https://www.counterpointresearch.com/global-xr-AR/VR-headsets-market-share/>

⁵⁴ <https://www.roadtovr.com/oculus-quest-store-revenue-1-billion-milestone-growth-meta/>

⁵⁵ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁵⁶ <https://uploadvr.com/gdc-survey-2021-oculus-quest-vr/>

⁵⁷ <https://armkeil.blob.core.windows.net/developer/Files/pdf/report/newzoo-arm-AR/VR-opportunity-for-mobile.pdf>

⁵⁸ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁵⁹ <https://uploadvr.com/zuckerberg-meta-headsets-cost/>

⁶⁰ For example see: <https://www.slideshare.net/AugmentedWorldExpo/mike-boland-artillery-intelligence-where-will-the-big-five-take-spatial-computing>; <https://uploadvr.com/tim-cook-ar-headset-stay-tuned/>; <https://www.macrumors.com/roundup/apple-glasses/>

There is speculation that Google is developing an AR headset and more recently, Amazon also.⁶¹

- The advent of an Apple device raises the prospect that “XR might have its ‘iPhone moment’.”⁶² (Although this sentiment is not shared by all commentators.⁶³)
- The launch and discontinuation of Google Glass has shown that top tech brands can fail with an XR product. Nevertheless Apple, Google and Meta are three of the biggest companies in the world, and their shared commitment to XR can only increase the potential for market expansion.
- It is supposed that Sony, Samsung and HTC are also developing new headset and eyeglass products. This stream of new hardware development will stimulate “rising developer interest and elevated levels of funding for upcoming content productions.”⁶⁴
- Additionally, influential consumer brands from outside of tech (Nike, Disney) are making a commitment to the immersive sector.⁶⁵

The metaverse: driving XR investment beyond Meta

- Mark Zuckerberg’s vision of the metaverse has had an extraordinary effect on the technology community. What a metaverse could mean in practice is still a matter of conjecture. However it is relatively clear that XR is a core enabling technology that is essential for any prospect of realising the metaverse vision.⁶⁶
- Meta’s Quest 2 headset (as described above) is already contributing to an expansion of the market.
- The technology community beyond Meta is investing to support metaverse XR priorities. Qualcomm (manufacturer of chips used in headsets) opened a European XR Lab in January 2022, a press release stating “Qualcomm Technologies is ... increasing its investment in XR technology in Europe to further reinforce its role as the ticket to the metaverse.”⁶⁷ In March it launched a \$100m developer fund called the Snapdragon Metaverse fund.⁶⁸ In May 2022, PWC said “companies developing AI, virtual reality (VR), augmented reality (AR) and connective hardware are attractive acquisition targets as interest in the metaverse grows.”⁶⁹
- It is also reported that metaverse “has become a new buzzword in China ... Chinese have begun testing the water by developing metaverse type apps, trademarking metaverse-related phrases, and investing in the VR/AR segment.”

⁶¹ <https://uk.pcmag.com/vr-1/138269/report-google-is-developing-an-ar-headset> and <https://uploadvr.com/amazon-job-listings-AR/VR-product/>

⁶² <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁶³ <https://aecmag.com/technology/waiting-for-augmented-reality-ar-for-aec-architecture-construction/>

⁶⁴ <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁶⁵ <https://www.skillnetireland.ie/wp-content/uploads/2022/04/The-Irish-Immersive-Economy-report.pdf>

⁶⁶ <https://www.goldmansachs.com/insights/pages/gs-research/framing-the-future-of-web-3.0-metaverse-edition/report.pdf>

⁶⁷ <https://www.qualcomm.com/news/releases/2022/01/qualcomm-announces-collaboration-microsoft-expand-and-accelerate-ar-usher>

⁶⁸ <https://www.qualcomm.com/news/releases/2022/03/qualcomm-launches-100m-snapdragon-metaverse-fund>

⁶⁹ <https://www.pwc.com/gx/en/services/deals/trends/telecommunications-media-technology.html>

5G to increase demand and open up edge computing for smartphone users

- Mainstream rollout of 5G is currently underway⁷⁰ and in time it will improve the speed and latency of mobile data, bringing an enhanced user experience to mobile AR.
- Pokémon Go is a location-based collaborative game i.e. it all involves multiple players in the same location, playing the same game. Smart phones struggle with the data burden of such games, resulting in relatively simplistic game design and depletion of phone battery.⁷¹
- 5G connectivity will allow mobile devices to draw on remote processing via edge computing. Edge computing has been identified as a crucial enabler for immersive technology.⁷²
- As explained by Wired: “Rather than games having to send data to a distant central server, process it, and ping back a response, all of which slows down overall communication speeds, they will be able to access more power, closer to their users.”⁷³
- This application of edge computing should boost the sophistication and speed of location-based multiplayer games, and enable an improved user experience as AR becomes less of a strain on battery life.⁷⁴

China: the top market for XR although games consumption subject to regulation

- China is the lead consumer of immersive content and demand is expected to grow rapidly.
- China was estimated to account for almost 56% of global AR/VR spending in 2021.⁷⁵ The China AR/VR market is predicted to grow at 67.5% CAGR over the five years from 2021.⁷⁶
- This follows China's existing position as the largest gaming market in the world, giving demand for immersive games content a formidable starting point.⁷⁷
- On the other hand, China has introduced a ban on people below the age of 18 playing computer games for more than three hours per week.⁷⁸ This is a tightening of previous restrictions which allowed for 1½ hours per day. This suggests a potential slowing of demand for gaming products in general.
- While China is set to be the leading consumer of immersive content, the country is also a headset producer and exporter. Huawei has produced its own AR glasses.⁷⁹ iQiyi – described as the Netflix of China – has produced a standalone VR headset called the

⁷⁰ <https://gsacom.com/paper/lte-to-5g-june-2021-global-update/>

⁷¹ <https://www.wired.co.uk/article/bc/ericsson-5g-gaming>

⁷² <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf>

⁷³ <https://www.wired.co.uk/article/bc/ericsson-5g-gaming>

⁷⁴ <https://www.wired.co.uk/article/bc/ericsson-5g-gaming>

⁷⁵ <https://nexttrendsasia.org/glimpse-into-chinas-vr-ar-world/>

⁷⁶ <http://global.chinadaily.com.cn/a/202109/02/WS61302575a310efa1bd66cc2c.html>

⁷⁷ <https://newzoo.com/insights/rankings/top-10-countries-by-game-revenues>

⁷⁸ <https://www.cnbc.com/2021/08/30/china-to-ban-kids-from-playing-online-games-for-more-than-three-hours-per-week.html>

⁷⁹ <https://vr-expert.com/huawei-launches-their-own-assisted-reality-smart-glasses/>

Adventure Bloom.⁸⁰ Game content for the Adventure Bloom is expanding through partnerships with games developers. The Adventure Bloom will also offer film and TV, “fuelled by iQiyi’s massive content library.” DPVR produces a range of VR headsets that are distributed outside of China. In 2022 it announced completion of a “multimillion dollar” round of funding.⁸¹

VR distribution more fragmented in comparison with AR

- In common with the 2019 baseline analysis, VR content remains distributed across several platforms whereas AR is converging around two main distribution platforms, the iOS App Store and Android Google Play Store.⁸²

Location based VR entertainment offers access to expensive technology

- It is reported that major film studios are moving towards VR location based entertainment (LBE), examples being Warner Brothers installing VR Harry Potter experiences in New York and a Netflix VR roadshow based on Army of the Dead.⁸³
- Immersive LBE gives IP owners another revenue stream to exploit existing IP.

E.2.3 Barriers to growth

Demand side: lack of demand

- VR is a niche segment within the games market.⁸⁴ The Steam platform has 120m monthly active user of which 3.2% were VR headsets users in May 2022.⁸⁵ Although this represents several million users, there is nevertheless a relative lack of demand for VR in comparison with more mainstream gaming content.
- A survey among VR developers found ‘low audience adoption’ to be the most common challenge or deterrent when developing new VR content.⁸⁶
- Lack of demand has also been attributed to the AR segment.⁸⁷ Six years after its launch, the success of Pokémon GO still remains highly atypical of the wider AR gaming market.⁸⁸
- Business models within immersive technology are not yet established, creating uncertainty around revenue.⁸⁹ Monetisation of smartphone AR “is still under exploration.”⁹⁰

⁸⁰ <https://global.chinadaily.com.cn/a/202112/02/WS61a89035a310cdd39bc78fbc.html>

⁸¹ <https://www.prnewswire.com/news-releases/dpvr-completes-a-new-round-of-multimillion-dollar-financing-and-its-new-gaming-vr-headset-is-coming-soon-301570205.html>

⁸² <https://armkeil.blob.core.windows.net/developer/Files/pdf/report/newzoo-arm-AR/VR-opportunity-for-mobile.pdf>

⁸³ <https://www.linkedin.com/pulse/why-netflix-sending-zombies-after-location-based-virtual-bob-cooney>

⁸⁴ <https://www.gartner.com/smarterwithgartner/3-reasons-why-vr-and-ar-are-slow-to-take-off> and <https://arpost.co/2019/11/27/ar-and-vr-changed-our-lives-5-barriers-adoption/>

⁸⁵ <https://backlinko.com/steam-users>; <https://store.steampowered.com/hwsurvey/Steam-Hardware-Software-Survey-Welcome-to-Steam>

⁸⁶ <https://blog.vive.com/us/vr-developers-share-biggest-roadblocks-theyve-overcome/>

⁸⁷ <https://techcrunch.com/2021/01/23/augmented-reality-and-the-next-century-of-the-web/>

⁸⁸ <https://armkeil.blob.core.windows.net/developer/Files/pdf/report/newzoo-arm-AR/VR-opportunity-for-mobile.pdf>

⁸⁹ <https://www.immerseuk.org/wp-content/uploads/2019/11/The-Immersive-Economy-in-the-UK-Report-2019.pdf>

⁹⁰ <https://armkeil.blob.core.windows.net/developer/Files/pdf/report/newzoo-arm-AR/VR-opportunity-for-mobile.pdf>

Demand side: a relative lack of content from the major studios

- It is reported that major games producers by-and-large eschew VR developing content or else clone their existing AAA games for VR users.⁹¹
- This has resulted in a relative lack of content for VR games and the predominance of indie studios in VR design.⁹²
- 2019 research finds that many developers and producers are waiting for greater adoption before entering the market and producing new titles.⁹³

SupplySide: supply chain issues

- Global supply chain issues during the pandemic led to hardware shortages with producers unable to fulfil growing demand.⁹⁴
- As a result of increasing manufacturing and shipping costs, Meta increased the price of Quest 2 headset by US\$100 in January 2022.⁹⁵
-

SupplySide: a skills shortage

- A skills shortage within the content production community is often identified as a substantial industry challenge.
- In 2020, a US recruitment website recorded a 1400% year-on-year increase in adverts for AR and VR developers. Journalists undertaking a spot check on the Meta (then Facebook) careers page found more 3,000 AR/VR roles and another 1,000 across Google, Microsoft, Apple and Amazon, with recruitment demand said to be outstripping supply.⁹⁶
- Within the UK, the skills gap includes a lack of technical skills, a lack of relevant experience, a scarcity of graduates with relevant skills and the lack of professional training.⁹⁷ A UK study specifically found a shortage of professionals with Unity and Unreal skills – the two standard development platforms for VR games.⁹⁸

SupplySide: lack of integration with existing everyday use-cases

- The 2019 study outlined an opportunity for integration of immersive technology within existing mainstream apps (as distinguished from development of new 100% immersive apps or games). This seems equally relevant to the 2022 XR landscape.⁹⁹

⁹¹ <https://pinglestudio.com/blog/co-development/whats-the-future-of-vr-game-development-vr-trends--challenges>

⁹² <https://www.bitkraft.vc/wp-content/uploads/2021/10/21-10-BITKRAFT-Reality-Check-vF.pdf> and <https://pinglestudio.com/blog/co-development/whats-the-future-of-vr-game-development-vr-trends--challenges>

⁹³ <https://armkeil.blob.core.windows.net/developer/Files/pdf/report/newzoo-arm-AR/VR-opportunity-for-mobile.pdf>

⁹⁴ <https://www.globaldata.com/interest-in-ar-vr-grows-during-Covid-19-pandemic-but-market-needs-to-evolve-says-globaldata/>

⁹⁵ <https://www.oculus.com/blog/meta-quest-2-pricing-changes/>

⁹⁶ <https://www.vox.com/recode/2020/2/11/21121275/augmented-virtual-reality-hiring-software-engineers-hired>

⁹⁷ <https://www.storyfutures.com/uploads/images/SFICC-Report-2019-20.2.20.pdf>

⁹⁸ <https://www.storyfutures.com/uploads/images/SFICC-Report-2019-20.2.20.pdf>

⁹⁹ <https://techcrunch.com/2019/01/14/for-AR/VR-2-0-to-live-AR/VR-1-0-must-die/>

- Social network Snap has successfully demonstrated this model by integrating AR features into its platform.¹⁰⁰
- For this integration to take place, it is advocated that XR must map out a new set of “critical use cases, with features in critical apps that we use all day, every day.”¹⁰¹

SupplySide: virtual live streaming segment subject to significant barriers

- Barriers to growth in this segment include: cost of VR cameras; specialist technology requirements of handling high-pixel count streams; specialist skill sets required from a range of disciplines.¹⁰²

Regulation: as VR develops in the future, so more questions will arise about data protection standards and legal implications

- The way in which data protection standard should play out in the context of VR does not seem properly understood. According to a journalist: “GDPR does cover some aspects of data privacy for VR users but these will need clarification and extension to be considered adequate. Minimum security standards have yet to be established for VR specifically ...”¹⁰³
- XR applications of the future will use large volumes of highly personal user data such as eyeball movement and facial expressions. This in turn raises questions about data protection standards.
- Commentators can be somewhat disturbed by Meta's involvement in XR given its poor track record to date on data protection issues.¹⁰⁴
- Discussion of immersive communities in the media has also triggered discussion of the legal implications associated with usage and ownership of immersive communities. ‘The knotty problem of applying real-world laws to VR and AR’ reads the title of an article that asks question such as “When and how do laws and regulations (such as indecent exposure, fraud or assault) apply to XR conduct that is first governed by contract on a private platform?”¹⁰⁵

Gradual improvements to the hardware design problems

- Hardware design has conventionally been a problematic area for the immersive technology sector. VR headsets have typically required tethering to a games console or high-spec PC. This impedes user mobility and raises the consumer cost of entry into VR. Battery life is also an issue across the category.

¹⁰⁰ <https://www.marketingdive.com/news/snapchat-social-commerce-augmented-reality-virtual-shopping/622991/>

¹⁰¹ <https://techcrunch.com/2019/01/14/for-AR/VR-2-0-to-live-AR/VR-1-0-must-die/>

¹⁰² <https://www.abc.org/trends/vr-the-future-of-live-content/5656.article>

¹⁰³ <https://medium.com/@thomaswickens/virtual-reality-and-data-privacy-860aa266dd7e>

¹⁰⁴ <https://www.technipages.com/can-you-trust-oculus-quest-2s-privacy-features>

¹⁰⁵ <https://www.weforum.org/agenda/2021/08/real-world-laws-ar-and-vr/>

- Some of these barriers to consumer adoption can be expected to dissipate. Meta's Quest 2 - an untethered headset with high quality gameplay at an affordable price – could be seen as part of a “transition ... to standalone mobile virtual reality devices.”¹⁰⁶
- Motorola has produced a processing unit that can be worn around the neck like a lanyard in order to support a headset without need for connection to a laptop.¹⁰⁷ Qualcomm is creating a system to enable AR glasses to work in conjunction with a smart phone and thereby avoiding physical tethering.¹⁰⁸
- These product innovations demonstrate that suppliers are attempting to solve the problems that are inhibiting market growth.

¹⁰⁶ <https://www.diamandis.com/blog/convergence-catalyzer-part-3-AR/VR>

¹⁰⁷ <https://www.theverge.com/2022/2/15/22934526/motorola-verizon-5g-neckband-vr-headset-ar-smart-glasses-qualcomm>

¹⁰⁸ <https://www.qualcomm.com/news/releases/2020/05/qualcomm-collaborates-15-global-operators-deliver-xr-viewers>

Appendix F Interim Process Evaluation

This section presents the key findings from the interim process evaluation, conducted in 2020 with the aim of understanding the effectiveness of the programme design, governance, and programme processes.

The programme was carefully designed around a set of mechanisms (or programme components) to address market failures in developing commercially sustainable creative immersive experiences and technologies. The market failures and barriers were identified through industry consultation and pre-programme scoping work.

Is the value of the whole greater than the sum of the parts?

We found that the mechanisms had value in their own right but the intention – and the potential value – would be greater if the instruments operate more as interlocking elements of a de facto sector development programme. However, at the point the process evaluation was undertaken, there was little evidence that the mechanisms that have been put in place to allow for cross-fertilisation between the programme strands.

The exception to this was the interaction between a number of grant recipients with Investment Accelerator programme. Four companies awarded Design Foundations projects and three awarded PIIC projects applied for access to Investment Accelerator programme with one award emerging from those applications. The successful company, Maze Theory, planned to use the new funding to combine the outputs of their Design Foundations project with other game formats and validate their developments.

SFA is connected with the AHRC Creative Industries Cluster Programme (CICP) and has a specific role to work with the nine regional clusters to support on training and development needs. This engagement work took longer than anticipated to get off the ground. Contributory factors to the delays included the different timescales that the two projects were working to, and the fact that the NCIS programme team have also had to balance the benefits of connecting up their activity with CICP activity against reporting arrangements which require a clear separation between the two of output counting and finance.

In part, this general lack of cross fertilisation, both within the programme and with the CICP, may have just been a factor of the pace and timescale of the programme at this early stage.

Are the mechanisms that are used the most effective ones for delivering the programme's objectives?

Evidence from both the survey and interviews with programme participants suggested that the combined AotF programme was deemed relevant and appropriate. But at the stage the evidence base was assembled through the evaluation, it was not sufficient to make definitive statements on whether these are the *most* effective mechanisms that could be used. In part, this also reflects the fact that the evaluation did not include a comparative review of other mechanisms that might have been chosen to achieve similar results.

Is the programme's Governance structure working effectively?

The governance structure for AotF was appropriate, with both the Programme Board and the Challenge Director having been seen to demonstrate strong leadership of the programme. The balance between the Challenge Director and Programme Board also seems to have been struck, ensuring the programme was both flexible, innovative and reflective of the needs of the programme, whilst also ensuring that due process is followed to ensure programme integrity through robust and coherent decisions. The Creative Industries Advisory Group (CIAG) had also largely been working well and has been a valuable mechanism for building ownership among stakeholders and in encouraging cross-Council working.

We made the following recommendations to further improve the effectiveness of the programme's Governance arrangements:

1. a small number of additions to the membership of the Programme Board to ensure alternately a greater connection downstream into industry, and upstream into central government.
2. augmenting the membership of the Creative Industries Advisory Group (CIAG) to better reflect the immersive technology sector).
3. making greater efforts to better integrate AotF with the Creative Industries Sector Deal.

Are the programme's processes appropriate, robust and efficient?

The AotF programme largely delivered the strands and competitions within the programme in line with standard Innovate UK practices. As such, analysis presented in this section mainly focussed on the practices and processes that were unique to the AotF programme, or had significant implications on the programme's success.¹⁰⁹

It is at the level of process that some friction in the AotF Challenge has been evident. This arose due to some initial tensions regarding the role and remit of the Challenge Director vis-à-vis Innovate UK, and the fitness of the latter's existing processes to implement the new ISCF AotF Challenge. In turn, these seem to have been driven by (i) the particular demands of the ISCFs, which differ in some crucial respects from the type of innovation programme that Innovate UK more regularly delivers; and (ii) the nature of the creative industries sector, in terms of its structure (predominantly small and micro businesses), its partial and limited exposure to prior Innovate UK programmes, and the distinctive nature of creative R&D as compared to science and technology-based R&D.

Taking account of these differences, the Challenge Director devised a briefing programme that sought to engage more deeply with the sector at pre-application stage, as well as taking more executive control over the selection process. The extra lengths that the AotF programme team went to in terms of the briefing stage were well received by the sector and resulted in a high-level of participants who were new to Innovate UK. The changes that were made to the selection process were also welcomed by participants and the resulting revised selection model combined independent assessment with a strategic overview of the programme and sectoral expertise.

Feedback on selection decisions also raised some issues, with occasional delays adding to the more difficult task of having to reject many strong applications – for a programme that was oversubscribed and had a higher bar set in terms of the projects that got funding as compared to other comparable programmes.

The programme initially intended to appoint a set of Independent Advisors to provide strategic, technical and commercial advice to the Demonstrator projects. The Advisors would have worked directly with (and across) projects and report to the Challenge Director. Unfortunately, a decision was taken by the ISCF steering board not to proceed with the Independent Adviser appointments.

As to the overall appropriateness of the AotF processes for creative sector SMEs, interviews carried out across the evaluation suggest that the sector saw participating in the AotF programme as carrying a high / very high managerial and administrative burden. This presented a real difficulty and barrier to micro and small companies. Any future UKRI

¹⁰⁹ The application and selection of SFA was delivered as part of the Clusters programme and is outside the scope of this evaluation.

programmes aiming at the creative industries could usefully reflect upon how to further adapt and streamline the processes for selection and the monitoring of spend accordingly.