technopolis group

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Evaluation of the ISCF Audience of the Future

Phase 2: Interim report

Version 2

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Phase 2: Interim report

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Executive Summary

This report

This is the Interim report of the evaluation of the Audience of the Future Challenge.

The scope of the evaluation is to assess the extent to which the programme is making or has made an impact considering its original aims. The evaluation will test the extent to which the programme delivers the outcomes and impact for industry and the extent to which these are attributable to ISCF funding.

This report provides a follow-up assessment of the progress made by the programme so far (with respect to its objectives and the indicators identified in the Evaluation Framework). Whenever possible we provide a comparison with the baseline position to identify trends, and with a control group or benchmark to assess the extent to which the observed results can be attributed to the programme. The report also presents emerging findings with respect to the Creative Immersive Content sector in the UK and a wider (international) analysis (with focus on recent developments in China).

Interim results – wider context

Sector level analysis

According to our analysis, a total of **1,286 companies** are working in the Creative Immersive Content sector in 2020, to some extent. **This represents a decrease of 8.5% in comparison with the prior year.** This decline suggests that some companies active in this sector have struggled to survive the economic consequences of the ongoing Covid-19 pandemic that begin in March 2020.

More than a third of the companies (36%, or 462 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.

The ISCF AotF programme is engaging with 136 companies from the sector (this means that 10 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).

In contrast with the number of companies, **we find an increase of 29% of the workforce in comparison with the baseline position.** We estimate that there are currently 36,258 people working in the Creative Immersive Content sector or in related roles/tasks. This includes: 13,901 people working within the DCM CI sectors. This figure represents 0.7% of people working in the Creative Industries Sector (and 0.2 percentage points higher in comparison with the baseline).

Furthermore, looking again at the entire workforce, we estimate that there is an increase of 47% in the proportion of the workforce 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.

There is however a slight decline of the UK workforce as a percentage of the EU workforce in this sector, in comparison to the baseline position. This is mainly due to the substantive

expansion of the EU workforce mostly around the 'tech skilled' category (58% higher in comparison to the baseline).

Regarding **geographical distribution**, and focusing on the DCMS CI sector sub-group, London has the largest workforce (7,586). This represents an increase of 12% (~800 more people).

Furthermore, the London workforce accounts for almost 58% of the total UK Creative Immersive Content workforce (equal to the baseline position).

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 0.56% jobs in the CI sector in the region. **The highest penetrations – for cities with a workforce of 100 or more – are instead to be found in Sheffield (231, 0.87%), Cambridge (247, 0.82%), and Brighton and Hove (306, 0.77%).** In these three cases, workforce and penetration is slightly higher in comparison with the baseline. This signals the growing importance of the sector in these cities.

In terms of **public R&D investment**, we have identified a total of 30 projects, with a combined value of £5.6m (in terms of public investment) over the past year (in line with information collected at the baseline stage.) **At roughly twice this total value, the support provided via the AotF programme (£33m in 2018-2020, i.e. £11m yearly) constitutes a substantial additional investment in this area by the UK government.**

We also estimate that private investment in the Creative Immersive sector has been $100m (£82m) in the past year, based on the values raised in last investment round (and on disclosed information). This represents a decrease of 17.5% in comparison with the baseline.

The overall amount of private investment in the UK is lower in comparison with the rest of the EU, $100m versus $169m (but still substantial considering that we are comparing one country against 27). This presents a change in comparison with the baseline position, mostly driven by the substantial increase in the total value of deals within the EU in the past year (123%).

Further analysis reveals that the profile of investment in the UK has shifted towards early stage companies and these results indicate a higher appetite for risk among those investing in UK based ventures.

Wider market analysis – China

China represents 7% of the global industry and is the largest single market for immersive. Led by China, Asia is set to dominate the consumption of AR/VR for the next five years, driving more revenue than North America and Europe combined, with China the largest single market for immersive in the long term.

The Chinese government is driving investment domestically through the provision of government-backed matched-investment initiatives. In 2020, the total spending on AR/VR-related products and services in the Chinese market accounted for more than half of the global market share (approximately 55%), a significant increase from before the epidemic. The overall market size of China will reach around $6.6 Bn USD by the end of 2020, a year-on-year increase of 72.1% compared to 2019, surpassing the United States and Japan in terms of scale and growth, and ranking first in the world.

Investments in AR have recently surpassed investment in VR. VR investment saw a 45% decrease in 2020 compared with 2019; AR investment saw only a drop of 10% during the pandemic.

Recent policies to mitigate global trade disputes have put greater emphasis on domestic production. Paradoxically this policy could boost international collaborations in R&D, as the Chinese look to increase its capacity in creativity and innovation through international partnerships and investment. However, these partnerships should reinforce the development of new co-authored goods, services, IP, technologies and content, that are specific to the Chinese context.

Adoption of immersive is high in China, the market is primed and there is latent demand for 5G which is likely to further drive adoption. 5G which is set to drive access to mobile immersive applications, and it is already being rolled out across tier one cities in China. This is significant because pre-5G connectivity in China is much slower then 4G connectivity in the UK, making access to HD video let alone immersive content - difficult.

International producers and manufactures are already benefiting from the Chinese market with Oculus outselling Chinese headsets. Oculus market share increased from 18.8% in 2018 to 39.2% in 2019Q3 in China. Popularity in China this helped Oculus to become the global headset leader.

Interim results – the AotF programme

Demonstrators

The Interim findings related to the Demonstrators are unsurprisingly dominated by how the four projects have had to deal with the COVID-19 pandemic. All of the projects have had to move their teams to remote working and all have had to 'pivot' their projects to deal with the new realities for audiences during the pandemic. The Demonstrators which were more focused on Location-Based Experiences (LBEs) and whose consortium partners' existing businesses have been hardest hit by the pandemic have had to pivot the most and been hardest hit.

But the Covid crisis has also generated opportunities for the Demonstrators. The Covid-driven pivots share the same trajectory – more virtual and digitally connected components and workflow. This necessity has driven innovation in the Demonstrators and two of the four projects (WEAVR and The Big Fix Up) report that the revised Covid-influence projects and plans are an improvement on their original plans. It is also apparent that these two Demonstrators are those where the partners within the consortiums have been able to pull together the best through the Covid-affected period. Conversely, core partners in the Performance Demonstrator have been hit badly in terms of revenue and staffing, which has slowed progress, and structural and attitudinal differences contributed to some collaboration challenges between the core partners in the Visitor Experience Demonstrator. Finally, aggravating factors shared by both the Performance and Visitor Experience Demonstrators are the centrality of LBEs to their projects and the use of Magic Leap AR headset technology which has not performed as hoped.

However, **all the Demonstrators have (to-date) come through this turbulent and uncertain period intact and each have elements that have been / or will be delivered**. 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.

Reflecting on the Interim findings, a number of inter-related factors appear salient to the observed outcomes. These include: structural organisational characteristics (e.g. size, sectoral background), as these appear to influence attitudes and behaviours that are important to collaboration, innovation and R&D, such as ways of working, decision-making process and attitudes to risk; the nature and degree of commercial incentives, as these may have an influence on how aligned partners are in terms of priorities for the project; how well or less well partners are able to protect resources and attention for the project from internal competition

from partners' core business – the Demonstrators provide a good example of how structural differentiation (i.e. creating a new and separate entity) can help; and the involvement of the knowledge base has been an unexpectedly valuable component for two of the Demonstrators, in validating and informing decision-making.

Grants and investments

Overall, **participants in the Design Foundation projects reported positive outcomes and impacts to their overall business performance**. Participants reported an increase in their overall (median) turnover and FTEs, and these increases were greater than observed in the counterfactual cohort. Moreover, participating organisations reported increased levels of investment in R&D for immersive technologies and increased R&D intensity, again higher than those reported by the unsuccessful applicants. Both results indicate that the programme is already having a (net) positive impact on participants across these dimensions.

The Design Foundation projects have provided a valuable platform for participants to build new collaborations, with the majority collaborating with new partners. This is especially true for building new collaborations with micro companies. Overall, the majority of participants agree or strongly agree that their Audience of the Future project enhanced their partnerships, with almost all indicating they see avenues for future collaboration.

The majority of organisations developed a new creative immersive product through their Design Foundation project, with around half developing a new creative immersive service. Funded Design Foundation projects have made very good progress in terms of their Technology Readiness Levels, with the majority taking their project from feasibility (TRL 1 – 2) towards demonstration. Most participants also reported new or improved working processes. As a result, almost half of Design Foundation participants reported new revenue streams attributed to new products/services or new customers supported by their AotF project. By contrast, the majority of unsuccessful applicants did not continue with their intended project and did not progress the TRL of their project. These results further indicate that the funding and structure provided by the grants was critical to implementing the participants' idea, as unsuccessful applicants seem to have struggled to find alternative resources to continue with their ideas.

Almost all participants agreed that the programme had supported the development of new skills among their staff and improve the internal capabilities.

1 Introduction

1.1 Audience of the Future

The Audience of the Future (AotF) programme was launched in March 2018 as part of the Creative Industries Sector Deal with up to £33m from the Industrial Strategy Challenge Fund to support the development of immersive experiences and technologies in the UK-based creative sector. The programme is comprised of three main areas of investment: The National Centre for Immersive Storytelling (NCIS) called the StoryFutures Academy, the Demonstrator programme, and other smaller grants and investment for research and development (including Production Innovation for Immersive Content, Design Foundations and Investment Accelerator). The programme runs until the end of March 2021.

The programme's high-level objectives are: (i) 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; (ii) 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 (iii) 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 will test the extent to which the programme delivers the outcomes and impact for industry 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 activity is organised as follow:

- *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
- The present *Interim report and updated process evaluation*, submitted in January 2021
- *Review and update,* planned to be delivered in May 2021
- *Final evaluation report*, planned to be delivered in March 2022.

1.3 This report

This report provides a follow-up assessment of the progress made by the programme so far (with respect to its objectives and the indicators identified in the Evaluation Framework). Whenever possible we provide a comparison with the baseline position to identify trends, and with a control group or benchmark to assess the extent to which the observed results can be attributed to the programme. The report also presents emerging findings with respect to the

Creative Immersive Content sector in the UK and a wider (international) analysis (with focus on recent developments in China).

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 evidence pertaining to the wider context of the programme and includes both the Sector Analysis (Section 2.1) and the Wider Market Analysis with a particular focus on China (Section 2.2).
- Section 3 sets out the emerging evidence of the impact of the Audience of the Future programme for programme participants. This includes presentation of the results of the Stakeholder Consultation (Section 3.1) and interim case studies of the four AotF Demonstrators presenting progress to date (Section 3.2). Section 3.3. sets out evidence of impact for Design Foundation participants and their respective counterfactual group gathered during the post-exit survey of this AotF competition strand.
- Section 4 provides presents interim results of the process evaluation, with explicit focus on the Digital Catapult Support for the Demonstrator programme. Note that further analysis will be conducted as part of the process evaluation of the programme in the next stage of the study.
- Section 5 then provides a summary of the overarching conclusions we can draw, based on this emerging evidence, about the impact of the AotF programme and its position within the wider market landscape.

1.4 Methodology

Table 1 below summarises the activities undertaken to complete this report.

Table 1 Methodology for the Interim Report (phase 2)

Evaluation approach	Details
Sector level analysis #2	Update on the experimental statistics benchmark, including analysis of the CCI immersive content vertical (skills, companies, public and private investments)
Wider market analysis	Mid-point review & update report on market analysis and current conditions, with a particular focus on the immersive content vertical in China.
Stakeholder consultations	Mix of focus groups and one-to-one interviews with stakeholders, assessing programme progress to-date, wider awareness, interest and linkages with the wider industry
Demonstrators	Check-in interviews with the Demonstrator leads and their partners. Interviews with the team at the Digital Catapult.
Post-exit survey for Design Foundation programme (G&I)	CATI post-exit survey to the Design Foundation companies (PIIC and IA will be surveyed in November 2021).

2 Interim results – 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 and at this interim stage.

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 SIC codes or thematic fields, do not capture it in its entirely. In fact, our analysis has revealed that **30% of companies active in Creative Immersive Content fall outside the Creative Industries definition established by DCMS** (which relies on SIC codes).

At this interim stage, we are paying special attention to how the sector has changed in the past year or so. 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 programme).

Period of analysis

The baseline position corresponds to figures as captured in July 2019, while the current position corresponds to figures as captured in October 2020, unless indicated otherwise.

Methodology

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

1. **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 Appendix D). 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 D) and by Age of business.
2. **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.
3. **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 D) projects related

to "Creative immersive content". A wider discussion of other investments which do not appear in our baseline analysis is included below.

4. **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 1,286 companies are working in the Creative Immersive Content sector in 2020, to some extent. This represents a decrease of 8.5% in comparison with the prior 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 survive the economic consequences of the ongoing Covid-19 pandemic that begin in March 2020.

Note that the companies classified outside the DCMS definition of the Creative Industries (DCMS CI)[2] (which represent 30% of the total number of companies), are driving the total decline in the number of companies (with 21% decrease). This suggest 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)" (29%) and "Film, TV, video, radio and photography" (18%) (see Table 2).

Table 2 Number of companies working in the Creative Immersive Content sector, by DCMS CI classification (2020)

	Baseline		**Current position**	
Sector	Number	Percent.	Number	Percent.
Other (Non DCMS CI)	493	35%	390	30%
IT, software and computer services	395	28%	367	29%
Film, TV, video, radio and photography	226	16%	228	18%
Music, performing and visual arts	106	8%	110	9%
Design: product, graphic and fashion design	71	5%	68	5%
Advertising and marketing	53	4%	50	4%
Architecture	40	3%	44	3%
Publishing	17	1%	23	2%
Museums, galleries and libraries	5	0%	6	0%
Grand Total	1,406	100%	1,286	100%

Source: Technopolis and BOP Consulting (2020)

[1] The total figures (both at the baseline and at this interim 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 D 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.

The ISCF AotF programme is engaging with 136 companies from the sector (this means that 10 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). There is a relatively high percentage of newcomers in the "IT, software and computer services" (22%), "Architecture" (20%), and "Advertising and marketing" (20%) sub-sectors. The latter two were found to have only 8% and 15% newcomers respectively at the baseline point.

Table 3 Age of companies working on the Immersive Content sector, by DCMS CI classification (2020)

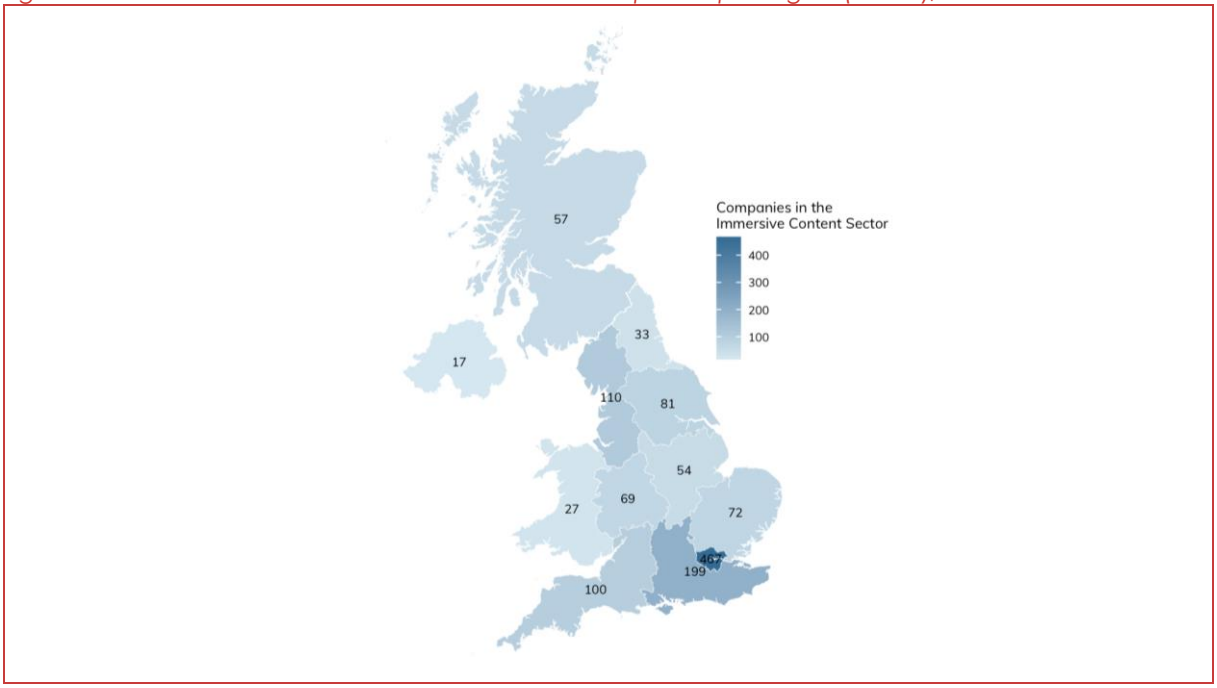
Sector	1 Yr	1-3 Yrs	3-10 Yrs	10+ Yrs	Total	Newcomers *
Advertising and marketing	15%	0%	43%	42%	100%	+5 pp
Architecture	3%	5%	48%	45%	100%	+12 pp
Design: product, graphic and fashion design	8%	3%	61%	28%	100%	+7 pp
Film, TV, video, radio and photography	12%	8%	51%	30%	100%	-3 pp
IT, software and computer services	10%	12%	53%	25%	100%	+0 pp
Museums, galleries and libraries	0%	0%	40%	60%	100%	+0 pp
Music, performing and visual arts	7%	10%	45%	38%	100%	+1 pp
Non DCMS CI	8%	8%	50%	35%	100%	+0 pp
Publishing	12%	6%	24%	59%	100%	-1 pp

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

As shown below in Figure 1, **more than a third of the companies (36%, or 462 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.

Additionally, a higher percentage (55%) of the young companies (3 years or less) are located in London and the South East (42% and 13% respectively), suggesting that the specialisation of these activities within London is being reinforced over time. These results are similar to the baseline.

Figure 1 Number of Creative Immersive Content companies per region (NUTS1), 2019



Source: Technopolis and BOP Consulting (2020)

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 **36,258 people identified themselves as working in the Creative Immersive Content sector** or in related roles/tasks, this includes:

- **13,901** people working within the DCM CI sectors. This figure represents 0.7% of people working in the Creative Industries Sector[3] (and 0.2 percentage points higher in comparison with the baseline).
- **22,357** people working outside the DCM CI sectors.

The overall total represents a 29% increase in comparison with the baseline position, as shown in Table 4. At the baseline, we estimated 11,028 people identified themselves as working in Creative Immersive Content sector, and within the DCM CI sectors (i.e. 21% lower than the current estimate). 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 47% increase in the percentage of the workforce 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 2020 with figures for 2019. https://www.gov.uk/government/publications/dcms-sectors-economic-estimates-2019-employment/dcms-sectors-economic-estimates-2019-employment. Accessed in January 2021.

The table below also present the EU figures. It shows that the share of the UK people within the EU workforce has decreased slightly since the baseline position. This is mainly due to the substantive expansion of the EU workforce mostly around the 'tech skilled' category (58% growth in comparison to the baseline).

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

	Baseline	**Current position**	**Change** (in percentage)
Total all UK immersive content	28,211	36,258	29%
Total all UK immersive content, tech skilled	7,281	10,716	47%
Total EU immersive content (incl. UK)	92,107	130,176	41%
Total EU immersive content, tech skilled (incl. UK)	21,294	33,597	58%
	Baseline	**Current position**	**Change** (in percentage)
UK immersive as % of EU	31%	28%	-3%
UK immersive as % of EU, tech skilled	34%	32%	-2%

Source: Technopolis and BOP Consulting (2020)

Table 5 Workforce: total all UK Creative Immersive Content

	Baseline	**Current position**	**Change** (in percentage points)
Total all UK immersive	28,211	36,258	29%
Total all UK immersive, % tech skilled	26%	30%	4%

Source: Technopolis and BOP Consulting (2020)

In terms of experience and looking again at the entire Creative Immersive Content sector, we see 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 7). 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

Years of experience	**Baseline**	**Current position**	**Change** (in percentage points)
0-5 yrs	24%	19%	-4%
5-10 yrs	28%	26%	-2%
10+ yrs	49%	55%	6%

Source: Technopolis and BOP Consulting (2020)

Table 7 Workforce: Creative Immersive content – top five roles

Top five roles	**Baseline**	**Current position**	**Change** (in percentage points)
Arts and Design	17%	17%	0%
Business Development	15%	14%	-1%
Engineering	11%	12%	1%
Media and Communication	8%	8%	0%
Information Technology	7%	7%	0%

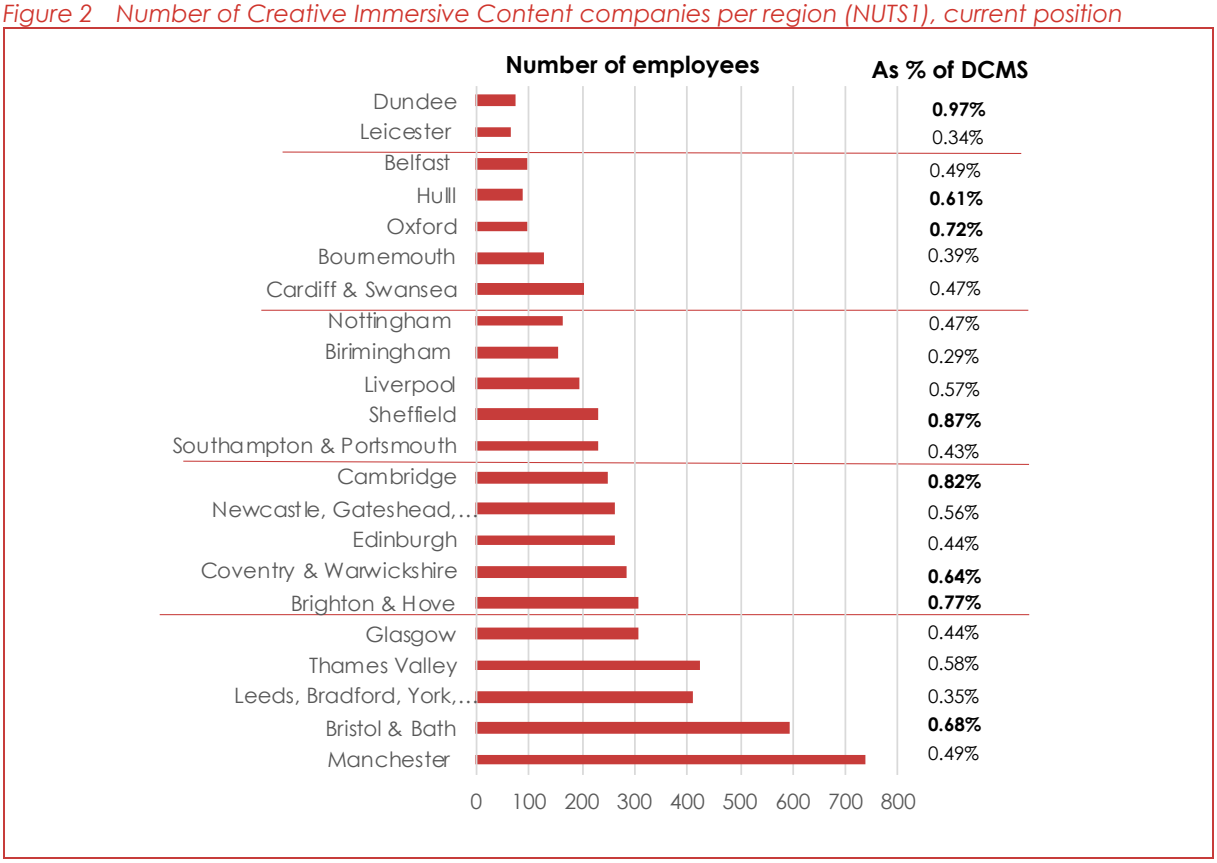
Source: Technopolis and BOP Consulting (2020)

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.

Regarding geographical distribution, and focusing on the DCMS CI sector sub-group, London has the largest workforce (7,586). This represents an increase of 12% (~800 more people). Furthermore, the London workforce accounts for almost 58% of the total UK Creative Immersive Content workforce (equal to the baseline position).

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 0.56% jobs in the CI sector in the region. The highest penetrations – for cities with a workforce of 100 or more – are instead to be found in Sheffield (231, 0.87%), Cambridge (247, 0.82%), and Brighton and Hove (306, 0.77%). In these three cases, workforce and penetration is slightly higher in comparison to the baseline. This signals the growing importance of the sector in these cities.

Figure 2 Number of Creative Immersive Content companies per region (NUTS1), current position



Source: Technopolis and BOP Consulting (2020)

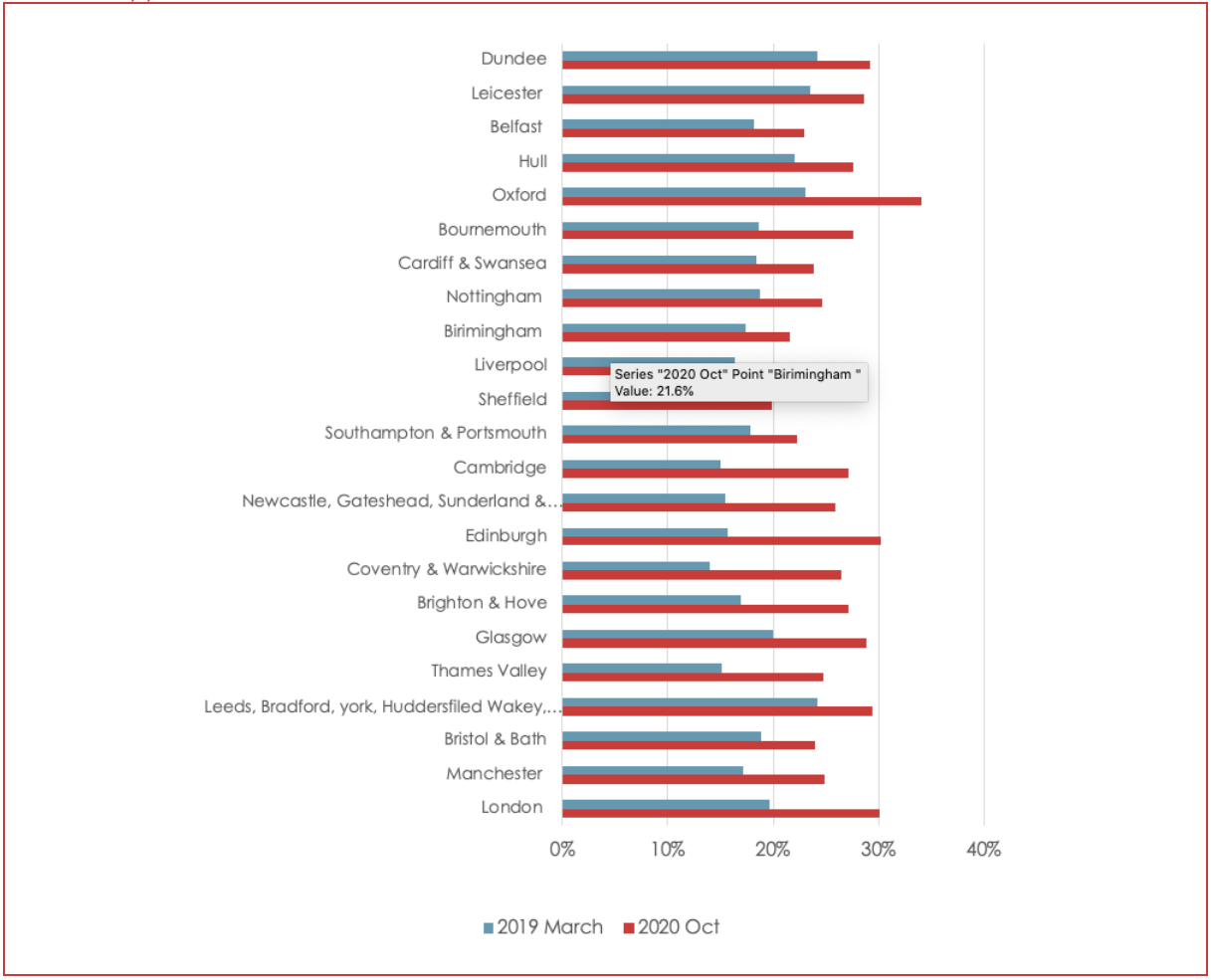
Data collected via LinkedIn for the purpose of this exercise also allows us to identify people that have signalled that they are open to new opportunities (in the platform), which can be used as proxy for estimating the proportion of people that may be considering a change in jobs. In this current climate, 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, 28% of the workforce in the Immersive Creative Content sector is open to new opportunities. This represents an increase of 9 percentage points in comparison to the baseline (when the figure was 19%). Furthermore, 39% of those looking for

new opportunities are currently working full-time, while in the baseline this group represented only 23% of the total.

Figure 3 below presents the results at the city level. The highest shift since the baseline +is shown in Edinburgh (14.4 pp), Coventry & Warwickshire (12.5pp), Cambridge (12.1pp), Oxford (10.9pp) and London (10.5pp).

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 59% as mentioned above). This in part reflects the changes in working patterns as a result of the restrictions imposed as part of the response to the COVID-19 pandemic.

Figure 3 Number of Creative Immersive Content companies per region (NUTS1), open to new opportunities



Source: Source: Technopolis and BOP Consulting (2020)

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 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.

Focusing on organisations that we classified as being part of the Creative Immersive Content Sector and have a commercial partner, we have identified a total of 30 projects, with a combined value of £5.6m (in terms of public investment) over the past year. This is in line with information collected at the baseline stage, in which we identified 87 projects for a total value of £16.8m over a period of three years. In other words, 29 projects and £5.6 funding per year, on average (although this baseline and current position excludes programmes such as Creative XR and the Creative Industry Cluster Programmes).

At roughly twice this total value, the support provided via the AotF programme (£33m in 2018-2020, i.e. £11m per year) constitutes a substantial additional investment in this area by the UK government.

The projects are led by 24 businesses and 6 Higher Education Institutions, with projects lead mainly by organisations operating in 'IT, software and computer services' (9 out 24, 38%) and 'Film, TV, video, radio and photography' sectors (5 out of 24, 21%). The majority of projects (24) are funded by Innovate UK, 3 by the AHRC, 3 by EPSRC.[4]

Most of the projects (57%) are valued between £30k-£100k, and around a third are of a larger scale (£250k-£1m). Examples of (large scale) projects include:

- 4i: Immersive Interaction design for Indie developers with Interactive machine learning, led by Goldsmiths College. Budget: £503,847
- ARiVR, led by Rocketmakers Limited (a "IT, software and computer services" company located in the South West. Budget: £538,911
- HAPPIE- Haptic Authoring Pipeline for the Production of Immersive Experiences, led by Generic Robotics Limited (a company located in the West Midlands). Budget: £782,921
- StoryFutures China: UK-China Transnational Strategic Partnership for Immersive Storytelling in Museums and Cultural Institutions, led by Brunel University in London. Budget: £417,380

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 has been $100m (£82m) in the past year, based on the values raised in last investment round** (and on disclosed information). This represents a decrease of 17.5% in comparison to the baseline (calculated as yearly average, based on the information from the prior three years).

Furthermore, we estimate a total of 45 deals have taken place over the past year, 34 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 (76%) the actual level of investment would be well in excess of the estimated $100m.[5] Furthermore, this indicates that the total private investment in this area could be (at least) 7-8 times higher in comparison to public support to R&D in the past year.[6]

The overall amount of private investment in the UK is lower compared to the rest of the EU, **$100m versus $169m** (see Table 8), (but still substantial considering that we are comparing one country against 27). This presents a change in comparison to the baseline position, mostly driven by the substantial increase in the total value of deals within the EU in the past year

[4] This includes a number of projects funded by Innovate UK but led by HEIs e.g. Liverpool John Moores University and Immersive Interactive Limited and Queen's University Belfast & Ostick & Williams Limited

[5] 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%).

[6] If we compare it with the value of the AofT and the CreativeXR programmes, as well as the value of the other immersive projects funded by UKRI.

(123%). Even though the number of deals in the EU has remained constant (~68), the average value of each deal has more than double in size (from $1.1m to $2.5m). The average size of the deals that took place in the UK has, on the other hand, remained relatively constant (from $2.9m in the baseline to $2.2m 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 almost 20 times higher. In France, there has also been a decline in equity deals of 50.7% in comparison with the baseline position.

The UK and EU 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 there has been a contraction of minus 3.2% in comparison to the baseline.

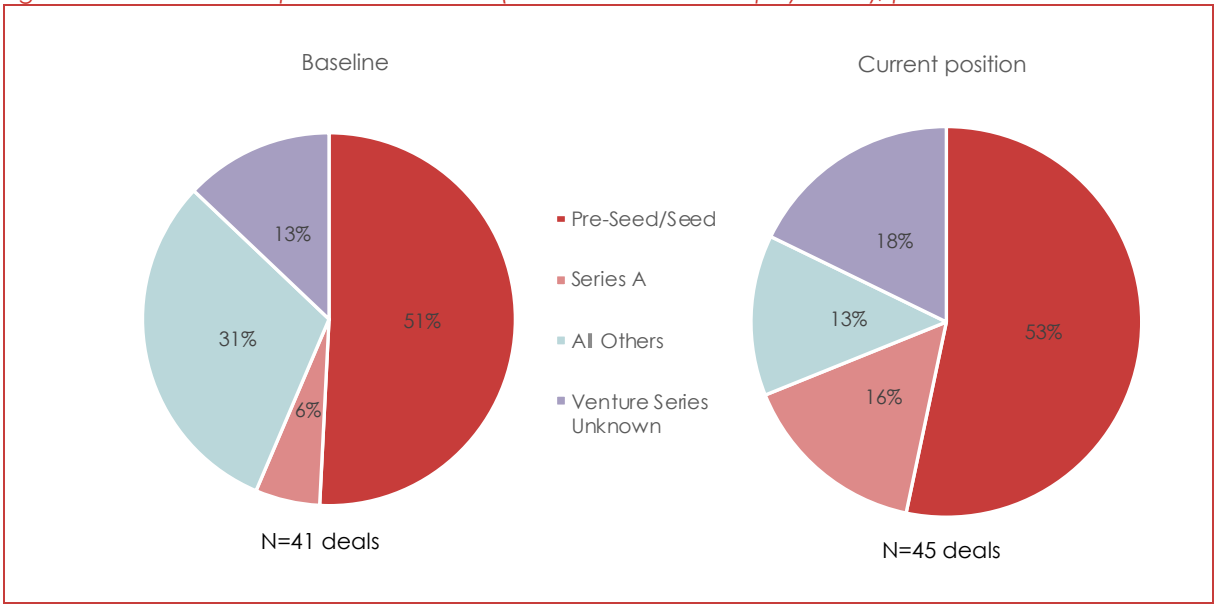
Further analysis reveals that the profile of investment in the UK has shifted towards early stage companies. At the baseline, 53.3% and 15.6% of the deals related to Pre-seed/Seed and Series A, respectively (and 68.9% across both). In contrast, those two rounds represented 56.4% of all deals at the baseline 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 12.5pp) is higher in comparison to the EU (where the increase in value of deals taking place in those two early rounds of investment is 10.6pp).

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

	Baseline*	**Current position****	**Change** (in percentage)
UK	$ 120,997,465	$ 99,783,741	-17.5%
EU (minus UK)	$ 75,583,688	$ 168,655,034	123.1%
France	$ 10,298,461	$ 5,080,099	-50.7%
Rest of the world	$3,478,418,587	$ 3,367,792,920	-3.2%
	Baseline*	**Current position****	**Change** (in percentage)
UK as a proportion of EU (EU+UK)	62%	37%	-24%

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

Figure 4 Distribution of private investment (based on value of equity deals), per investment round



Source: Technopolis and BOP Consulting (2020)

The table below shows that six participant companies have secured deals during the period 2018 to 2020. The amount raised by those companies (in 2020) is relatively small in comparison with the total amount raised by all companies ($1.5m on average, in comparison with the total average of $2.2m).

Table 10 provides short case studies with information on companies that have secured substantial deals, including Maze Theory Limited (an AotF programme participant).

Table 9 Activity among participant companies in the AotF programme

Company	Location	Funding Type	2018	2019	2020	Total Funding Amount
Also Known As / Head Set Studio Ltd*	London	Pre-Seed			£30,000	£30,000
Facesoft Ltd **	London	Seed	ND			ND
Go Jauntly Ltd	London	Seed	ND			ND
Gravity Sketch Limited	London	Seed	$1,700,000		$3,700,000	$5,400,000
Igloo Vision Limited	Craven Arms	Series Unknown	£548,000	£550,000	£435,000	£1,800,000
Maze Theory Limited	London	Seed			£1,100,000	£1,400,000

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

Table 10 Private investment – case studies

Company Name: Smartify CIC Location: London URL: https://smartify.org.uk Founded: 2015

Profile

- Smartify have developed a platform to deliver dynamic augmented reality-based visitor experiences with a focus on the arts and heritage sector. The company has seen growth of over 300% in the last 12 months having adapted to deliver online arts education during the COVID-19 pandemic.

  The company has an estimated revenue range of less than $1m.

Investment

- Number of funding deals: 3 (6 including grants)
- Total funding amount: $1.6m.
- Their last funding round was announced on the 11th November 2020. The single investor in the £1m deal was Pembroke VCT a venture capital trust focused on 'building the brands of tomorrow'.

Company Name: XR Games Limited

Location: Leeds
URL: https://www.xrgames.io/
Founded: 2017

Profile

- XR Games is an award-winning game development studio who have created immersive games for some of the world's biggest brands including Sony, the BBC and Facebook.
- The company has an estimated revenue range of $10M to $50M.

Investment

- Number of funding deals: 2
- Total funding amount: $4.5m.
- Their last venture funding round, announced on 28th November 2019 and valued at £1.5m, was led by Praetura Ventures alongside existing investor ACT Capital Partners.
- The investment will enable XR Games to increase its capacity for work-for-hire contracts and expand its team in Leeds. It will also enable the company to expand its games portfolio with new projects in partnership with Hollywood film studios and world-famous media and entertainment companies.

Company Name: Maze Theory Ltd

Location: London
URL: https://www.maze-theory.com/
Founded: 2018

Profile

- Maze Theory is a virtual reality developer. They launched their first major project – '**Doctor Who - The Edge Of Time**' in November 2019. The company is currently developing its next VR game, Peaky Blinders – The King's Ransom.

Investment

- Number of funding deals: 1 (2 including grants)
- Total funding amount: £1.4m
- Maze Theory announced a £1.1m seed funding round in May 2020. The deal was part of the UK Creative Content EIS Fund from Calculus Capital and Stargrove Pictures, in association with the BFI.
- Calculus described the rationale for the deal: 'We were attracted by Maze Theory's ability to secure high profile IP, resulting in a strong slate of reputable titles, each of which has high commercial capabilities. The team's ability to develop games across multiple platforms provides diversification, as well as exposure to larger markets.'

- On the 5th of November 2020 Maze Theory opened a new office in Los Angeles. The LA office will work alongside the Maze Theory London team to grow the studios presence in the US and build relationships with tech partners in Silicon Valley and the big IP studios in Hollywood.
- The company has grown by 30% since March 2020.

2.2 Wider Market Analysis - China

2.2.1 Introduction

This section provides a wider analysis of the immersive technologies industry in China and the impact of China on the international industry. This includes providing an overview of private and public investment, government policies and audiences and consumer trends in the country. This work follows a wider analysis report on the international immersive industries.

For this work we consider immersive technologies in the context of the Audience of the Future programme. The majority of available research in China relates to AR and VR, and consequently, the AR and VR markets and their related devices and where available, creative applications are the focus of this analysis.

While we have referenced source material throughout, the source material for this work is predominately in Chinese and taken from existing Chinese market research and policy documentation. Where possible we have looked to use data from 2020 so that the effects of the COVID-19 pandemic are factored into the analysis, this has not always been possible.

2.2.2 Key findings

China represents 7% of the global industry
According to recent Chinese market research, China represents around 7% of the global industry.[7] China already has the second largest film industry and was recently surpassed by the US as the second largest video games industry.

Led by China, Asia is set to dominate the consumption of AR/VR for the next five years, driving more revenue than North America and Europe combined, with China the largest single market for immersive in the long term.[8]

Government driving investment with China continuing to lead on global investment
In China, the government tends to have a disproportionate impact on the development of industries. And in 2019, the State Council, the central government authority in China issued "guidance" in relation to the stimulation of "cultural consumption". The policy or guidance specifically highlighted immersive as an area for growth.[9]

Following this guidance, local and municipal governments took that guidance as an instruction to establish what in China are called "government (backed) guidance funds" for immersive.[10] Essentially these funds provide matched investment for private investment in private companies. A private investor pledges to make an investment in a company in a particular sector that the government have provided "guidance" for. The government will then match

[7] Illuthion 2020 China Immersive Industries White Paper

[8] https://www.digi-capital.com/news/2019/01/for-ar-vr-2-0-to-live-ar-vr-1-0-must-die/

[9] http://www.gov.cn/xinwen/2019-08/23/content_5423828.htm

[10] https://itif.org/publications/2019/02/19/fact-week-chinese-government-backed-investment-funds-aim-control-17-trillion

that investment providing greater security and less risk for the private investor and in-turn increasing investment in the sector overall.

Since that guidance from the government - investment in immersive has exploded across the country[11,12] and according to market research China now leads global investment and spending on immersive technologies.

In 2020, the total spending on AR/VR-related products and services in the Chinese market accounted for more than half of the global market share (approximately 55%), a significant increase from before the epidemic.[13] The overall market size of China will reach around $6.6 Bn USD by the end of 2020, a year-on-year increase of 72.1% compared to 2019, surpassing the United States and Japan in terms of scale and growth, and ranking first in the world.

In the first half of 2020, the investment and financing of VR and AR showed a large divergence in China. Since the large-scale investment of Magic Leap in 2016, the amount of investment in AR has surpassed VR. VR investment saw a 45% decrease in 2020 compared with 2019; AR investment saw only a drop of 10% during the pandemic. The largest reported commercial investments in China this year was the ¥200 M CNY round B financing of Kunyou Optoelectronics, followed by the ¥130 M CNY round A financing of AR glasses MAD Gaze.

Focus on R&D and innovation to drive consumption of domestic content

There are currently 13 immersive research hubs across the country driving research and innovation in this area (see Figure 5).

These research hubs are in line with the governments "dual circulation strategy" (DCS).[14] This policy looks to grow domestic demand for Chinese "created" goods and services. DCS places greater emphasis on developing capacity in creativity and innovation. DSC was developed as part of the 14th Five Year Plan (2021 – 2025) and seeks to: "prevent and dissolve the hidden risks and to actively respond to the impact and challenges brought about by changes in the external environment." The intention is to have growth driven by domestic demand, reducing China's dependence on imported technologies/IP/content and to put greater emphasis on domestic creation and innovation. This policy is in direct response to the ongoing trade dispute with the US.

[11] http://www.chinadaily.com.cn/m/beijing/zhongguancun/2017-04/19/content_28997493.htm

[12] https://www.chinamoneynetwork.com/2017/02/28/chinas-western-province-establishes-vr-town-to-support-vr-development

[13] http://www.eepw.com.cn/article/202011/420006.htm

[14] https://www.china-briefing.com/news/what-is-chinas-dual-circulation-strategy-and-why-should-foreign-investors-take-note/

Figure 5 National immersive Research Hubs across China

Paradoxically this policy could boost international collaborations in R&D, as the Chinese look to increase its capacity in creativity and innovation through international partnerships and investment. However, these partnerships should reinforce the development of new co-authored goods, services, IP, technologies and content, that are specific to the Chinese context.

DCS essentially looks to create more sustainable consumption patterns by driving consumption of locally produced goods and services – one would assume that China will potentially look to import less and potentially become a net exporter. However, for historical and cultural reasons this is not likely to be the case anytime soon. China has been trying to export content and become less reliant on foreign content imports for years and while the country excels and developing and manufacturing technology, there isn't the cultural basis for producing international standard content. Unlike the UK, China tends to be a net-importer of content and content-based IP. Chinese producers don't have the training, the experienced domestic talent or the infrastructure. That might change but it will take a long time.

Using the video games industry as a reference, China will produce content, but it will be low on production values with a high turnover of titles. Unlike in the west where the production values tend to be a lot higher and a lower turnover of new titles. This low value - high turnover of content in China might be appropriate for the domestic market but it won't work internationally.

High adoption of immersive in China with 5G coming online

One of the other reasons why consumption is likely to be higher in China is the tendency towards higher adoption of new technologies and latent demand for 5G.

The Chinese tend to be enthusiastic early adopters of new technology even if the technology isn't yet perfect. In China theme parks, gaming cafes and shopping malls have made high end VR headsets available for years. So, the market is primed. Also, in China, there is less fear and nervousness around access to personal data and privacy - the Chinese government's support for the development of the industry and the centralised approach to government lowers regulatory barriers around data and eliminates any personal data access issues for businesses.

It is anticipated that there will be an early and greater uptake for 5G in China. 5G which is set to drive access to mobile immersive applications, and it is already being rolled out across tier one cities in China. This is significant because pre-5G connectivity in China is much slower then

4G connectivity in the UK, making access to HD video let alone immersive content - difficult. This suggests there is latent and pent-up demand for 5G in China.

With this in mind, the three major telecoms operators in China have collectively invested over $25 Bn USD in 5G in 2020. For China Telecom their 5G spending will account for over 50% of its entire expenditure for the year. Another giant operator, China Unicom is making VR and AR headsets available alongside upgrades and 5G subscriptions, and it is investing in what it describes as the "5G XR Ecological Alliance". Also, the main telecoms operators and Huawei are developing "cloud VR capability", essentially competing immersive infrastructure.

Immersive consumption in China is already benefiting international producers

Facebook's Oculus is the most popular headset in China, outselling its Chinese rivals in China, and its market share is increasing. Oculus market share increased from 18.8% in 2018 to 39.2% in 2019Q3 in China. Popularity in China this helped Oculus to become the global headset leader.

During this period the Chinese brands Pico and 3Glasses also doubled their growth. Pico's market share increased from 2.6% in 2018Q3 to 6.4% in 2019Q3, surpassing HTC. 3Glasses' market share increased from 1.8% in 2018Q3 to 4.7% in 2019Q3, the same as HTC.

Figure 6 VR headset sales in China

表 12：全球 VR 品牌头显出货量市占率

公司	2018Q3	2018Q4	2019Q1	2019Q2	2019Q3
Facebook	18.8%	27.5%	10.5%	38.8%	39.2%
Sony	27.5%	31.9%	38.1%	19.8%	20.9%
Pico	2.6%	3.7%	7.1%	5.4%	6.4%
HTC	12.0%	7.1%	8.0%	6.3%	4.7%
3Glasses	1.8%	1.6%	3.0%	2.9%	4.7%
Others	37.2%	28.1%	33.3%	26.9%	24.1%

资料来源：IDC，

In 2018, Steam's userbase in China surpassed 30 million users.[15] The popularity of Steam in China led to Valve announcing a partnership with Perfect World to create a Chinese version of Steam.[16] Simplified Chinese has now become the largest language demographic on Steam, Chinese is now the language of choice for 38% of users, with English users at 30%.[17]

Barriers to entering the China market remain

While the opportunities in China for international producers are there, accessing the Chinese market is difficult, notoriously difficult for international businesses. Similar to the existing video games, TV, film and video markets in China, barriers to entry to the Chinese market for international immersive content producers are likely to include:

- China has strict laws censoring and regulating the distribution of foreign produced content in China including digital video, film, TV and video games.[18] Immersive content will need to adhere to the same laws and regulatory restrictions.

[15] https://twitter.com/ZhugeEX/status/1052586971556659200

[16] https://variety.com/2018/gaming/news/steam-china-announced-1202842338/

[17] https://store.steampowered.com/hwsurvey/Steam-Hardware-Software-Survey-Welcome-to-Steam

[18] https://www.chinalawblog.com/2018/09/new-chinese-laws-to-hit-streaming-broadcasting-of-foreign-content.html

- Chinese user / audience data access and portability[19] of that data beyond China is prohibited by law as result of China's recent Cyber Security Laws. To bypass this problem and adhere to the new laws, Apple are set to open a second data centre in China at a cost of $160 M USD[20]. This is a cost beyond most international immersive producers.
- There is also a significant overhead of doing business in China, differing business practices, and the language and cultural barriers persist, with tight restrictions on the flow of capital in and out of the country.

[19] https://thediplomat.com/2017/06/chinas-cybersecurity-law-what-you-need-to-know/

[20] http://www.chinadaily.com.cn/a/201802/08/WS5a7b8d78a3106e7dcc13b692.html

3 Interim results – the AotF programme

3.1 Demonstrators

3.1.1 Overview

This Interim stage of consultation with the Demonstrators is unsurprisingly dominated by how the four projects have had to deal with the COVID-19 pandemic. All of the projects have had to move their teams to remote working and all have had to 'pivot' their projects to deal with the new realities for audiences during the pandemic. How significant the pivot has had to be has been determined firstly by the degree to which the Demonstrators were focused on Location-Based Experiences (LBEs) or not. This means that the Visitor Experience and Performance Demonstrators were most exposed in terms of their original plans, though each of the Demonstrators has had some physical elements that have had to be abandoned or indefinitely postponed. Another important impact that some of the Demonstrators have 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 organisations participating in the Demonstrators, an inability to trade has led to significant losses of capacity and skills as staff have either been let go or furloughed.

However, there are also often opportunities in crises and so it has been for some of the Demonstrators. The COVID-driven pivots all have the same trajectory – more virtual and digitally connected components and workflow. This necessity has driven innovation in the Demonstrators and two of the four projects (WEAVR and The Big Fix Up) report that the revised COVID-influence projects and plans are an improvement on their original intentions. It is also apparent that these two Demonstrators are those where the partners within the consortiums have been able to pull together the best through the COVID-affected period. Conversely, core organisations in the Performance Demonstrator have been hit badly in terms of revenue and staffing, which has slowed progress, and structural and attitudinal differences contributed to some collaboration challenges between the core partners in the Visitor Experience Demonstrator. Finally, an aggravating factor in both the Performance and Visitor Experience Demonstrators are that they are each using Magic Leap headsets and the technology has not performed as hoped.

Case Study 1 - WEAVR: Immersive Cross-Reality Experiences in Esports

Current position and changes with respect to original set up

The main consortium partners we spoke to for this interim report are Dock10, York University and ESL. All of the consortium partners were very positive about how the project has progressed and adapted to the pandemic.

The Esports demonstrator was always inherently digital, dependant on technology and remote/online audiences. The impact of the pandemic and the loss of live in-venue audiences resulted in more deliverables related to online experiences being brought forward to year two. As the project pivoted to an online proposition and away from arena events this essentially brought forward the road map for the project. All of the partners agreed this was a positive challenge to overcome.

Due to travel restrictions planned in-venue activities had to be postponed and while positive for the online component of the project, it does mean that the project is unable to expose in-venue audiences to headset-based experiences. The arena shows were designed as a way to support the adoption of headsets. For ESL, venue-based experiences are also important for their business model – and without arena shows there is a significant loss in revenue putting greater emphasis on generating revenues from online experiences.

Case Study 1 - WEAVR: Immersive Cross-Reality Experiences in Esports

The project is 'inherently remote and digital', and it was always designed to be managed remotely. While maintaining rapport across the team has required extra effort, the project has pivoted to an online model very efficiently according to all of the consortium leads.

Early evidence of progress and overcoming challenges

The project is delivering to target and according to the consortium leads, they have 'captured' three live events including one in Thailand, this is one more than was originally targeted. This would not have been possible if the events were not held remotely.

The loss of planned arena engagement, where the intention was to expose new audiences to high-end VR experiences, has been replaced with online surveys and focus groups.

'Everyone is in R&D mode! Brilliant time to experiment.'

For ESL, when the pandemic hit, management wanted to pull back on R&D however the consortium argued for an increase in R&D and an acceleration of the project. This points towards a consortium with a unified purpose and vision. An acceleration of the project has enabled the consortium to attempt to move beyond R&D and they are actively seeking to carry out pre-commercial trials, and to validate the project commercially. Pre-commercial trials will require separate commercial investment.

Validating Weavr online commercially is critical as previously online events were predominantly considered as a marketing tool to persuade people to come to a venue to experience Esports in-person. And while pivoting to online has increased audiences for Esports, venue related revenue is obviously down.

The success of the project has not changed the consortium partners aspirations for immersive. The project has justified the investment the partners have made in immersive, reaffirming a commitment to immersive and accelerating their intention to make further investments in immersive.

According to the industry partners, working with an academic partner has been particularly beneficial, and not something they would have done if it had not been mandatory. The partners are able to access intelligence that provides validation of engagement through research methods.

Regarding talent, it was always a struggle to recruit talent, and until there is a further commitment to investment and funding in the project, retaining existing talent and hiring new talent will be difficult.

Next steps

'The government has done something remarkable with this investment – this will drive the future of the creative industries – Esports is a lens to view how other sectors will use the technology'

The project is now focused on pre-commercial trials and 'monetising online audiences'. There are two aspects to investments in Weavr that the consortium are exploring 1) the commercialisation of Esports and related data-driven services, and 2) supporting the integration of, and a transition to, immersive for other traditional sectors, i.e. sports and live entertainment.

They are actively going to VCs. Developing an effective elevator pitch and pitch deck has been difficult 'as the business model hasn't been entirely validated'. They are hopeful the next big demonstrator event, ESL Germany, will validate the business model. As Weavr is a framework not a platform i.e. B2B, they are 'selling' the framework to other businesses and sectors.

Barriers to adoption remain with the headsets – 'it's all about this'. Adoption will remain low unless 'more exciting experiences come online'. 'Everyone needs to crack this'. Resolution needs to be high and costs need to be low, and according to consortium partners, 'resolution and cost are in conflict'.

The government can further support the development of immersive experiences by having a more 'consistent approach to capturing personal data'. It should not be a situation where a small number of producers have access to all of the data. Biometric data will compound this issue, monopolies ('data monopolies') will slow access to data and thus slow development of the sector. 'Look at the container model in shipping – open models for data have commercial and social advantages.'

Case Study 2 - Immersive performances of the future

Current position and changes with respect to original set up

The main consortium partners we spoke to for this interim report are the RSC and the Philharmonia Orchestra.

As a project designed to be entirely location based, with one of the main consortium partners, Magic Leap going through a period of major restructuring, and with 70-80% of the RSC's and Punch Drunk's staff furloughed, the project has changed 'dramatically' as a result of the pandemic. Both organisations we spoke to have also seen a collapse in their organisation's revenues. Beyond furloughing this has resulted in a permanent loss of staff, including staff related to immersive production. Government funding has 'saved' both organisations, however 'the future remains uncertain'.

The shift to online, has seen the project pivot to a focus on the development of 'shared virtual production environments' – 'I don't want to change how people experience theatre but how people create'. For both partners and their organisations, live location-based experiences remain the primary focus of their work. For this project while there will be a live experience distributed online as a result of the demonstrator – the project is now focused on the development and validation of 'shared virtual production environments' for live location-based events.

Early evidence of progress / overcoming challenges

'The virtual production process is the innovation'

The pandemic has shifted the focus of the project to developing and testing 'shared virtual production environments'. The intention here is to use video game engines and other technologies to enable live event producers to review visual and aural experiences in a virtual environment throughout the production of a location-based event. This would also enable creators and live event producers to work and collaborate remotely, potentially lowering the cost and risk of pre-production. The idea is to provide creatives with "more freedom to create' before anything is produced or brought to stage. 'There is typically a huge transition going from rehearsals to stage'. According to the partners, this will help the 'sustainability of the industry' and 'set the foundations for the future of live performance'.

There remains a live component to the project which will be a 'completely digital delivery' with 11 shows "live streamed" in March 2021. The event will be 20 minutes long. One partner suggested that the pandemic has 'enabled us to be more aspirational'. 'This will be the first time all of the technologies we are using will have been brought together for one experience.' For the event, the consortium is creating a bespoke platform which will enable a maximum of 10,000 live streams per show. The event will attempt to 'merge the gaming world and the theatre world'. An interactive immersive experience as a theatrical event. 'We need to pitch right - not as a video game'.

Another consortium partner, Portsmouth University will provide production facilities and technology to support production and delivery of the newly devised event. Using Portsmouth's resources, provides access to the wider research ecosystem. 'Research partners have been brilliant', 'all of our decisions are based on research and informed by research'

In addition, the consortium is 'on track to offering workshops regarding digital distribution of live performances'.

Next steps

According to partners, 'there remains a lot of work to be done to realise the ambitions of this project.'

The event and audiences will come first, then they 'will reflect on learnings" and then consider 'IP that (they) will individually exploit'. Partners hope that there will be IP that will come out of the project that they can individually exploit. There is a 'huge amount of work done on the potential revenue streams and developing talent' – 'tech talent is very expensive' and 'without a commercial model how do we increase the workforce in this area?'

And while internally, and at the 'top level' – there is a "passion to innovate and drive forward" partners are cautious at doing so, 'at a time when other people have lost their jobs'.

Case Study 2 - Immersive performances of the future

For the future of immersive, beyond revenues and talent, "adoption is a problem" but there is hope for 5G and a 'hero device' coming online and driving adoption. According to their research, "pick up of AR/VR is still small" – 'audiences still require a sense of connection' – 'to reach audiences' immersive has 'to be accessible and communal', 'this will require a huge change'.

Case Study 3 - Moving image: The Big Fix Up

Current position and changes with respect to original set up

Fictioneers lead the Moving Image Demonstrator - a joint venture company owned by Tiny Rebel Games, Sugar Creative, and Potato. The Demonstrator is a collaboration between Fictioneers and Aardman, who are providing the Wallace and Gromit IP and writing a new story for an immersive, cross media adventure for the characters ('The Big Fix Up'). While a high profile brand and IP with national and international recognition is integral to the project, the overall goal of the Demonstrator is to create an IP agnostic platform and back end for handling immersive projects.

The Big Fix Up was originally designed as a 'three act' experience. The first two acts were always designed as mixed media experiences (AR, youtube, print) but the third and final act was originally planned as a paid-for ticketed XR Location Based Experience (LBE) set in the city of Bristol. The pandemic has meant a pivot to a fully digital three act cross media experience. The resulting app will be launched for iOS and Android in late January 20201. The LBE component ('The Grub Fest') has been retained but delayed to later in 2021. The extra focus and time given over to the digital experience has enabled the consortium to expand their horizons beyond the UK and the app will now be launched simultaneously in the UK, the US and Canada, with future plans for a global roll out.

Early evidence of progress / overcoming challenges

The consortium was working well before the pandemic hit. In the initial project proposal, Fictioneers was intended as a *post*-project joint venture. The intention was that this would be the vehicle for the IP developed through the project. A single entity would avoid diluting the IP across three partners and thereby make the joint venture more attractive to potential investors. After the award of the AotF funding, an early decision was taken to accelerate Fictioneers' development and treat it as start-up that would develop and manage the whole project itself - complete with its own office, website and staff drawn from the three partners plus the quasi-independent Project Manager (whose role is to manage the relationships between the core partners, holding them to account and ensuring clear decisioning, as well as working with any vendors that the consortium use). This had the desired effect: 'it broke down silos, it made us think more fluently about how to iterate, and how the team could work more cohesively… it created a mission for Fictioneers.'

This cohesion across the team and the partners was required when the pandemic hit. First of all it required a major change to team working. The team could no longer all come together in Bristol. Although this was a hindrance it also turned out to have advantages. Freed from the requirement for team members to be physically present in Bristol, Fictioneers were able to hire from a much more geographically dispersed (and therefore larger) labour pool. Via LinkedIN and other platforms they recruited people from other parts of the UK, Sweden and even South America, which meant they were able to source specialist skills more easily and cost effectively. Secondly, remote working meant that workflow and project management had to be changed, with the team switching to a ticketing and knowledge management system (Jira and Confluence), together with greater use of Slack and HangOuts. Having to work remotely and using the tools meant greater discipline across the team ensuring that, 'everything just got much better planned'. Fictioneers collaboration with Ardman also went well, even though the core consortium were used to working in an agile fashion whereas Ardman previously have a waterfall approach; the Project Manager therefore supported Ardman to work in this new fashion.

Creating The Big Fix Up required the team to overcome a host of tech challenges. In production terms, this started with spending a long time testing out the tech: 'We ended up with Unity and centred on Phantasm for the lighting and scanning but it took a lot of time to assess the options and then it took us a while to work out how to build the UX, as no one had done it before'. Similarly, this

Case Study 3 - Moving image: The Big Fix Up

was followed by challenges brought about by the leading edge nature of what the team were trying to develop: 'we were detecting capability and bugs that not even Unity knew about'. Pivoting to digital then required diminishing the multi-player outdoor experience and putting more emphasis and enhancement on the other aspects of the project. The team had to respond and mobilise very quickly to build new tech to make up for the lack of the outdoor experience – an entire 3D digital model of Bristol was built that players will project in their own home ('Act 3' of the story).

Making the app work across handsets threw up another series of tech challenges. There is a limit to the extent that the app can be made to work on legacy phones: the consortium agreed on iPhone 7 as the furthest back that the app could go as it also has to work on the new 4K iPhone 11. In the end, it has been tested on all the top 50 phones in the US. Optimising the app to work across this range required a lot of work, particularly to make it run successfully on the new iPhone 11 ('When we started developing it for the 11 it made the phone hot and would drain the battery in 10 mins!'). Distribution tech challenges also occurred: 'Google have a threshold on the size of apps [for their store], so that put a challenge on the optimisation: we sliced it, you now download it in bits.'

An unexpected and non-technical challenge arose from the consortium's decision to widen the rollout beyond the UK. In launching across the States and Canada, Fictioneers had to navigate the legal codes of the different countries and, in the case of the US, each individual state. This threw up complications as some states' laws (e.g. California) were very hard to understand and required Fictioneers to buy in specialist US legal advice.

In summary, the different companies that make up Fictioneers are united in believing that: 'the pandemic has changed the project for the better – it made us think what really matters about the experience and has taught us how to work differently'; 'we were able to take the COVID situation and come up with a plan to turn it into a positive'; 'the COVID-inspired pivot has allowed us to test our commercial goals much more.'

Not only is The Big Fix Up ready for launch (free to download with in-app purchases), but a short B2B version of the app and LBE is also in development ('Rogue Lad'), aimed at the leisure and tourism market (e.g. cruise ships and hotels), which will be sold on a licensing basis. Fictioneers have also established a reputation and partnerships with a host of major industry players, from Unity, Google and Apple, to Netflix, Amazon Prime, TikTok, and SnapChat.

Most importantly, Fictioneers are well on their way to creating the IP agnostic platform they originally envisaged, the MUST platform (Multi-User Storytelling Platform). While still in the later stages of development, the team report that 'we know that what we have developed is leading edge, having talked to people like Unity, Disney, and Google - they are all massively impressed.' Not only will this benefit Fictioneers subsequent ability to develop their own mixed media / immersive products, but the team have found that, 'some really important tech has come out of it that we can commercialise and build upon.' The intention is that the tools and tech embodied in the platform will be packaged and licensed to other developers of immersive content, with the further possibility down the line of another iteration that targets user generated content: 'If we had only delivered The Big Fix Up we wouldn't have learned anything, we would have just delivered a fancy app. It's the platform and backend that's the thing.'

Next steps

The main challenge and next steps for the consortium are, 'how to develop Fictioneers as an investable business, while continuing to develop the product'. While the team have spoken with investors and potential offers have been coming through, it is a difficult process. One of the factors that has made it so is the nature of how Fictioneers has been set up. The downside to setting up the JV so early has proven to be that it is not structured optimally for how the project has turned out, so the team report that they are, 'now having to unwind it to get investment in… we now have much more opinions about it – so if we started from scratch we would have had a better idea about it. '

Case Study 4 – Visitor Experience: Dinosaurs + Robots

Current position and changes with respect to original set up

The VE Demonstrator consortium is led by production company Factory 42. The company led on the build of two XR Location-Based Experiences (LBEs), based on IP and expertise provided by two museum partners (National History Museum, NHM, and the Science Museum), with the Almeida Theatre providing story input and dramaturgy. Factory 42 are also responsible for leading the post-project commercial exploitation and had originally intended to build their business around Dinosaurs + Robots, as an exemplar of their expertise in XR LBEs. The consortium had two further partners to help with marketing and distribution: Sky and Intu (the shopping centre owner). The latter was particularly important as one of the main objectives of the project was for the museums to take museum content out of their institutions, as they seek to broaden their audiences and pursue new commercial opportunities (beyond touring the LBEs to other museums). The intention was for short format versions to be piloted in Intu's shopping centres.

The LBEs were to be collaborative, group-based experiences that made use of the new Magic Leap headsets and technology. When the pandemic hit, the consortium had just started the first live trial of the shorter format LBE at one of Intu's shopping centres. This had to be halted and was never resumed and the LBEs were similarly never able to be run in the two museums. Not only were the museums closed for five months, but when they re-opened it was not possible to fit the LBEs into the designated spaces within the museums due to the schedule of building works and exhibitions which meant that the LBEs had 'missed their window' – alternative spaces were either not available or deemed unsuitable for the experience. Finally, the museums also had a real doubt about visitors' appetite for working closely with each other and interacting with facilitators and actors, given the ongoing pandemic.

With the recognition that it was not going to be possible to stage the LBEs in the museums, the decision was taken to pivot towards apps. While apps were a part of the original project design, they were always intended to be the minor component compared with the LBEs. The challenge was then to move the apps centre stage and develop them in a very limited timeframe. Two entirely new apps were developed and launched within approximately six months, launching for iOS and Android in the Autumn of 2020.

Factory 42 still plan to take forward the XR LBEs in the future when it is safe to do so, though not in the format as originally intended, and not with Intu as the non-museum partner as the company went into administration in the Summer of 2020. While the Almeida remain interested in continuing to work on the LBEs, the museum partners will no longer be involved in this aspect of the project.

Early evidence of progress / overcoming challenges

The team had soft launched the LBE in the Metro Centre in Gateshead for 4-5 days when, 'on the day that the partners were going to launch into marketing, lockdown measures came into force. It was massively frustrating; it was testing well and we had good user data.' Getting to this point had meant surmounting numerous challenges: technical; creative, logistical, and in terms of partnership working. As noted in the Baseline interviews, all the main partners felt that the project was very ambitious as it was trying to innovate in multiple different dimensions simultaneously (creative, technical, commercial). There was all round agreement that a huge amount of learning occurred through the development of the LBE.

The first area was just understanding the technology better. As there are almost no similar experiences and Magic Leap (ML) was new tech, it was only through learning by doing that the team could establish exactly what the technology could and could not do. The team's initial expectations for the ML tech were high but, even with support from Magic leap themselves, the technology proved difficult and imposed a number of constraints on what could be done. Building the digital and physical elements side-by-side was essential in this process of discovery: '[you need to know] what the set looks like, what the lighting is, avoiding shiny surfaces, making sure that people don't occlude the mixed reality objects, etc.' Latterly, the headsets – which had performed well when tested in February - were also found to overheat in hot temperatures when tested in Summer. All of which poses some challenges as to the ease with which the XR LBE might be toured in future, given its particular space and environmental requirements. These technical difficulties led one of the museum partners to conclude that, 'Magic Leap feels not quite production ready, it feels like a prototype.'

Case Study 4 – Visitor Experience: Dinosaurs + Robots

Nevertheless, the consortium still managed to hit their first milestone of 'getting immersive, educational museum content into a shopping centre – out of the museums' buildings – in a fun but authentic and factually accurate way.' Both the Dinosaurs and Robots LBEs were also selected for inclusion at SXSW (which also never went ahead), which is an industry esteem indicator for the quality of both experiences.

The museums also felt that, even with the live test halted, that they still had gained, 'a way of thinking through ticket price, capacity and throughput in determining commercial viability' of an XR LBE. Audience research in relation to digital experiences is the other key area in which both museums have gained a lot from the project ('we had been looking to build that capacity in-house') and this will remain a focus going forward: 'There currently isn't much rigorous research on AR and science museums' and, 'we are still interested in immersive experiences within the museums. We want to know how to join the production values of a *Harry Potter* movie, and *Avengers* game with the amazing stories we have in the museum – but that's just very expensive at the moment.'

In moving away from the LBEs, one of the positives was that the age restriction that was previously in place due to the Magic Leap headsets no longer applied. The decision was taken to make the apps for younger children and make them more educational. This required changes to the team and the roles that some of the partners played. The apps were no longer based on the stories that were written for the LBEs and, as they were entirely virtual, there was also no need for input on the physical theatrical side either. This meant that the Almeida's role was reduced and their only involvement in the apps was to direct the voiceovers. Instead, Factory 42 worked with curators from both museums, as well as bringing in additional specific expertise in science learning, at the request of the Science Museum.

Developing the apps and getting them into the app stores in such a short period of time was considered to be a significant success by all consortium members. While the Science Museum has more experience of similar projects ('It [the app] feels quite comfortable for us – it's like some of the stuff in the galleries and some of the other games we've done'), this represented real innovation for the NHM: 'we have done some apps before but not in a gaming way. The Museum has never really done gamification before – active, enjoyable learning experiences.' Further, the Dinos app (*My Dino Mission AR*) was named one of the "hottest apps in the UK" by Apple upon release, though downloads of both apps have been modest to-date.

However, all partners agree that these achievements to-date have been hard won and that the process of development and the relationships among the core consortium partners has at times been difficult. There are a number of factors that were reported as to what had contributed to these difficulties.

Mismatch in partner objectives. The Demonstrator required the consortium to undertake R&D and then move rapidly into user testing and the assessment of commercial viability. The museums found this combination difficult: 'Is it an R&D process or a finished commercial product? This was quite difficult, challenging. And a very short timeframe – to do R&D and move towards a commercial product. It was hard to exactly envision how it would work'; 'We were quite comfortable with it as R&D – we're running research grants to do very experimental things. But then there's the demonstrating the commercial viability of this, so they [Factory 42] wanted it to be a product at the end that's sort of market ready. We were more comfortable with, "it's a kind of experiment"'. In turn, this mismatch is rooted in:

Differing organisational structures, processes and working cultures. The interviews conducted for the Baseline Report showed that one of the challenges that the consortium had encountered was to overcome the different languages and vocabulary that people within the team used, which reflected different disciplinary backgrounds in TV, museums, theatre, games, and leisure attractions. However, these differences turned out to be indicative of deeper and more structural differences across the different organisations within the core consortium. In particular, the interviews show significant differences across the organisations in relation to the *speed of decision-making and action, and attitudes towards ambiguity, control and risk*.

In essence, Factory 42 and the Almeida, the small organisations and the less publicly-funded organisations in the consortium, were able to move faster ('We have had to work in a very nimble way, this isn't how museums work and their decision-making sets ups are very different… the museums

Case Study 4 – Visitor Experience: Dinosaurs + Robots

found it very scary, they felt they couldn't do it in the timescale'; 'the speed of working was very different. In theatre we are very used to making creative work quickly and with little resources. Museums have so many restrictions on their practice and decision-making processes.'), and had a higher threshold for not knowing what the final outcome was going to look like in advance than the large museum partners. Alternately, the museums accountability structures, their charitable status and the greater external constraints under which they operate ('we have very clear statutory requirements around H&S etc – and we have internalised these ways of working that needed to be made more explicit in order to be shared'), all meant that the museums moved more slowly, felt more wary about the open-endedness of the creative R&D process ('the narrative and experience was always pulling in different directions and was always in flux and that was difficult for the Museum'), more wary about their lack of control over the process ('we normally take a lead on the creativity and vision; it's very different to being in a consortium with lots of different creative voices'; 'normally we commission projects – which are knowable products'), and were at times less able to take risks through the project, particularly the Science Museum ('the Demonstrators are trying to innovate on too many dimensions at once'; 'one of the creative tensions is between being grounded in real science and being more of an entertainment experience'; and after the suggestion that the two projects should be joined together (Next steps below): 'there are paranormal elements in the NHM project that are just a deal breaker for us. The 'non authenticity' is a deal breaker').

Gaps in project management, communication and skills. There was a general feeling from the museums that the project management, production management and administration of the project would have benefitted from more resources ('it needed more layers of production support, studio management, client management'), which would have given greater structure and clarity to the process ('I don't know that we were ever clear about project management methods: is this agile, is this cascade?'). Conversely, there were occasions when the museums did not fully participate in project meetings, particularly at the beginning of the process. In hindsight, it was acknowledged by the museums that this had negatively impacted the project as this was the moment to have been clearer about their expectations, objectives, constraints and ways of working ('There was a sense that the things that were really important to the Museum weren't that important to the consortium. We needed to have made these things clearer at the outset… we didn't really have that "north star" to hang onto so when things got difficult, it ended up being quite fraught.' Lastly, there were very varying degrees of skills and experience with regard to narrative-led interactive immersive experiences among the lead representatives for the different organisations and this also contributed to the challenges that were encountered in partnership working.

Next steps

Factory 42 and the Almeida have been working on a revised version of the XR LBE and both partners are very grateful for the 'incredible support' they have received from UKRI and the Programme Director in persisting with the project. The consortium has applied for an extension to the project in order to live test a revised LBE and is awaiting a decision from UKRI.

When it is able to be resurrected, the experience will be a longer and substantially different one. It will merge what were the two separate experiences into one and therefore run for longer (it will last for about an hour (rather than 20 minutes as previously), and most of the action will take place in the real world with Magic Leap held back until the very end of the experience. The partners are looking for a suitable warehouse type space in which to test it.

For Factory 42 the next steps are also about consolidating their business. They raised a late seed round in February 2020 and the intention was then to seek more funding to rollout the Dinosaurs + Robots project commercially. However, the company know that 'trying to build a business on LBEs at the moment is a non-starter' so mobile and 5G will be the new focus. The company also launched 42 Kids in the summer of 2020, a children's content division which seeks to capitalise on the experience of building the two D+R apps.

For the museums, it is more a case of trying to distil and transfer the learning from the project into their ongoing work to engage audiences: 'we have really valued the opportunity. I need the time to reflect and think through – it has got a bit lost because of lockdown. It is so rare to have the opportunity to work with new people and test boundaries. We will have an internal project review to

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determine the lessons learned: how does it apply to future projects, what does it mean for engagement? What have we learnt about audiences' motivation, price sensitivity etc?' Both museums remain keen to include immersive experiences within their offer, but have a more informed understanding of what it takes and what are the key constraints: 'audience expectations are very high re production values, and museums are very good at this for our core offer. But these immersive experiences are an order of magnitude more complicated and expensive'; 'would we do it again? If it was with 'known' tech, which is stable and which we knew the cost of, then yes'; and 'Museums are the poor church mouse compared to Harry Potter studios, so is it even viable for us to have ambitions in this space? But in 10-15 years when the tech is more mature it will become commonplace.'

3.1.2 Cross-Analysis

Challenges

Understandably, the biggest challenges encountered by the Demonstrators over this reporting period were related to the pandemic. However, it is also clear looking at Table 11 and Table 12 that the challenges reported at this interim stage are also related to implementation and execution of the projects, as opposed to those reported at Baseline, which tended to be related to planning, scoping and refining the concept, governance and other tasks associated with set-up.

Table 11 Challenges: Commercial, operational & IP

	Baseline	Interim
Dinosaurs + Robots: Visitor Experience	**Operational**: installing large-scale paid-for MR experiences inside very busy national museum building envelopes **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)	**Commercial**: one of the project partners (Intu) went into administration, leaving the consortium with no non-museum physical distribution partner **Commercial / organisational:** differing priorities, processes and working cultures created tension across the consortium; the museums will no longer be involved in the LBE
WEAVR: esports	**Commercial**: finding media rights for esports (current media rights frameworks are not fit for purpose in esports) **Commercial**: developing the post-programme exploitation plan and establishing the ownership of NewCo and sorting out the IP arrangements	**Commercial**: now focused on commercial trials re how to monetise online esports audiences and how to integrate immersive into other traditional sectors
Future of Live Performance	**Commercial**: reaching and converting international audiences for immersive content requires a different model of marketing to the model UK cultural organisations are familiar with. **Commercial**: a lack of IP, licencing and distribution skills within some of the	**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

	Baseline	Interim
	cultural businesses, which is a barrier to making the potential new business models work	**Commercial**: not clear what the revenue and IP model is for the shared virtual production environments
Moving Image	**Commercial**: due to Aardman's existing rights agreements some of *Wallace & Gromit*'s iconic content, such as the theme music used in the feature films, was unavailable for the Demonstrator project	**Commercial:** navigating differing US states' laws regarding data required specialist legal advice **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

Table 12 Challenges: Technology, production and process

	Baseline	Interim
Dinosaurs + Robots: Visitor Experience	**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 **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 **Organisational:** recruiting skilled people that are able to blend games, TV and live performance is a real challenge	**Technical:** the Magic Leap headsets proved difficult to work with and unreliable in certain conditions **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 **Technical:** the pivot to a digital only experience (for now) meant creating and distributing two apps within a very short timeframe (6-7 months) **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
WEAVR: esports	**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 on in terms of proliferation of end user VR devices) **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	**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) **Organisational**: ESL originally wanted to reduce R&D when pandemic hit, but were ultimately convinced to increase it instead

	Baseline	Interim
	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)	**Organisational**: hiring and retaining appropriately skilled talent is an ongoing challenge **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)
Future of Live Performance	**Technical:** balancing experimentation and R&D with delivering "something amazing" for large audiences is a tension within the project **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	**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
Moving Image	**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) **Technical:** creating ambitious and compelling AR content that will still work on the average mobile phone **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	**Technical:** testing the tech to choose to build the project took a long time; the UX build was also difficult as no similar projects to build upon **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 **Technical**: lot of work spent optimizing the app to work on top 50 headsets and to be able to be downloaded from app stores

Observations on the interim findings

It has clearly been a very difficult time for all the Demonstrators and their constituent organisations. That all the projects have come through the period to-date more or less intact and all having projects that can still be delivered is to their great credit. UKRI's role in supporting them through this period is also noted. While it is still too early to draw overall conclusions about the Demonstrators, there are some interim observations that can be made.

Composition of the core consortia: It seems that having organisations as key partners that are similar in type brings some advantages. By 'type' we mean by size, by whether they are public or private, and by sectoral background, including their degree of existing knowledge and experience in digital media and tech. The Interim findings suggest 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. Therefore, if the core consortium contains partners whose organisational characteristics differ markedly, it seems more likely that there will be a greater amount of friction in the collaboration.

Project management: Challenges in collaboration can, in part, be managed through good project management. The Demonstrators each have different models of project management and some seem to have worked better than others to-date. Where there is likely to be friction in a consortium, having an empowered and (preferably) independent Project Manager whose job it is to hold each partner to account, may help to overcome some collaboration challenges.

Alignment of purpose and incentives: While this seems a basic hygiene factor for collaboration, the Interim findings suggest that this is not always the case. In particular, if partners have differing amounts of 'skin in the game' it may also mean differing commercial and organisational incentives which translates into different priorities for the project. Alignment issues may also have other causes, such as:

Internal competition for resources and attention between the project and partners' core business: This is a classic dilemma within innovation as a whole. One of the ways to protect resources, attention and priority for R&D and innovation projects undertaken by existing businesses is structural differentiation (i.e. create a new and separate entity). One of the Demonstrators has successfully used this strategy (the Moving Image Demonstrator) and of the three that did not, two (the Visitor Experience and the Performance Demonstrator) have had to grapple with these issues, albeit to varying degrees and for differing reasons.

Reusable assets and replicable and scalable processes versus unique experiences tied into specific IP: In the Baseline Report, we noted that the Demonstrators were split 50:50 in terms of where they sat on this continuum. What has changed is that the Performance Demonstrator's pivot towards creating shared virtual production environments for live performance now means that three of the four Demonstrators are more focused on creating reusable assets and scalable processes. While the pivot potentially creates greater value across the wider sector, it also raises questions about what brand / IP value and skills the core partners bring to undertaking this new and very different task.

Involvement of the knowledge base: Two of the four Demonstrators (e-sports and Performance) have reported the value that they have derived from having universities and researchers involved in their consortia. Research insights have been generated that have validated and informed decision-making, which neither consortia would have considered making use of had the inclusion of researchers not been a requirement of the Demonstrator programme.

3.2 Grants and investments

This note presents findings and analysis from the survey of Design Foundation applications, conducted in September-October 2020.

Table 13 below presents the key indicators collected at this stage, which is discussed in further detail in subsequent subsections. Table 14 presents longitudinal indicators with comparison against the baseline position for the same population. For those respondents who provided a range, the middle point has been selected. For indicators compared against the baseline position, we present only the median and means of participants that provided data for both the baseline and ex-post positions (i.e. this is based on longitudinal data that compares like to likes).

Some methodological considerations

The information is based on a relative number of responses (given the size of the cohorts taking part in those strands of the programme). Given the small size of the Design Foundations strand, the number of responses secured here is also relatively low (approximately 24 complete responses from participants). As such we present median values of those indicators to mitigate the effect of potential outliers on mean values. A table with both median and mean values for key indicators is presented in Table 23, Appendix C.

Given the small nature of the strand and the sample the results need to be taken with caution, however this information still goes some way to providing interim insights into the outcomes and impacts of the programme overall. Further analysis on the statistical significance of these results will be conducted in 2021, where we also plan to the results from the Design Foundations survey with the forthcoming survey of Investment Accelerator and Production Innovation in Immersive Content applicants to increase the sample size.

Result overview

Overall, participants in the Design Foundation projects reported positive outcomes and impacts to their overall business performance. Participants reported an increase in their overall (median) turnover and FTE, and that increase is greater than that of the counterfactual cohort. Moreover, participating organisations reported increased levels of investment in R&D for immersive technologies and increased R&D intensity, higher than those reported by the unsuccessful applicants. Both results indicate that the programme is already having a (net) positive impact on participants across those dimensions.

The Design Foundation projects have provided a valuable platform for participants to build new collaborations, with the majority collaborating with new partners. This is especially true for building new collaborations with micro companies. Overall the majority of participants agree or strongly agree that their Audience of the Future project enhanced their partnerships, with almost all indicating they see avenues for future collaboration.

The majority of organisations developed a new creative immersive product through their Design Foundation project, with around half developing a new creative immersive service. Funded Design Foundation projects have made very good progress in terms of their Technology Readiness Levels, with the majority taking their project from feasibility (TRL 1 – 2) towards demonstration. Most participants also reported new or improved working processes. As a result, almost half of Design Foundation participants reported new revenue streams attributed to new products/services or new customers supported by their AotF project. By contrast, the majority of unsuccessful applicants did not continue with their intended project and did not progress the TRL of their project. These results further indicate that the funding and structure provided by the grants was critical to implementing the participants' idea, as

unsuccessful applicants seem to have struggled to find alternative resources to continue with their ideas.

Almost all participants agreed that the programme had supported the development of new skills among their staff and improve the internal capabilities.

Table 13 Design Foundation, post-exit indicators overview

Indicator		Post-exit
Outcome area 1: Collaboration		
Number of new partnerships for participating enterprises, organisation and researchers		68%(71/104)
% agree/strongly agree programme led to enhanced partnerships		95% (21/22)
% of organisations that indicate that they can see avenues for future collaboration with industry/academia due to the programme		91% (20/22)
Outcome area 2: Innovation		
Number of organisations reporting new production methods		54% (13/24)
Number of organisations reporting improved production methods		42% (10/24)
Number of audience-facing prototypes or pilots developed		79% (19/24)
Number and % of organisations reporting new creative immersive product		79% (19/24)
Number and % of organisations reporting new creative immersive service		50% (12/24)
Number of organisations reporting new or improved working processes	New	79% (19/24)
	Improved	54% (13/24)
Number and % of organisations reporting improved content, product or service	Product	29% (7/24)
	Service	33% (8/24)
Number of organisations who have developed R&D roadmaps		55% (12/22)
Number of organisations which indicate they have trialled/tested new business models		42% (10/24)
Number of signed IP license agreements as a result of AotF		10
Number of organisations indicating they have developed new IP and/or exploitable trade secrets as a result of the programme		46% (11/21)
Number of new spin-out companies from projects from existing enterprises		2
Number of organisations indicating they anticipate or have developed new revenue streams from new products/services or new customers.	Developed	42% (10/24)
	Anticipated	42% (10/24)
Value of revenue streams from immersive content	New products/services/customers	£25,000*
	New immersive platforms	£20,000*
Number and % of firms reporting that participating in programme has led to an increase in internal capabilities	New skills among staff	96% (23/24)
	Improved internal capabilities	92% (22/24)

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.* median value

Table 14 Design Foundation, Longitudinal indicators overview

Indicator		Successful		Unsuccessful		Assessment
		Baseline	Post-exit	Baseline	Post-exit	
Outcome area 3: Economic performance						
Business and organisation turnover †	Median	£65,000	£150,000 ▲	£75,000	£83,500 ▲	

Turnover derived from products or services in immersive content or technology †	Median	£0	£35,000 ▲	£1,875	£22,500 ▲	
Turnover in immersive content or technology attributable to exports †	Median	£0	£0 ■	£0	£0 ■	
Annual spending on external suppliers for activities related to immersive content or technologies	Median	£0	£25,000 ▲	£0	£10,000 ▲	
Number of full-time equivalent employees †	Median	2.0	3.0 ▲	2	2 ▲	
Number of freelancers/ contractors (FTE) employed in immersive, businesses only	Median	2	2 ■	0.0	0.5 ▲	
Average salary of employees	Median	£32,500	£40,000 ▲	£23,500	£23,500 ■	
GVA (as calculated by applying an average ratio of turnover to GVA for the creative industries)[21] †	Median	£32,630	£75,300 ▲	£37,650	£41,666 ▲	
Productivity (GVA per FTE)[22] †	Median	£15,060	£25,602 ▲	£18,825	£20,080 ▲	
Outcome area 4: Investment						
Value of R&D investment in immersive content or technologies, businesses only	Median	£25,000	£25,000 ■	£10,400	£7,000 ▼	
R&D Intensity (Calculated as R&D investment as a proportion of turnover)[23]	Median	20%	31% ▲	5%	10% ▲	
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: Longitudinal survey, baseline July 2019; and Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis Base: 21 successful and 32 unsuccessful businesses. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and FTE of 7,000 and one successful company which split into two.

3.2.1 Counterfactual

The majority of unsuccessful applicants (24, 69%) said they did not continue with their intended project. Of the 10 organisations that have continued with their project indicated that they were doing so with a longer timeframe and reduced scope. Six companies (17%) had pursued the project with alternative public or private sources of funding.

3.2.2 Collaboration (outcome area 1)

The design of the Design Foundation competition invites collaboration both between business and academic partners. The majority of Design Foundation participants surveyed in October

[21] 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.

[22] 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).

[23] 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%

2020 were working in collaboration with at-least one partner organisation (92%). Of these participating organisations, 79% were collaborating with at least one new partner, with most collaborating with two new partners (median). The **majority of participants agree or strongly agree that their Audience of the Future project enhanced their partnerships** (95%, 21/22).

Collaboration with industry

Collaborating with micro-businesses (n=20). Of these partnerships, 90% were new and 90% see avenues for collaborating in the future. For 65% of respondents, this was the first time they had collaborated with micro-businesses.

Collaborating with SMEs (n=11). Of these partnerships, 64% were new and 82% see avenues for collaborating in the future. For 45% of respondents, this was the first time they had collaborated with SMEs.

Collaborating with large businesses (n=2). Neither of these partnerships were new and both agreed they saw avenues for future collaboration.

Collaboration with Academia and industry

Collaborating with Academic research groups or PROs (n=12). Of these partnerships, 83% were new and 92% see avenues for collaborating in the future. For 69% of respondents, this was the first time they had collaborated with SMEs.

Collaborating with a charity or public sector organisation (n=6). Of these partnerships, 67% were new and all saw avenues for collaborating in the future (100%). For 50% of respondents, this was the first time they had collaborated with a charity or public sector organisation.

3.2.3 Innovation (outcome area 2)

3.2.3.1 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. An overview of the average numbers of reported innovation outputs is presented in Table 25 and Table 26, Appendix C.

New and improved methods and processes

The majority of the 24 participants surveyed had developed new working processes or improved existing working processes as part of their Design Foundation projects (79% and 54% respectively). Companies also reported developing new production methods (54%) or making improvements to existing production methods (42%).

Participants gave examples new and improved processes around both technology and working processes. New and improved working included processes for distributing work and manage projects, and for communicating effectively and build shared understanding with partners. In particular, participants often cited new and improved mechanisms for collaborating with partners in the creative sector, improving communication and understanding of the needs and working practices for creative sector employees and organisations. Some examples provided by participants include:

> *"The main thing for us was understanding how to work with creative partners, in a cost-effective way. We've learned how to work more to brief and about the logistics regarding technology."*

> *"Effective distributed of working for development and testing of new VR experiences has been the key thing. It's been about more productivity, project management and a distributed working model that have been the three things we've focused on improving."*

> *"The processes were around collaborating with partners who had very different attitudes towards and understanding of immersive technologies. We developed a shared understanding of how to work with immersive technologies and one another which was quite transformative."*

> *"It's helped us to better understand the needs of very different theatre practitioners, at the height of prestige in their different areas. We are taking theatre into the digital realm. It's enabled us to push boundaries, understand different sectors and find solutions across those sectors."*

Participants also provided examples of new and improved processes relating to the technical aspects of their projects. This included applying and/or developing new mechanisms and processes to improve the immersive technologies themselves, or to facilitate further collaboration and development. Some participants also noted developing new delivery mechanisms, adapting and adjusting products and processes to enable the implementation of immersive technologies and products in new contexts. Some examples of these improvements to the technical processes are presented below.

> *"We were using 2D animation in a 3D environment which was new to our scientist. The rendering process was new to our contractors (but probably not to the industry). It's all new to me. The whole team were 'up skilling'."*

> *"We improved access to data from our system to make it deliver more creative ways of rendering content. Our core sensory technology was being used to detect human behaviour. We used it to change atmospherics in live musical performances. In order to do that, we had to make our data more accessible to the creative people in the micro team."*

> *"We were looking at a new process that combined an existing TV brand with live performance and gaming using immersive tools. For all the parties involved, that was a completely new way of working. We needed to create*

a narrative that was an extension of the existing TV narrative. We had to create that new narrative in consideration of the gaming, theatrical and immersive elements of the experience."

New and improved content and products

The majority of successful applicants had developed a new creative immersive product or experience as through their Design Foundation project (19 companies, 79%). On average, most companies reported just one new product or experience (median), though some respondents reported producing up to five new products or experiences. Seven applicants (29%) had improved an existing product, most of whom reported improving just one product.

New and improved services and audience facing prototypes or pilots

Around half successful Design Foundation applicants had developed a new creative immersive service (12 successful applicants, 50%). Most produced just one new creative immersive service (median). Eight companies (33%) had improved an existing service, on average one per participant (median).

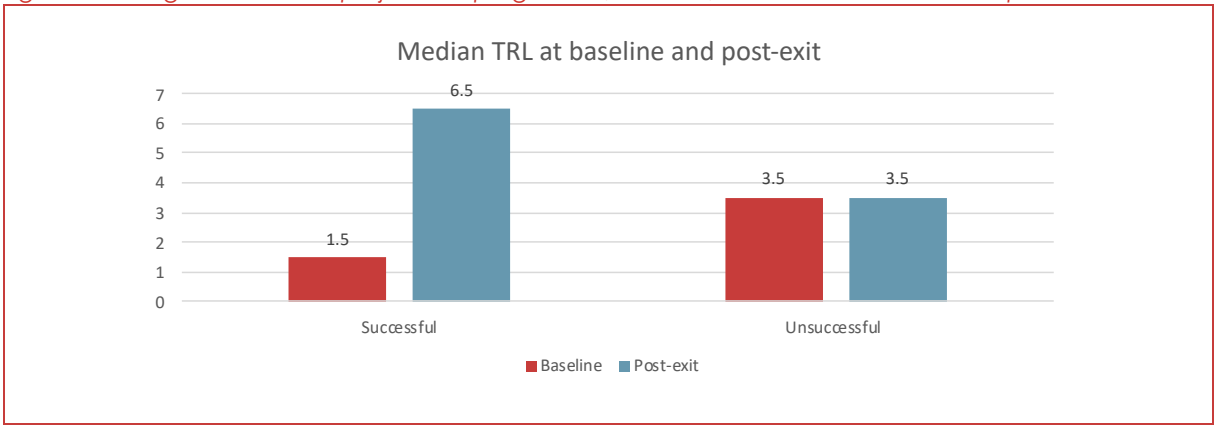
The majority of Design Foundation projects had developed an audience facing prototype or pilot during their project (19 successful applicants, 79%). Most produced one prototype or pilot, whilst a small number of companies produced more than one. In total, the 19 companies reported 39 new prototypes or pilots as a result of their Design Foundation projects.

3.2.3.2 Technology Readiness Levels

Funded Design Foundation projects have made very good progress in terms of their Technology Readiness Levels (TRL). The majority of funded projects progressed the TRL of their project by at-least one level (91%, 21 respondents), with most progressing more than one level (78%). On average, the Design Foundation projects have been able to take their projects from Feasibility (TRL 1 – 2) towards demonstration either for initial validation (TRL 5-6) or in a real environment (TRL 7-8) (see Figure 7). A small number of projects (4) were able to progress their project from 'Feasibility' through to 'Commercialisation'.

Unsuccessful applicants, in contrast, on average have remained at the same TRL at the Proof of Concept stage. The majority of unsuccessful applicants (76%, 26 respondents) did not progress the TRL level of their project. This provides further evidence that the Design Foundation strand has helped to accelerate the development and validation of early-stage products and experiences for further development.

Figure 7 Design Foundation project TRL progression, median, business and academic partners



Source: Design Foundation longitudinal survey, baseline July 2019 and post-exit survey Sep-Oct 2020, BOP/Technopolis. Base: 23 successful and 35 unsuccessful

3.2.3.3 Outputs and revenue streams

As a result of these new products and services and the opportunities to trial new business models, Design Foundation projects were able to generate new revenue streams. Overall, between a third and half of Design Foundation participants have secured new revenue streams as a result of their project. Given the purpose and design of the strand to support early stage TRL projects, this is an impressive outcome.

Within their Design Foundation projects, **10 participants had trailed or demonstrated new business models (42%)**. Most companies reported a financial return of around £25k (n=7). A further 17% expect to demonstrate new business models in the future.

Almost half of successful applicants reported they had produced new IP and/or exploitable trade secrets as a result of their Design Foundation projects (11, 46%). The majority of these companies have not yet secured a financial return from this new IP or trade secrets (median of £0), with the exception of one company who reported a return of £100k. A further 6 applicants (25%) expected to develop new IP in the future.

As part of their Design Foundation projects, **six participants had signed a total of 10 license agreements as part of their AotF project** (29%). Most participants signed one licence agreement (median), with only one participant reporting five signed agreements. Of these participants, three reported no direct financial return, whilst two reported return between £0 and £50k.

A third of successful applicants had developed new immersive platforms (8, 33%). The median financial return on these platforms was £20k. A further 7 organisations (29%) expected to develop new immersive platforms in the future.

Of the participants that had developed new products or services, **42% have secured new revenue streams from new products or services, or new customers** (n=10). The median financial return for these organisations was £20k[24]. Notably one company reported a financial return of ~£350k from a new immersive platform that had opened them up to new customers. A further 10 (42%) companies expected to do secure these new revenue streams in the future.

Two Design Foundation participants reported **creating a new spin out companies**, with a further four expecting to do so in the future. The value of these two spin-outs was estimated to be between £0 and £50,000 each. One of these participants provided further detail of their new spin out company, saying,

> *"We've formed a new company which evolved as a result of that grant. We changed our business offering and are now presenting as digital marketing consultants. The grant funding findings enabled us to do everything that we're doing today. It helped us for our new start up. We've had another grant that we've used to develop a BETA version of an app, instead of VR, for a similar concept. The AotF grant made us confident that we can produce research with applicable findings. It helped us to start our new set up with sure footings."*

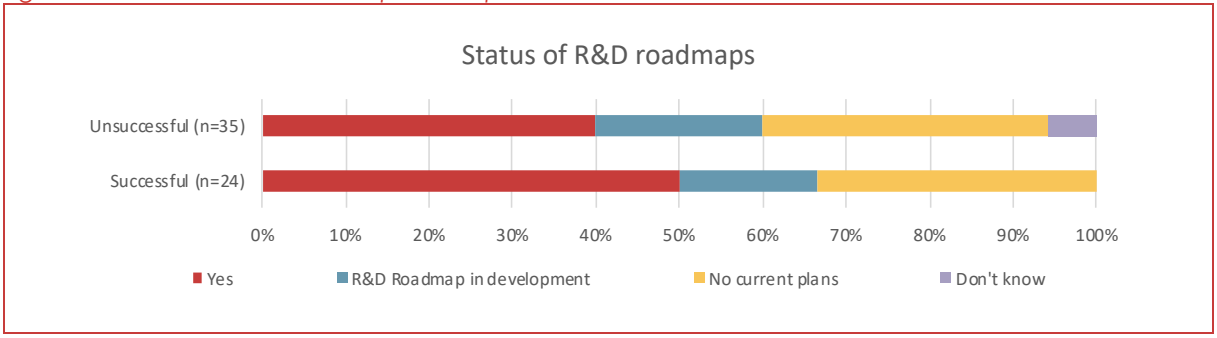
3.2.3.4 R&D roadmaps

Half of Design Foundation participants have developed an R&D roadmap, with a further 17% in the process of development. A lower proportion of unsuccessful applicants (40%) have

[24] Information was provided in bands, and we have calculated a middle point to arrive to a numeric estimate.

already developed and R&D roadmap, though a further 20% were in the process of development (see Figure 8). Around a third of successful and unsuccessful applicants have no plans to do so.

Figure 8 Status of R&D Roadmap development



Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

3.2.3.5 Capacity building

Evidence emerging from the longitudinal survey shows positive outcomes with respect to capacity building and skills development, as shown below.

Nearly all successful applicants to the Design Foundation strand (n=24), including businesses and academics, reported their involvement in the Audience of the Future programme had led to:

96% — **New skills among staff,** with 63% saying this had happened to a large extent

92% — **Increased internal capabilities within their organisation / research group**, with 63% saying this had happened to a large extent

Both successful and unsuccessful academic applicants reported an increase in their understanding of commercial research in the area of immersive content and technologies, with most increasing from Medium to High.

3.2.4 Economic (outcome area 3)

This section sets out the economic effects of the programme in terms of turnover, exports, and productivity of businesses which will also feed into the economic impact evaluation. Other relevant parameters have also been collected in order to inform the economic evaluation, to be delivered in the final evaluation. The information is presented for both successful business applicants and the control group (unsuccessful business applicants).

Economic effects of the programme (in terms of turnover and exports) are expected to materialise for Design Foundation participants in the coming years once technologies are mature enough to be commercialised and generate income. We did not expect major changes in those indicators at this point time, however the information gathered on turnover and exports demonstrate that progress has been made since the baseline stage.

Given the small number of responses, we have presented here the median values to address the fact that some mean number could be driven by a small number of responses. A full table presenting both means and median values for each indicator is presented in Table 23, Appendix C.

3.2.4.1 Turnover

Table 15 shows that **Design Foundations participants have had, on average, an increase in their turnover** of around £85k. [25] In comparison, unsuccessful businesses have seen an increase of around £8k. As the total value of the Design Foundations grants is £20k-£60k, this suggests that the impact of the programme on turnover has gone beyond the value of the grant income.

The **increase in turnover derived from immersive content or technologies was greater for successful business** (from £0 to £35k, median). Whilst unsuccessful businesses have also reported an increase, they increased to lesser extent from £0 to circa £22k.

Exports on the other hand, have remained largely the same for both participants and the counterfactual. For both groups, the median value of return attributed to export of immersive products or services was £0.

Note that this data correspond to those businesses for which we have data at both baseline and ex-post points to ensure comparability.

Table 15 Turnover and exports, businesses (median)

Indicator	Successful		Unsuccessful	
	Baseline	Post-exit	Baseline	Post-exit
Business and organisation turnover †	£65,000	£150,000 ▲	£75,000	£83,500 ▲
Turnover derived from products or services in immersive content or technology †	£0	£35,000 ▲	£1,875	£22,500 ▲
Turnover in immersive content or technology attributable to exports †	£0	£0 ■	£0	£0 ■
Annual spending on external suppliers for activities related to immersive content or technologies	£0	£25,000 ▲	£0	£10,000 ▲

Source: Longitudinal survey, baseline July 2019; and Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis Base: 21 successful and 32 unsuccessful businesses. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and FTE of 7,000 and one successful company which split into two.

3.2.4.2 Employment

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

Participants in the Design Foundation strand reported an increase in the number of Full Time Employees, from 2 to 3 (median). Participating businesses also reported an increase in the number of freelancers / contractors employed in immersive, from a median 0.5 FTE freelancers to 1.5 FTE freelancers. By contrast unsuccessful businesses reported that their numbers of employment of FTE staff stayed the same, whilst their employment of freelancers/ contractors increased by around 0.5 FTE.

[25] Where information was provided in bands, and we have calculated a middle point to arrive to a numeric estimate.

Participating businesses also reported that the median of the average salary of their employees increased since the baseline point of circa £7,500. By contrast, unsuccessful business reported that the median of the average salary of their employee salaries stayed the same.

Table 16 Employment, business and academia (median)

Indicator	Successful		Unsuccessful	
	Baseline	Post-exit	Baseline	Post-exit
Number of full-time equivalent employees †	2.0	3.0 ▲	2	2 ■
Number of freelancers/ contractors (FTE) employed in immersive, businesses only	2	2 ■	0.0	0.5 ▲
Average salary of employees	£32,500	£40,000 ▲	£23,500	£23,500 ■

Source: Longitudinal survey, baseline July 2019; and Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis Base: 24 successful and 35 unsuccessful businesses and academic groups. † 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

Reflecting the increase in turnover, **participants in the Design Foundation strand of the programme reported an increase in the GVA** from circa £32k to circa £75k (median). Reflecting this change, the productivity of successful businesses increased from circa £15k to £25k. Whilst unsuccessful applicants also reported an increase in GVA and productivity, this is notably less significant than the increase reported by the participating organisations.

Table 17 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)[26] †	£32,630	£75,300 ▲	£37,650	£41,666 ▲
Productivity (GVA per FTE)[27] †	£15,060	£25,602 ▲	£18,825	£20,080 ▲

Source: Longitudinal survey, baseline July 2019; and Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis Base: 21 successful and 32 unsuccessful businesses. † Excluding one unsuccessful applicant outlier reporting turnover of over £50m and FTE of 7,000

3.2.5 Investment (outcome area 4)

3.2.5.1 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. Successful applicants to the Design Foundations were asked to report the amount that their company invested in R&D annually prior to the programme, and to date.

[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 financial year, number of employees has been assumed to be 1 (i.e. one person company).

Half **successful applicants had increased their R&D intensity** (50%, 7 of 14) since the baseline point. The median level of R&D investment stayed the same for participating organisations.

By contrast, 8 of the 22 unsuccessful businesses had increased their R&D intensity following the end of the programme (36%). The **majority of unsuccessful business either maintained the same levels of annual R&D spending, or decreased their spending**, with a decrease in the median level of investment from circa £10k to £7k. This suggests the programme has been valuable for supporting participating businesses to maintain and increase their R&D spending.

For the majority of successful and unsuccessful applicants, 100% of their R&D investment was self-financed (median).

Table 18 R&D investment, businesses

Indicator		Successful		Unsuccessful	
		Baseline	Post-exit	Baseline	Post-exit
Value of R&D investment in immersive content or technologies, businesses only	Median	£25,000	£25,000 ■	£10,400	£7,000 ▼
R&D Intensity (Calculated as R&D investment as a proportion of turnover)[28]	Median	20%	31% ▲	5%	10% ▲
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: Longitudinal survey, baseline July 2019; and Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis. Base: 21 successful and 32 unsuccessful businesses. † Excluding one outlier reporting turnover of over £50m

One of the academic participants had already secured further grant funding based on the developments made during their AotF project. The participant detailed that this funding was valued at £5.2m to build the UK's first centre for creative and immersive XR. The two other academic participants surveyed at this stage indicated there was a high probability they would secure further grant funding in the future.

3.2.6 Impact of COVID-19

The COVID-19 pandemic has had a significant impact the on the creative industries, particularly those involved in live performance.

As perhaps expected, there are two divergent experiences of the COVID-19 pandemic and resulting lockdowns largely driven by the extent to which business and their offerings were/are centred on live, in-person interaction. Overall, both participants and non-participants with a primary focus on live events / experiences reported a strong drive to **pivot their products and activities away from live performance towards digital products and services**. In line with this, companies reported reflecting more broadly on their overall business direction and strategy, and were seeking new revenue streams and partnerships to mobilise new commercial directions. As a result, some businesses also reported an increase drive to **diversify their business**

[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%

offerings and models to increase the resilience in the future. Respondents also noted on the work currently being done to adjust the services and events they could run once lockdown restrictions lift but social distancing still applies. For example, mechanisms to ensure social distancing during interactive experiences or improving the means of disinfecting equipment (e.g. wearable headsets) between use. This seems to indicate that whilst some businesses are engaging with a full pivot of their products and services, many are still intending to continue to work in live performance/experience as soon as they're able.

By contrast, those organisations offering products and services for remote use had found little negative impact on their turnover or profitability. For these companies, the most significant impacts and challenges pertained to the challenges around working from home, and developing and testing new products from a distance.

Notably, companies also remarked on the **competitiveness of the funding landscape**, regardless of their business model. Companies felt that the competitiveness for both public and private funding had increased significantly over the last nine months, due in part to the increased demand from companies looking to join the 'remote' market space, as well as reticence from private investors in the current financial climate.

Many respondents (successful and unsuccessful) noted that the absence of live events and the uncertainty around the future of live events has resulted in the **loss of skilled and valuable staff**. Similarly, staff members were limited on the amount of time they could commit to projects due to personal circumstances (e.g. caring responsibilities).

Whilst some participants in the programme noted that the AotF Design Foundation project facilitated their adaptation to the COVID-19 pandemic, many noted that their ability to pivot their business models and products was enabled by further grant funding specifically for this purpose. As the Design Foundations projects finished sometime before the pandemic hit the UK in spring 2020, participants noted that they had little contact with the AotF team during this time.

3.3 Stakeholder consultation

This second round of interviews was targeted to canvassing the views of stakeholders in industry, as the wider views of government and sector support organisations was sought in Phase 1. The one-to-one interviews and one workshop was held in October and November 2020 to address the following indicators:

- Outcome 13: Participating companies receive external recognition; Exemplary projects recognised by external stakeholders
- Outcome 14: Strengthened regional hubs; Stakeholders' assessment of strength of regional hubs where AotF funded projects have been successful
- Impact 4: Increased R&D investment in creative immersive technology (UK and abroad); Perception of the investment environment for immersive content
- Impact 6: Reputation of the UK creative immersive content industry is raised; Stakeholder assessment of reputation of UK creative immersive content industry

3.3.1 Outcome 13: Exemplary projects recognised by external stakeholders

While there was general awareness of the Audience of the Future programme, there was little knowledge regarding specific individual projects, including the Demonstrators. However, it was acknowledged by all that this was in part due to the impact of the pandemic, causing projects to pause as it became impossible to showcase large-scale immersive LBEs. Some interviewees were familiar with individuals who had worked (as sub-contractors) on one or more projects;

none had submitted a bid themselves. One observation was that the programme should perhaps have focused more on digital content and less on large scale 'experiences', to address the lack of profile of existing VR content ('name me someone who has had three hit VR games').

3.3.2 Outcome 14: Stakeholders' assessment of strength of regional hubs where AotF funded projects have been successful

London is the acknowledged major hub for immersive in the UK (as is demonstrated in the Sector analysis, in Section 2.1). Beyond this, stakeholders' opinions differed as to which were the next most important hubs. For instance, a Manchester-based respondent argued that the North West – Manchester and Liverpool combined – represented a cluster to rival London (however our data shows that both cities combined, have 13% of the companies active in the sector in London).

Other London-based respondents identified Brighton and Bristol (described as a 'micro-cluster' by the Manchester respondent) as significant hubs outside London (which goes in line with the data, as they occupy a 2nd and 3rd position, based on number of companies active in the sector).

HEIs were referenced – Manchester, again, as having, 'the largest student population in Europe' and excellent computer science courses; and Staffordshire University's games programme, as well as the RCA. Other kinds of 'horizontal' clusters – including Digigirls, a forum for LBGTQI XR creators – were mentioned. None of the respondents expressed awareness of links between AotF Demonstrators and regional hubs (even when prompted).

3.3.3 Impact 4: Perception of the investment environment for immersive content

Access to finance, and investors' perception of risk in XR, was still perceived to be a significant constraint in the development of new creative content. One respondent linked it to the existing difficulties in securing finance for games, which are still seen as 'toys for children' by many investors despite more than three decades of commercial success.

Another consultee noted that the investment climate in the US continues to be more favourable for immersive propositions than in the UK. One interviewee reported that Facebook's unwillingness to provide sale figures for Oculus HMDs is a contributory problem in seeking project finance, as no-one can be exactly sure of the size (and therefore potential value) of the addressable market.

Another perspective was that future growth would only be unlocked with a significantly increased focus on investment in a wider content, production and training ecosystem, and in more diverse talent, ensuring that 'alumni' of previous programmes were engaged in feeding back their experiences and learnings to a wider group of artists and creative enterprises with the aim of increasing the size and diversity of the talent base.

One interviewee contrasted the UK's market-led approach unfavourably with Finland's structured investment and related international promotion of start-up companies working in XR.

3.3.4 Impact 6: Stakeholder assessment of reputation of UK creative immersive content industry

The UK's international strengths in immersive were categorised by industry stakeholders as residing in the quality of the creative input (as in other areas of the creative industries), despite this often being done 'in a cottage industry way'. Some stakeholders see the UK as 'punching above its weight' in immersive, in a way which parallels existing success in games, film and the creative industries in general. Others were slightly less positive, reporting that despite strong

public backing the UK is doing no more than would be expected on the basis of its size and existing strengths, and pointed instead to the continued dominance of the US and China, and even strong earlier backing for immersive from France.

There was greater agreement about the value brought by the Department of International Trade promotion of immersive at events such as SxSW, which are seen as a good platform for UK creative industries and a 'bridge for collaboration'.

Interviewees highlighted opportunities both with competitors in larger markets (US, China, East Asian countries) and new collaborators in emerging markets (Africa, Brazil). This stressed knowledge exchange and 'communities of practice' involving artists, academies, academics and researchers as being a vital platform for future growth.

There was a consensus that immersive should be represented internationally as part of UK's creative industries sector, and not as a 'technology' play. However, Demonstrators themselves did not feature in those responses.

3.3.5 Further observations from consultations with Stakeholders

Some interviewees felt that the scale of the Demonstrator projects had been too big, requiring too much complexity, and therefore limiting it to more established companies with the capacity to mount a larger bid. Other related comments were that the programme:

- Could have required less money but fewer strings – 'not start-up money, not mega-money, but scale-up money' – like a scaled-up version of the UK Games Fund, offering grants to companies with some previous experience of XR production or companies established in other fields (e.g., games) looking to produce their first XR content
- Suffered from a lack of diversity – it needed to move beyond the 'favourites' of government agencies to address access and barriers to entry for more diverse (including female, black, queer) talent
- Could have learned from BFI's recent successes in financing and distributing high-quality UK film content – with the suggestion that building a reputation for UK immersive content through a sustained and consistent offer of new content was an approach that government should investigate further.

4 Interim results – Process Evaluation: Digital Catapult Support for the Demonstrator programme

This section presents interim results of the process evaluation, with explicit focus on the Digital Catapult Support for the Demonstrator programme. Further analysis will be conducted as part of the process evaluation of the programme in the next stage of the study.

The Digital Catapult has been 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:

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

As we wrote in the Framework Report:

> "The activities planned to deliver against these objectives include maintaining direct contact with each of the Demonstrator consortia on a regular basis, supporting cross Demonstrator activities (Shared Learning Workshops, Forums etc.), engagement with wider stakeholder groups (Sector specific workshops, SME engagement events, brokerage events) and dissemination activities (blogs, social media, case studies, dissemination events etc). The Digital Catapult will also be looking to conduct additional research activity, providing expertise that enables Demonstrators to improve the quality of their work and overcome challenges.
>
> The project will run for 2.5 years and was kicked off in December 2018. The project is delivered through collaboration between the Digital Catapult and UKRI, with management and oversight overseen by a Project group, chaired by UKRI. Notably, the Digital Catapult does not have a monitoring or evaluation role.
>
> The total cost of the 'essential costs' of this strand of the programme (staff, overheads, venue hire, dissemination) will be £898,282."

4.1 Activities delivered and planned

The 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 and the needs of companies and individuals within it.

- In particular, the idea that the Catapult's network of immersive start-ups could be a key part of the environment supporting the technical elements of Demonstrators did not materialise. Instead, the Demonstrators turned out to be more tech savvy than what was initially presumed to be the case, so almost everything was kept in-house by the Demonstrators.
- Alternately, the idea of the Catapult undertaking research had been assumed to be a relatively small part of the work, but this strand of activity got traction and has grown in importance. Two reports have been delivered to-date, one on 'The Immersive Audience Journey', which brings insights from customer journey mapping and other service design processes to bear on immersive creative content and experiences, and 'The UK Creative Immersive Landscape', which looks at the business model and scale-up challenges facing small immersive creative producers. Although both reports do draw on some material gained from the Demonstrators, the reports are much wider in their scope and also cover

material and insights from other programmes (e.g. CreativeXR), organisations (e.g. Immerse UK) and research (e.g. from academics). A third report on market research is in process and a fourth report is planned that will pull together the insights from across the three reports and combine this with useful tools for practitioners across the sector.

The other work strands have progressed more according to plan.

- Three shared learning workshops have been run where the Catapult convenes the Demonstrator representatives (businesses / museums and universities). The first meeting was run in June 2020 on audience development, two others have been subsequently delivered with a final workshop still to be delivered that will share knowledge on the research work the Catapult has been undertaking as part of their contract with UKRI. The workshops have also included wider stakeholders and representatives from the sector who are not involved in the Demonstrators/AotF programme.
- Monthly forums have been run for the Demonstrators, designed as a 'safe space' for the Demonstrators for them to articulate things outside the monitoring system, and to share best practices, learning, and risks and opportunities.
- Providing responsive technical support. The Catapult has provided ongoing technical support and responded to a lot of ad hoc requests and questions (e.g. by sharing contacts and introducing the Demonstrators to people, to developers, etc.). They also identified collective needs across the Demonstrators in relation to Unity and mobile applications and distribution. A workshop with Unity was run to meet the needs of the former and a masterclass was provided by the Catapult on the latter. The Catapult has also provided access to the Demonstrators to a network of labs, if needed, for those organisations that do not have technologies and assets in house (e.g. 5g).
- Engaging wider stakeholders and disseminating learning and showcasing. In addition to the inclusion of practitioners and researchers who are not a part of the AotF programme in the Demonstrator workshops, the Catapult has run two full partner days, convening representatives from the sister UKRI Creative Industries Cluster Programme (CICP), as well as the wider interested community. The Catapult therefore see their dissemination activity to have happened through their convening activities, plus some organic / ad hoc collaborations with other partners (e.g. they have run additional dissemination / convening workshops in London, Belfast and later two online due to Covid).

4.2 Reception of the Digital Catapult support by the Demonstrators

At present, there is a structural challenge for the evaluation in terms of assessing the Digital Catapult's contribution to the Demonstrators from the Demonstrators' perspective. This is because the leads within the consortium partners for each of the Demonstrators, who been the subjects for interview throughout the evaluation, are not (with a few exceptions) the representatives within the Demonstrators who have engaged with the Catapult's AotF activities. Indeed, 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.

Instead, the staff from the Demonstrators who have engaged the most with the activities are, according to the Catapult, the production and technical staff across the various teams. Without including some of these actors in the evaluation, it is hard to properly assess how the Demonstrators have viewed the Digital Catapult's support.

Given this major limitation, we present here our initial observations about the role of the Digital Catapult, bearing in mind that we intend to capture more information from the people from the Demonstrators that have engaged with the relevant activities, as part of the full process evaluation, in the next stage of the study.

The Demonstrator interviews that we conducted with project leads, there was in general a lack of engagement and awareness as to what, precisely, was the intended role of the Digital Catapult in terms of their strand of the AotF programme. 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, other than they have an extremely nice office. Are they about evaluation and White Papers?").

However, on the occasions when project leads did actually 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. 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."

4.3 Digital Catapult's reflections on their Demonstrator support role

The Catapult team that has delivered the Demonstrator support activities acknowledge that the process has been challenging at times. One of the proposed strands of activity did not happen at all (involving start-ups and scale-ups in the Demonstrator projects), while others changed in emphasis and make-up. For instance, the tech lead for each Demonstrator was envisaged to join each of the monthly forums. In practice, attendance at the forums has been more varied – some people have been consistent in attendance, others less so - but the Catapult report that, "even if individuals did not attend, most see the importance of having a space where they can drop in and ask questions."

The Catapult team also acknowledge that their role in the Demonstrator programme was, "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 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 a bit more." In part, 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.

They also felt that elements of their work could have been benefitted from more scoping from UKRI. For instance, the decision to involve representatives from the CICP was a decision that the Catapult took themselves, "it was something that grew organically." They feel that closer integration with the clusters working on immersive within the CICP would have been beneficial. Likewise, the Catapult team reported that they would have liked to have been able to engage with the smaller funded projects within the other strands of the AotF programme (i.e. PIIC and Design Foundations), but they "never had visibility and access to their projects."

5 Conclusions

Wider context

In terms of the wider (national) context, we find that the Creative Immersive Content sector in 2020 is slightly under pressure but in any case, showing signs of growth, with a decrease in the number of companies operating, but an increase in the workforce.

London remains the main Hub of Creative Immersive Content, along with Sheffield, Cambridge, Brighton and Hove, and Bristol.

Private investment has decline slightly, but on a positive note, the profile of investment in the UK has shifted towards early stage companies and these results indicate a higher appetite for risk among those investing in UK based ventures.

In terms of the wider (international) context, China represents 7% of the global industry with China the largest single market for immersive. The Chinese government is driving investment domestically through the provision of government-backed matched-investment initiatives. Investments in AR has recently surpassed investment in VR. Recent policies to mitigate global trade disputes have put great emphasis on domestic production and paradoxically this may present opportunities for foreign players interested in collaborative R&D. Adoption of immersive is high in China, the market is primed and there is latent demand for 5G which is likely to further drive adoption. International producers and manufactures are already benefiting from the Chinese market with Oculus outselling Chinese headsets.

AotF Programme

The Interim findings related to the Demonstrators are unsurprisingly dominated by how the four projects have had to deal with the COVID-19 pandemic. All of the projects have had to move their teams to remote working and all have had to 'pivot' their projects to deal with the new realities for audiences during the pandemic. The Demonstrators which were more focused on Location-Based Experiences (LBEs) and whose consortium partners' existing businesses have been hardest hit by the pandemic have had to pivot the most and been hardest hit.

But the Covid crisis has also generated opportunities for the Demonstrators. The Covid-driven pivots share the same trajectory – more virtual and digitally connected components and workflow. Moreover, all the Demonstrators have (to-date) come through this turbulent and uncertain period intact and each have elements that have been / or will be delivered. 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.

A number of inter-related factors appear salient to the observed outcomes. These include: structural organisational characteristics (e.g. size, sectoral background), as these appear to influence attitudes and behaviours that are important to collaboration, innovation and R&D, such as ways of working, decision-making process and attitudes to risk; the nature and degree of commercial incentives, as these may have an influence on how aligned partners are in terms of priorities for the project; how well or less well partners are able to protect resources and attention for the project from internal competition from partners' core business – the Demonstrators provide a good example of how structural differentiation (i.e. creating a new and separate entity) can help; and the involvement of the knowledge base has been an unexpectedly valuable component for two of the Demonstrators, in validating and informing decision-making.

On the other hand, participants in the Design Foundation projects reported positive outcomes and impacts to their overall business performance. Participants reported an increase in their

overall (median) turnover and FTEs, and these increases were greater than observed in the counterfactual cohort. Moreover, participating organisations reported increased levels of investment in R&D for immersive technologies and increased R&D intensity, again higher than those reported by the unsuccessful applicants. Both results indicate that the programme is already having a (net) positive impact on participants across these dimensions.

The Design Foundation projects have provided a valuable platform for participants to build new collaborations, with the majority collaborating with new partners. This is especially true for building new collaborations with micro companies.

The majority of organisations developed a new creative immersive product through their Design Foundation project, with around half developing a new creative immersive service. Funded Design Foundation projects have made very good progress in terms of their Technology Readiness Levels, with the majority taking their project from feasibility (TRL 1 – 2) towards demonstration. Most participants also reported new or improved working processes. As a result, almost half of Design Foundation participants reported new revenue streams attributed to new products/services or new customers supported by their AotF project. Again, these results are better in comparison with a counterfactual cohort.

Almost all participants agreed that the programme had supported the development of new skills among their staff and improve the internal capabilities.

Appendix A Impact indicators: interim update

Table 19 Impact for ecosystems indicators and data sources

Impact	Indicator	Activity strands	Data source	Data availability: Baseline zero/ Baseline/ Emerging evidence/ Interim update	Figure on baseline (Successful)	Figure on baseline (Unsuccessful)	Figure on post-exit (Design Foundations only)	Figure at interim
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 Interim update	-	-	96% (23/24) reported that the programme helped development of new skills among their staff and 92% (22/24) 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	Baseline zero Interim update	-	-	50% (7/14) of successful businesses increased their R&D intensity. 48% (8/22) of unsuccessful businesses increased their R&D intensity	
	Evidence of change in absorptive capacity within organisations	G&I and Demonstrator	G&I case studies and Demonstrator interviews	Baseline zero Interim update (Demonstrators only)	-			See Table 11 and Table 12 for an overview of interim position

								(Demonstrators only)
	Evidence of organisational change including reduced rigidities and constraints to innovation (longer-term)	G&I	G&I interviews/case studies	Baseline zero	-			(not updated in this phase of the evaluation)
		Demonstrators	Demonstrator interviews	Baseline zero Interim update	-			See Table 11 and Table 12 for an overview of interim position
Impact 2: Increased income and productivity	Increase in turnover of supported businesses	G&I	G&I programme survey - successful and unsuccessful	Baseline Interim update	Successful: mean=£381,250 median=£65,000	Unsuccessful: mean=£694,648 median=£75,000	Successful: mean=£667,188 median=£150,00 Unsuccessful: mean=£900,556 median=£83,500	
		Demonstrators	Demonstrator quantitative instrument	Baseline	Median = £4,072,110; Mean = £38,840,292			(not updated in this phase of the evaluation)
	Increase in GVA of supported businesses	G&I	G&I programme survey - successful and unsuccessful	Baseline Interim update	Successful: mean=£191,388 median=£32,630	Unsuccessful: mean=£348,713 median=£37,650	Successful: mean=£334,928 median=£75,300 Unsuccessful: mean=£452,079 median=£41,666	
		Demonstrators	Demonstrator quantitative instrument	Baseline Interim update	Total = £350,960,879 Median = £1,255,000, Mean = £17,548,044			(not updated in this phase of the evaluation)

	Change in number of FTE employees in supported businesses	G&I	G&I programme survey - successful and unsuccessful	Baseline Interim update	Successful: mean=6 median=2	Unsuccessful: mean=11 median=2	Successful: mean=14 median=3 Unsuccessful: mean=14 median=2	
		Demonstrators	Demonstrator quantitative instrument	Baseline	Median = 66; Mean = 493			(not updated in this phase of the evaluation)
	Calculated productivity (GVA per FTE) in supported businesses	G&I	Calculated	Baseline Interim update	Successful: mean=£19,292 median=£15,060	Unsuccessful: mean=£23,339 median=£18,825	Successful: mean=£34,103 median=£25,602 Unsuccessful: mean=£27,787 median=£20,080	
		Demonstrators	Demonstrator quantitative instrument	Baseline	Total = £667,856, Median = 35,050, Mean = £33,393			(not updated in this phase of the evaluation)
	Examples of productivity improvements	G&I	G&I interviews/case studies	Baseline zero	-			(not updated in this phase of the evaluation)
		Demonstrators	Demonstrator interviews/case studies	Baseline zero Interim update	-			See Table 11 and Table 12 for an overview of interim position
Impact 3: Increased exports	Increase volume/value of exports	G&I	G&I programme survey - successful and unsuccessful	Baseline Interim update	Successful: mean=£215,714 median=£0	Unsuccessful: mean=£10,458 median=£0	Successful: mean=£390,000 median=£0 Unsuccessful: mean=£34,215 median=£0	

		Demonstrators	Demonstrator quantitative instrument	Baseline	Median = n/a, Mean = £151,550			(not updated in this phase of the evaluation)
	Change in turnover from exports of supported businesses	G&I	G&I programme survey - successful and unsuccessful	Baseline zero Interim update	-		Successful: mean=12% increase median=0% Unsuccessful: mean=5% increase median=0%	
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)	Baseline Interim update	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%
	Change in public investment in immersive creative content	All	Sector Analysis (public investment)	Baseline	29 projects and £5.6 funds (yearly average of June 2016-June 2019)			30 projects and £5.6 funds (yearly average of June 2016-June 2019)
	Perception of the investment environment for immersive content	All	Stakeholder consultation	Baseline Interim update	Limited evidence from stakeholder consultations, however lack of scale of investment going into early stage businesses was identified as a challenge			See Section 3.3.3 'Perception of the investment environment for immersive content.

Impact 5: Increased skilled workforce	Change in the job function and experience level in the UK	All	Sector Analysis	Baseline Interim update	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%)
	Change in the UK proportion of workforce in the EU	All	Sector Analysis	Baseline Interim update	EU total immersive 92,107 incl. 21,294 technical. UK total immersive 28,211, incl 7,281 technical). UK as proportion of EU 31% total and 34% of technical			EU total immersive 130,176 incl. 33,597 technical. UK total immersive 36,258, incl 10,716 technical). UK as proportion of EU 28% total and 32% 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	Baseline	Between January 2017 and August 2019, 169 awards were made to creative immersive productions during this period by the events in the			(not updated in this phase of the evaluation)

					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).			
	Stakeholder assessment of reputation of UK creative immersive content industry	All	Stakeholder interviews	Baseline Interim update	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			See Section 3.3.4 'Stakeholder assessment of the reputation of the UK creative immersive content industry'

					to which this will continue to be the case.			
Impact 7 Removed due to duplication in original model with impact 3								
Impact 8: UK's relative position for immersive investment improves	UK proportion of EU and North America investment in immersive creative content at beginning of AotF and post-programme	All	Sector Analysis	Baseline	UK investment $121m, EU $75.6m		UK investment $100m, EU $169m	
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	Emerging evidence	-		See VU.CITY case study	
		Demonstrators	Demonstrator interviews	Baseline zero Interim update	-			See Table 11 and Table 12 for an overview of interim position

Appendix B **Profile of survey respondents**

Respondents were first contacted by UK Research and Innovation (UKRI) via email to inform them of the study and identify the most appropriate contacts to take part.

Fieldwork for the survey of Design Foundations projects and unsuccessful applicants commenced on 16th September 2020 and finished on 6th October 2020. Organisations that hold/have held both Design Foundation grants and PIIC or Investment Accelerator grants will be surveyed in Autumn 2021. The results presented here are for organisations that were successful only in their Design Foundation applications (successful), or not successful in applications to any strands (unsuccessful).

One survey was drafted to ensure consistency for comparative purposes, with additional routing to include targeted questions for each respondent type where necessary. Surveys targeted a 50% response rate with successful grant applicants, and 30% for those who had been unsuccessful. In total, 59 interviews were conducted across all respondent types (see table below for profile of respondents). Interviews lasted on average 15-20 minutes.

Due to differences in the numbers of successful and unsuccessful applicants, as well as the numbers of academics and businesses, the subsamples for both the successful and unsuccessful academics are small. These results should be treated with caution and differences in results between these survey types should be considered indicative only.

Table 20 Survey respondent profile by type

Respondent type	Successful	Unsuccessful	Grand Total
Academic	3	3	6
Business	21	32	53
Grand Total	24	35	59

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

Respondents were asked to confirm their name, organisation and job role. Businesses were then asked whether they were in creative or non-creative industries, and academics were asked whether they were a research group within a university, a museum or Research and Technology Organisation (RTO), or something else. These demographics are displayed in a tabular format below.

Table 21 Business demographic: industry type

	Successful		Unsuccessful	
Industry Type	Response	%	Response	%
Non-creative industry	6	29%	5	16%
Creative industry	15	71%	27	84%
Grand Total	21		32	

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

Table 22 Creative and Non-creative industry business demographics

Creative industry type	**Successful**		**Unsuccessful**	
	Response	%	Response	%
Other	5	33%	4	15%
Design (product, graphic & fashion)	4	27%	1	4%
Education	2	13%	0	0%
Immersive technology	2	13%	9	33%
Games	1	7%	6	22%
Live Performance	1	7%	3	11%
Film	0	0%	3	11%
Museum, Gallery & Library	0	0%	1	4%
Music	0	0%	0	0%
TV	0	0%	0	0%
Fine Art	0	0%	0	0%
Advertising and marketing	0	0%	0	0%
Grand Total	15		27	
Non-Creative industry type	**Successful**		**Unsuccessful**	
	Response	%	Response	%
Other	3	50%	1	20%
Software engineering	3	50%	2	40%
Electronics engineering (hardware)	0	0%	1	20%
Not answered	0	0	1	20%
Grand Total	6		5	

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

Appendix C **Definition Foundation Survey**

Table 23 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	£381,250	£667,188 ▲	£694,648	£900,556 ▲	
	Median	£65,000	£150,000 ▲	£75,000	£83,500 ▲	
Turnover derived from products or services in immersive content or technology †	Mean	£339,063	£606,813 ▲	£61,837	£142,771 ▲	
	Median	£0	£35,000 ▲	£1,875	£22,500 ▲	
Turnover in immersive content or technology attributable to exports †	Mean	£215,714	£390,000 ▲	£10,458	£34,215 ▲	
	Median	£0	£0 ■	£0	£0 ■	
Annual spending on external suppliers for activities related to immersive content or technologies	Mean	£2,273	£123,308 ▲	£13,194	£21,523 ▲	
	Median	£0	£25,000 ▲	£0	£10,000 ■	
Number of full-time equivalent employees †	Mean	6.1	13.6 ▲	11.4	13.6 ▲	
	Median	2.0	3.0 ▲	2	2 ■	
Number of freelancers/ contractors (FTE) employed in immersive, businesses only	Mean	2.8	2.8 ■	4.7	4.7 ■	
	Median	2	2 ■	0.0	0.5 ▲	
Average salary of employees	Mean	£27,656	£35,313 ▲	£23,385	£23,038 ■	
	Median	£32,500	£40,000 ▲	£23,500	£23,500 ■	
GVA (as calculated by applying an average ratio of turnover to GVA for the creative industries)[29] †	Mean	£191,388	£334,928 ▲	£348,713	£452,079 ▲	
	Median	£32,630	£75,300 ▲	£37,650	£41,666 ▲	
Productivity (GVA per FTE)[30] †	Mean	£19,292	£34,103 ▲	£23,339	£27,787 ▲	
	Median	£15,060	£25,602 ▲	£18,825	£20,080 ▲	
Outcome area 4: Investment						
Value of R&D investment in immersive content or technologies, businesses only	Mean	£90,769	£68,529 ▼	£24,516	£32,404 ▲	
	Median	£25,000	£25,000 ■	£10,400	£7,000 ▼	
R&D Intensity (Calculated as R&D investment as a proportion of turnover)[31]	Mean	31%	47% ▲	23%	17% ▼	
	Median	20%	31% ▲	5%	10% ▲	
R&D investment in immersive by source, businesses only, % of R&D investment	Mean	Self-financed: 75% Loan: 4% Equity: 2% Grant: 19%	Self-financed:77 % Loan: 2% Equity: 0% Grant: 21%	Self-financed: 82% Loan: 2% Equity: 0% Grant: 8%	Self-financed:95 % Loan: 0% Equity: 0% Grant: 2%	

[29] 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.

[30] 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).

[31] 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%

	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: Longitudinal survey, baseline July 2019; and Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis Base: 21 successful and 32 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 and one successful company which split into two

Table 24 Collaboration indicators, partners by type - averages and status of partnerships

	Micro businesses (n=20)	**SMEs (n=11)**	**Large businesses (n=2)**	**Academic research group or PRO (n=12)**	**Charity or public sector organisation (n=6)**	**Other (n=3)**
Average number of partnerships with partner types						
mean	1.88	0.79	0.08	0.88	0.38	0.33
median	1	0	0	0.5	0	0
n	24	24	24	24	24	24
Number of participants working with partners of that type						
Working with 1 or more partner of that type	20	11	2	12	6	3
%	83%	46%	8%	50%	25%	13%
Status of these partnerships						
First time collaborating with partner of this type	65%	45%	0%	69%	50%	67%
% of these partnerships that were new	90%	64%	0%	83%	67%	67%
% that see avenues for future collaboration with these partners	90%	82%	100%	92%	100%	67%
n	20	11	2	12	6	3

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

Table 25 Innovation indicators, counts and averages

	New creative immersive product or experience	**Improved product**	**New creative immersive service**	**Improved service**	**Audience facing prototypes or pilots**
Number of participants who produced output					
Count	19	7	12	8	19
%	79%	29%	50%	33%	79%
n	24	24	24	24	24
Average number of outputs reported					
mean	1.95	1.71	1.40	1.00	2.29

	New creative immersive product or experience	Improved product	New creative immersive service	Improved service	Audience facing prototypes or pilots
median	1	1	1	1	1
n	19	7	12	8	19

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

Table 26 Innovation indicators, outputs realised and financial return

	Trialled or demonstrated new business models		Produced new IP and/or exploitable trade secrets		Develop new immersive platforms		New revenue streams from new products or services, or new customers		New spin outs	
Outputs developed										
Output realised	10	42%	11	46%	8	33%	10	42%	2	8%
Output expected in the future	7	29%	6	25%	7	29%	10	42%	4	17%
Output not expected in the future	4	17%	5	21%	6	25%	3	13%	18	75%
n	24		24		24		24		24	
Reported financial return										
Mean	£14,286		£10,000		£62,143		£59,375		Two spin outs formed, exact value not know but estimated to be between £0-£50k and £100k-£500k	
Median	£25,000		£0		£20,000		£25,000			
n	7		10		7		8			

Source: Design Foundation post-exit survey Sep-Oct 2020, BOP/Technopolis.

Appendix D **Sector analysis**

Table 27 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 28 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

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

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