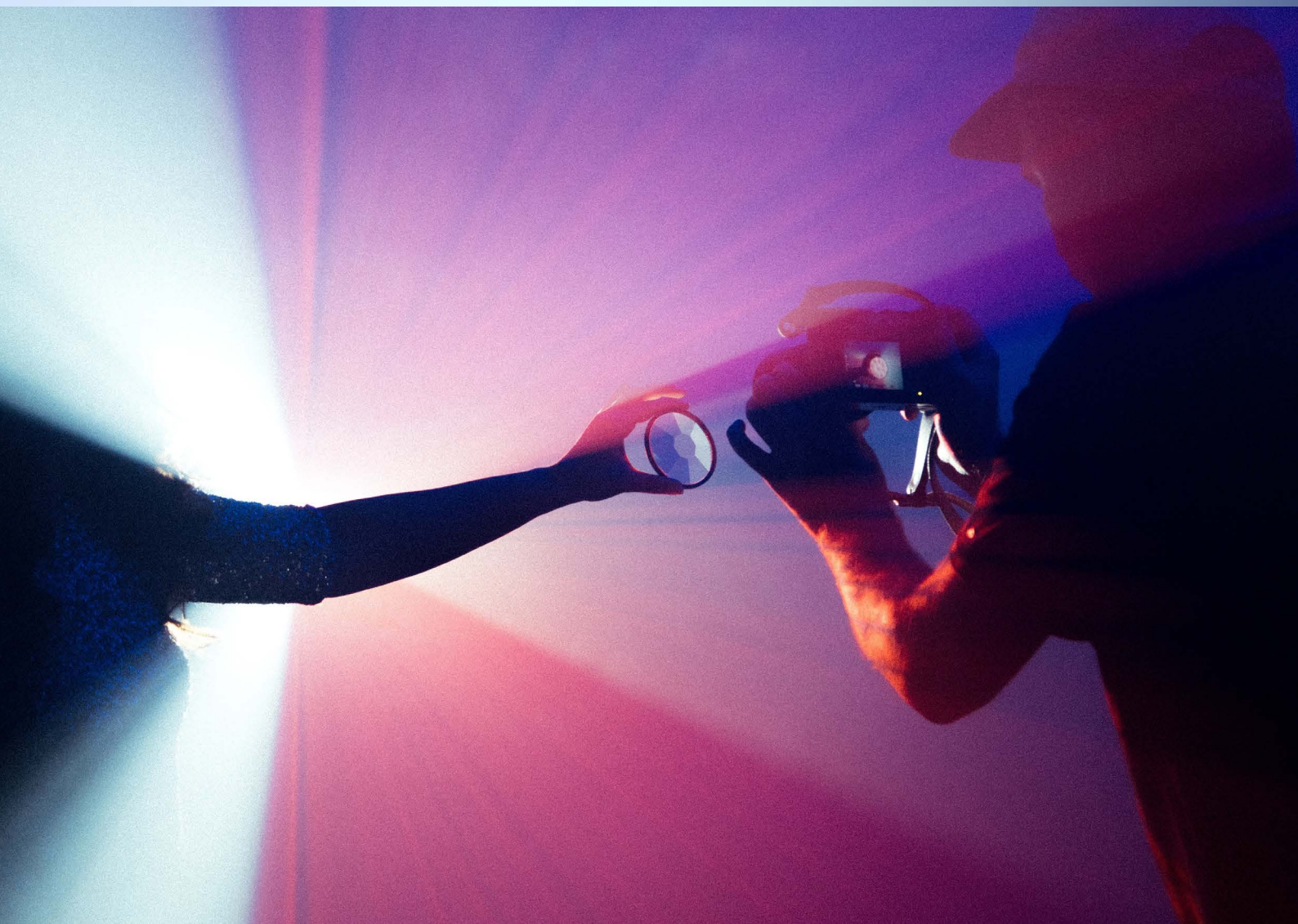


Harnessing Research and Development in the UK Creative Industries

Evidence and Case Studies



Scope of our advice

Investment in R&D is crucial to the future success of the UK's creative businesses and to our wider creative economy. However, we have consistently heard that the creative industries continue to be seen as lower priorities than traditional STEM sectors, despite their economic value.

Following our engagement with government during the development of the Creative Industries Sector Vision, we committed to offer advice on further actions to support R&D, innovation, and technology in the creative industries. In developing our advice, we did not seek to cover all sub-sectors of the creative industries. We focused on four sub-sectors with varying approaches to conducting R&D: gaming; film and TV; design-led engineering; and conservation and heritage science.

This pack includes case studies from across the sectors of focus, key evidence submitted by stakeholders, and discussion points from six roundtables hosted by the Council for Science and Technology with support from Sir Peter Bazalgette, the Association for UK Interactive Entertainment, the Arts and Humanities Research Council, and the Royal College of Art.

Film and TV



Film and TV are major contributors to our creative economy, and the UK's reputation in filmmaking, TV production, animation, and special effects is globally recognised. Since 2017, the UK's screen industries have more than doubled in size. Production spend alone has risen from £2.2 billion in 2017 to £5.6 billion in 2021, and is projected to reach £7.3 billion by 2025¹.

UK researchers are driving developments in new technologies supporting the convergence of screen, performance, and wider digital entertainment sectors. Examples of convergent technologies that are already changing the entertainment industry can be seen in the popular ABBA Voyage experience, which blends digital avatars with live performance². This presents an opportunity for government to work with industry, screen agencies, and experts to capitalise on technological advances to scale up the UK's creative and economic potential.

➔ On 17th July 2023, CST and Sir Peter Bazalgette co-chaired a roundtable with innovative companies and experts specialising in immersive technologies, 3D, and pre-production techniques. Key points from the discussion included:

- **Early-stage investment:** Government initiatives such as the Seed Enterprise Investment Scheme (SEIS) and Enterprise Investment Scheme (EIS) have greatly benefited some start-ups developing immersive technologies. However, early-stage funding from UKRI for the creative industries remains highly fragmented, difficult to navigate, and lacks clear eligibility guidance.
- **Infrastructure:** The increase in support for R&D facilities for screen technology and on-set virtual production is welcomed. Government should publicise and promote important new funding, including UKRI's Convergent Screen Technologies and performance in Realtime (CoSTAR) programme, to encourage uptake across the sector and drive innovation.
- **Artificial Intelligence:** AI is unlocking new opportunities in the film and TV sector. However there remains a lack of clarity, particularly for those using generative AI, on what standards they should comply with when developing new digital products. Previously proposed copyright exemptions for the AI industry have shown a lack of understanding of the UK's creative industries.
- **Digital infrastructure:** The UK needs to accelerate the roll-out of digital infrastructure (including 5G) that will enable the next generation of audiovisual immersive technologies.

CASE STUDY

The ABBA Voyage experience

ABBA Voyage has harnessed cutting-edge technology to revolutionise the music and entertainment industry, delivering a groundbreaking experience for society.

Through the innovative use of state-of-the-art digital avatars and motion-capture technology originating in the film and TV industry, ABBA's iconic personas have been resurrected to create virtual performances, seamlessly bridging the gap between the past and future.

Using 800 visual effects (VFX) artists, performances take place in a specially designed arena including a 65-million-pixel screen. Through the use of holographic technology and immersive soundscapes this experience has set a new standard for live entertainment, offering audiences an unforgettable sensory journey.

1. <https://blog.bfi.org.uk/long-read/foreword/>

2. <https://www.ukri.org/news/enter-the-metaverse-investment-into-uk-creative-industries/>

Gaming



The UK's gaming market is worth £7 billion, with a productivity rate that is reportedly twice the UK average³. With over 2,000 gaming businesses based in the UK supporting 73,000 jobs across the supply chain, the video games industry is vital to the UK economy. The video games industry is highly competitive and mobile, and without continued focus, investment, and a strong skills base, the UK risks being outcompeted by other countries.

The nature of video games content is evolving, as is how it is being served to consumers. This includes the growing fusion of creativity, art, and technology using cutting-edge techniques to develop new games and to bring new products to market. These technological advances have benefits across other sectors outside of the creative industries, as new ways to process, use, and visualise information and data continue to be developed⁴. This is exemplified by Epic Games' Unreal Engine, originally designed as a computer graphics games engine, now with applications in automotives, film and TV, live entertainment, and architecture.

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- ➔ On 8th June 2023, CST and the Association for UK Interactive Entertainment (UKIE) co-chaired a roundtable with leading gaming companies and experts. The below points include highlights from the roundtable and further evidence submitted:
- **R&D:** UK gaming companies undertake R&D daily. However, given that R&D in the gaming industry is different to 'traditional' R&D (for example by that of manufacturing companies) gaming companies find it hard to fit into pre-existing categories for R&D funding.
 - **Early-stage investment:** Funding remains highly fragmented with many companies having to self-fund across the sector. While Innovate UK grants have supported many companies, some companies report that grant processes are slow and grant assessors generally lack up-to-date knowledge of the gaming sector.
 - **Tax relief:** One of the government's primary strategies for supporting the video game industry has been through the Video Games Tax Relief. While this has been reported as hugely beneficial, the rate of relief provided by the replacement Video Games Expenditure Credit should be kept under review to ensure it is internationally competitive. After applying the current rate of corporation tax, the rate of relief is closer to 25% rather than the headline 34%. This is in comparison to the French tax credit for video games which sits at 30%, and countries such as Greece who offer a cash rebate of 40%.
 - **Apprenticeships:** Despite recent reforms, the video games industry continues to face difficulties in accessing the Apprenticeship Levy. £4.2 million in apprenticeship levy funding is going unspent by the games sector due to factors including the time and effort required to create apprenticeship standards, the flexibility of current programmes, and difficulty of finding relevant training providers for apprentices.
 - **Diversity:** The video games sector benefits from diverse perspectives and some evidence suggests that the sector is more inclusive in employing neurodiverse individuals than many other sectors. Innovative companies such as Brainspark Games highlight the potential for gaming to engage and support neurodiverse children through alternative approaches to education. However, broader diversity in the sector is lacking, and there is a need for skills development pathways to better support underrepresented groups.

3. <https://publications.parliament.uk/pa/ld5803/ldselect/ldcomm/125/12504.htm>

4. <https://committees.parliament.uk/writtenevidence/111077/html/>

CASE STUDY

Gaming, Education, and Neurodiversity - Brainspark Games

Brainspark Games⁵ is a multi-award winning Edtech Gaming startup, which develops immersive, educational mobile games aligned with Key Stages 2 and 3 of the UK national curriculum, to facilitate learning through play. Five games are now in production, covering Art, Climate, English, History and Maths. In addition to support from Barclays Bank, UKIE, the Game Changer Accelerator and UK Games Angels led by Nick Button-Brown, Brainspark Games are collaborating with six Local Authorities and 38 schools to 'playtest' their games, across the UK. Brainspark Games is currently developing GCSE games, and pioneering Innovate UK funded 'NeuroGames Technology'.

The company's central mission is to 'revolutionise the way children learn through play' to develop free, culturally inclusive content, which removes barriers to learning, particularly amongst diverse learners who often get left behind in the current education system. In 2023, 30% of children failed their Maths and English GCSEs⁶, with attainment significantly lower in disadvantaged children (in 'care' and those eligible for free school meals) and those with special educational needs (SEN)⁷.

In 2022, building on their partnership with The Education Space in Newham, Brainspark Games undertook playtesting with Education Links group of five SEN schools in East London, with over 110 neurodiverse pupils. 100% of pupils, including non-verbal and autistic children, who playtested the games engaged with and enjoyed them, stating they learnt more in less time and prefer them to traditional modes of teaching. This highlights the potential for gaming technology to engage diverse learners who struggle with more conventional forms of education.



Brainspark Games

5. <https://www.brainsparkgames.com/>

6. <https://www.theguardian.com/education/2023/aug/24/gcse-results-fall-england-anti-grade-inflation-plans>

7. <https://explore-education-statistics.service.gov.uk/find-statistics/key-stage-4-performance-revised>

CASE STUDY

Unreal Engine

Epic Games is a world-leading interactive entertainment company and developer of Unreal Engine. First released in 1998, Unreal Engine is now considered to be the world's most open and advanced 3D engine technology. It provides a platform for generating real-time 3D simulations, allowing users to deliver cutting-edge content, interactive experiences, and immersive virtual worlds. Unreal Engine has driven the development of globally popular video games, including *Rocket League* and *Fortnite*.

The technology has also garnered wide use outside of gaming, having been adopted by developers and companies across other creative industries and sectors of the wider economy. Unreal Engine has been used for virtual production in the film and TV industry, on over 550 major motion pictures and episodic TV shows⁸. For example, during the development of *His Dark Materials*, a fantasy drama series produced for the BBC and HBO, the technology enabled remote filming locations, complex set designs, and different camera angles to be modelled. This allowed pre-production teams to conceive and plan within spaces that they were unable to yet physically enter⁹.

Unreal Engine has also driven innovation across the wider economy, from the energy system to automotives. In 2018, Epic Games collaborated with McLaren's design team to create a tool for visualising configurations for different vehicles, resulting in a user interface which can easily swap parts and finishes¹⁰.

Epic Games has dozens of offices worldwide, including in Guildford, London, Manchester, and Newcastle. The company's London based Innovation Lab is a creative community space which encourages the convergence of Epic's technologies with different disciplines and expertise. The Innovation Lab capitalises on the strength and diversity of the UK's creative industries to ignite new partnerships and ideas.



An image of an environment created using the latest version of the Unreal Engine tools

8. <https://www.unrealengine.com/en-US/solutions/film-television>

9. <https://www.unrealengine.com/en-US/spotlights/designing-sets-and-action-sequences-on-his-dark-materials-with-virtual-production>

10. <https://www.unrealengine.com/en-US/tech-blog/making-a-real-time-design-tool-mclaren-automates-cad-import-with-unreal-studio>

Conservation and heritage science



Conservation and heritage science

Museums and galleries make a major contribution to the UK's soft power capability and international influence, with the British Museum, the National Gallery, and the Natural History Museum among the top 10 most visited museums in the world¹¹. In 2019, the UK heritage sector directly contributed £14.7 billion in GVA and provided over 206,000 jobs¹².

Conservation and heritage science describes the application of science and technology to our cultural heritage, so that we can improve its management and better understand the past¹³. The UK has strength in conservation and heritage science and was among the first to recognise it as a disciplinary area. Innovative and cross-disciplinary R&D conducted by conservation and heritage scientists is vital for ensuring that the value of the UK's cultural assets is maximised, maintained, and preserved for future generations. Conservation and heritage science research has the potential to generate wider spillover benefits into other industries and support national agendas on health, levelling up, and net zero.

→ CST held roundtables with experts from conservation and heritage science research institutes, museums, galleries, and archives in June and July, supported by the Arts and Humanities Research Council (AHRC). Key points from the discussion included:

- **Digitisation:** There is an increasing move to digitise assets held in the UK's museums and galleries. There is potential for the value of cultural assets to be exponentially increased through increased digitisation, allowing data to be better used and shared, thereby facilitating the creation of new knowledge, insights, products, and visitor experiences.
- **Capacity for research:** Despite the Research Infrastructure for Conservation and Heritage Science (RICHeS) programme, insufficient resources for conservation mean museums and galleries can only support small in-house specialist conservation teams, which risks research sustainability and the maintenance of UK collections.
- **Fragmented funding:** Due to its interdisciplinary nature, heritage science has consistently fallen between the gaps of UKRI grant funding, with multiple research councils having historically provided sporadic funding which ended before the need was met. The RICHeS programme is welcomed and will help drive spillover benefits, though it too is time limited.
- **Career pathways and retention:** Careers in heritage science receive considerable interest, but there are limited entry and career pathways. Apprenticeships and PhDs for heritage science are infrequent, and there are no easy pathways for those with scientific backgrounds to move into heritage science. Once in heritage science careers, poor remuneration and higher international pay makes it hard for UK organisations to retain good quality people.

11. <http://museums.eu/highlight/details/105664/the-most-visited-museums-in-the-world>

12. <https://historicengland.org.uk/content/heritage-counts/pub/2020/heritage-sector-in-england-and-its-impact-on-the-economy-2020/>

13. https://www.heritagescienceforum.org.uk/documents/NHSF_StrategicFramework-FINAL_Web.pdf

Conservation and heritage science

CASE STUDY

Towards a National Collection

Towards a National Collection is a five-year £18.9 million investment in the UK's world-renowned museums, archives, libraries, and galleries, funded through the UKRI Strategic Priorities Fund and administered by the AHRC.

The programme is undertaking the research and development required to create a unified virtual 'national collection' by dismantling barriers between different collections, opening UK heritage to a global audience.

By digitising cultural assets and making them inter-operable using cutting edge digital technology, a future infrastructure based on the programme will enable researchers to pose entirely new research questions, increase visitor engagement, enhance the accessibility of assets, and provide tangible economic and social benefits to communities throughout the UK.

This initiative positions the UK as a leader in digitisation, extending the value and impact of its cultural assets.



The British Museum, a partner of Towards a National Collection

CASE STUDY

Spillover benefits from conservation and heritage science R&D

Spillover benefits from conservation and heritage science R&D are both under-recognised and under-supported, with opportunities to harness the disruptive potential of work within the field often missed. The RICHeS programme has been established to better capture existing spillovers from conservation and heritage science R&D, and to actively drive more. The below sets out nascent areas where there is potential for driving greater knowledge dissemination and spillover benefits.

Healthcare

Optical Coherence Tomography (OCT) is a non-invasive 3D imaging method, initially designed for biomedical applications and subsequently repurposed by conservation science to examine the subsurface of old master paintings. Heritage scientists significantly improved the capabilities of OCT to allow more detailed study of the microscopic features of historical artworks in situ, resulting in the development of ultra-high resolution OCT (UHR-OCT), which enables imaging of transparent or semi-transparent layers of varnish and paint.

It was realised that UHR-OCT could have important applications back in the biomedical field, for the rapid in situ imaging of biofilms in neonatal feed tubes¹⁴. Biofilms form when bacteria build up on the tube surface, leaving premature babies susceptible to infections. Using UHR-OCT, feeding tubes can be imaged directly and non-invasively, enabling the detection of very thin, microscopic biofilms. This shows promise for improving the safety of vulnerable infants in intensive care.

Levelling up

A collaboration between Liverpool City Council and the National Digital Heritage Centre aims to link digital, creative and innovation expertise with heritage science to drive the restoration of derelict, listed heritage buildings into viable assets that help deprived areas to recover and grow. A digital twin of Liverpool – a virtual, 3D model of the city – is being used to map and track different measures of economic, environmental and social activity and determine the needs of the local community. These models explicitly consider strategic trade-offs in each project, in order to balance competing demands, needs, and technological changes. Using this information, building restoration can be tailored to directly support economic and social regeneration, creating, for example, new businesses, training sites, or work/study hubs. Digital twins are also used to model the heritage assets, optimise their re-design, and minimise restoration costs, ensuring that they don't create new financial burdens for communities.

Net Zero

Nearly a quarter of all UK homes were built before 1919, and over a third of commercial properties are classed as historical sites¹⁵. These are responsible for about a fifth of the nation's greenhouse gas emissions, with potential to significantly reduce this should traditional buildings be appropriately retrofitted. It's predicted that by improving the energy efficiency of historical properties built pre-1919, the UK could reduce carbon emissions from buildings by 5% each year. Heritage science research into the performance and adaptation of historic buildings is vital to inform how changes can be made to these structures whilst maintaining the building's historical value and cultural significance.

14. <https://www.nature.com/articles/s41598-017-15769-9>

15. https://www.grosvenor.com/getattachment/77042425-b1cc-4c45-b338-5193a1c93d32/Heritage-and-Carbon_Final_Digital_DPS.pdf?lang=en-GB

Design-led engineering



Design-led engineering describes using design principles alongside engineering to co-produce innovations. Many successful innovations and enterprises have arisen through the successful collaboration of these disciplines, including Dyson and Apple, where design is used as a strategic resource to make products fit for purpose. Collaboration between designers and engineers allows the power of emergent disruptive technologies to be harnessed, as design identifies purposes for engineering solutions.

In 2019, the design economy contributed £97.4 billion in GVA to the UK economy, and the use of design skills contributed a further £179 billion within additional, non-design sectors in the wider economy¹⁶. The UK is home to pioneering research institutes, including the Royal College of Art, which are driving interdisciplinary practices to develop design-led engineering skills.

→ On 22nd June 2023, CST and the Royal College of Art co-chaired a roundtable with design-led engineering experts. Key points from the discussion included:

- **Manufacturing:** The reduction in UK manufacturing capability is hindering innovation and economic growth in the UK. Companies are increasingly having to rely on manufacturing facilities based abroad. This risks the UK losing investment and reduces the incentive for innovative companies to base themselves in the UK.
- **Interdisciplinary skills:** Our education system separates STEM and AHSS subjects early, which is limiting as having a broad, interdisciplinary perspective allows individuals to quickly identify which innovations will fail or succeed. Practical experience is crucial but lacking from existing training in schools and universities at all levels, including in PhDs which could be addressed by greater collaboration with industry.
- **Talent pipeline:** The graduate pipeline continues to be mostly from London and elite universities. Harmful and false narratives about the limited job prospects associated with creative careers dissuades those from underrepresented backgrounds from applying. Recent government plans to cap the number of students on courses considered as 'low value' does not match ambitions for creative skills set out in the Creative Industries Sector Vision.
- **Knowledge exchange:** Support is needed to encourage individuals to move between industry and academia. A two-way flow between industry and academia needs to be catalysed to ensure that ideas and talent can be shared.

CASE STUDY

Royal College Art – NEMO and UNESCO Ocean Decade Partnership

The RCA have partnered with UNESCO (United Nations Educational, Scientific and Cultural Organisation) on a programme which focuses on tackling Ocean Decade Challenges related to ecosystem protection, sustainable ocean economies, and humanity's relationship with the ocean.

Through design-led engineering, students utilise data visualisation, data science, engineering, and innovation design to develop products, services, systems, and policy interventions for tackling ocean issues. The programme aligns ocean science with stakeholders and solutions to integrate scientific data with community conservation actions.

The partnership endeavours to create a global network of ocean co-design capabilities, initiate high-impact collaborations, and establish an Ocean Co-design Futures Observatory.

