Future Art Ecosystems

Vol 5. Art x Creative R&D

2

Contributors

Credits

Future Art Ecosystems is led by Victoria Ivanova, R&D Strategic Lead

Future Art Ecosystem 5: Art x Creative R&D

Produced by

Tommie Introna

Victoria Ivanova

Eva Jäger

Kay Watson

Guest Producer

Lina Martin-Chan

Written by

Nicholas Houde

Tommie Introna

Victoria Ivanova

Kay Watson

Copyediting

William Kherbek

Contributor interviews

Tommie Introna

Victoria Ivanova

Kay Watson

Roundtables chaired by

Hannah Andrews

Alex Boyes

Suhair Khan

Analysis by

Future Art Ecosystems

Advised by

Aslak Aamot Helm

Hannah Andrews

Kristina Glushkova

Julia Kaganskiy

Marta Ferreira de Sá and Benedict Singleton, Rival
Strategy

Katrina Sluis

Tarek E. Virani

Additional research

Anja Yenken

Designed by

Jack Murray-Brown

Roxy Zeiher

Reader Developed by

Jack Murray-Brown

Images courtesy of

Lauren Lee McCarthy

Faber Futures

Opponent Systems

221a

Watershed

Trust

Holly Herndon and Mat Dryhurst / Serpentine / Foreign Body Productions

futureartecosystems.org

6

Preface

Future Art Ecosystems (FAE) is a project for building 21st century cultural infrastructure to support art and advanced technologies for the public good. Through research and development with a growing community of artists, technologists, policy-makers, researchers and fellow organisations, FAE develops insights, tools and projects that advance our mission. Embedded in Serpentine's Arts Technologies team, FAE facilitates the emergence of new systems for art, technology and society. Previous briefings on the metaverse, decentralised technologies and artificial intelligence have led to experimental development, prototyping alternative ownership systems for art and data governance for AI training.[1]

The landscape of art and advanced technologies (AxAT) has undergone significant transformation over the past decade, with Creative R&D emerging as a distinct

domain integrating artistic experimentation, technological innovation, and cross-sector collaborations. The fifth volume of the Future Art Ecosystems briefing series - Art x Creative R&D (FAE5) - examines this critical nexus and offers concrete proposals for its development and impact.

This publication comes at a pivotal moment as the UK Government develops its Industrial Strategy and Sector Plan for the Creative Industries.[2] With technology and culture policy still in development, FAE5 presents a timely intervention to help shape these emerging priorities. The report offers policymakers a deeper understanding of AxAT's distinctive contribution to innovation ecosystems and the specific support structures needed to realise its full potential.

We are grateful to all the artists, researchers, technologists, policymakers and organisations who contributed their insights and expertise to this volume. Special thanks to our interview and roundtable participants who generously shared their experiences and perspectives. This work builds on Serpentine's decade-long commitment to supporting experimental practices at the intersection of art and technology and reflects our ongoing dedication to developing sustainable infrastructures for cultural innovation and for the public good.

1. 'PCO: A Stewardship Technology for Art', PCO: A stewardship technology for art, accessed 5 June 2025, https://pco.art/; Victoria Ivanova and Jennifer Ding, 'Choral Data "Trust" Experiment White Paper: Prototyping a GLAM Trusted Data Intermediary for Public Interest AI' (Serpentine Arts Technologies, 17 February 2025), https://doi.org/10.5281/ZENODO.14859320.

2. Department for Business and Trade, 'Invest 2035: The UK's Modern Industrial Strategy' (Department for Business and Trade, October 2024), https://www.gov.uk/government/consultations/invest-2035-the-uks-modern-industrial-strategy; Nicola Newson, 'Creative Industries: Growth, Jobs and Productivity', 30 January 2025, https://lordslibrary.parliament.uk/creative-industries-growth-jobs-and-productivity/.

Introduction

When Xerox established the Palo Alto Research Center (PARC) in 1970, it created what would become the archetypal model for cross-disciplinary ✎ creative research and development. PARC brought together technologists, designers, and creative thinkers in a deliberately open-ended ✳ research environment focused on inventing 'the office of the future'.[1] This approach became the genesis of innovations that would fundamentally transform modern computing and society: the graphical user interface (GUI), the computer mouse, object-oriented programming, the personal computer, networked computing, laser printing, and WYSIWYG ('What You See Is What You Get') word processing.[2] These were not merely technical achievements but represented new paradigms ✳ for human-computer interactions. Apple's Lisa and Macintosh computers directly implemented PARC's GUI

10

concepts. Adobe Systems was founded by former PARC researchers John Warnock and Charles Geschke.[3]

Joining PARC in 1975, artist David Em's collaboration with computer graphics pioneers Dick Shoup (inventor of the frame buffer) and Alvy Ray Smith exemplified this cross-pollination ✥. Working with SuperPaint - 'the first complete digital paint system' - they pushed both artistic and technical boundaries. Em created his first digital picture in 1975 using SuperPaint, but his contributions went far beyond individual artworks. Through experimental approaches to these nascent technologies, Em and his collaborators established fundamental techniques for digital image creation and manipulation that would become foundational to computer graphics, digital filmmaking, and the entire creative software industry.

Today, as in the early days of digital computing, societies face the precipice of deep technological transformation. However, unlike the Cold War era that birthed PARC, societies face a fundamentally different set of systemic

pressures and imperatives ✺. Environmentally, socially, and geopolitically, there is an urgent need for multiperspectival approaches to innovation. The emergence ✤ of large language models is reshaping how humans interact with information; blockchain technologies are reimagining ownership and governance; and quantum computing systems fundamentally challenge our understanding of computation itself, promising to revolutionise everything from cryptography to drug discovery. These technologies represent not merely technical advances, but fundamental paradigm shifts in how we organise society, create meaning and values, and understand human agency in technological systems.

Deliberately open-ended cross-disciplinary R&D environments have an important role to play in these societal transitions ✺, yet the mode of activity that they represent, and the manner in which it has evolved and proliferated across multiple domains since the 1970s, remains largely misunderstood. This not only represents a historical oversight, but more importantly, it means that many sites of Creative R&D active today - from artists experimenting with AI training datasets to designers prototyping new forms of human-AI collaboration to cultural institutions developing novel governance models for digital commons - often operate

without due visibility and legibility, lacking appropriate institutional support and funding frameworks.

Art and Advanced Technologies Lens on Creative R&D

It was the recognition of this blindspot that led to *Future Art Ecosystems 1: Art x Advanced Technologies* (FAE1) in 2020 identifying 'art and advanced technologies' (AxAT) as a distinct domain of cultural production. Rather than engaging with technology purely as a subject matter where interaction remains primarily conceptual, formal, or aesthetic, AxAT practices also develop experimental methodologies that bridge artistic and scientific inquiry, 'challenging and reshaping the role that technologies can play in culture and society'.[4] This might involve developing new interfaces for interacting with deep neural networks, or collaborating with materials scientists to create responsive bio-materials that challenge assumptions about the boundaries between living and non-living systems. This type of

13

Creative R&D is a key pillar of AxAT activity, even though it is currently not codified.

Creative R&D in AxAT is characterised by several key attributes:

Transversal/Crosscutting Ecosystems: Creative R&D operates across traditional sector boundaries ✽, often involving multi-stakeholder collaborations between cultural organisations, academic research, industry, and independent practices.

Inter/Transdisciplinary: Creative R&D in AxAT integrates knowledge and methodologies from diverse fields including art, computer science, engineering, philosophy, biology, and social sciences.

Mission-oriented: rather than being driven primarily by commercial imperatives or academic metrics, AxAT Creative R&D often addresses broader societal challenges ✾ and explores alternative technological futures. This orientation allows AxAT to function as a third space for technology development, intersecting with industry and research but maintaining a discrete position that enables unique forms of experimentation and inquiry.

14

Technological Interrogation: Creative R&D in AxAT engages in critical implementation, narrativisation, and the development of technologies and technological conditions, examining their social, ethical, and cultural implications.

Technology-agnostic: whilst technologies of distribution and presentation have dominated creative technology initiatives, AxAT Creative R&D can apply to all advanced technologies, from artificial intelligence and cryptography to biotechnology.

Institutional Hybridity: AxAT Creative R&D does not have a natural sector home and is currently hosted by different actors across cultural institutions, academic departments, industry labs, and independent studios.

The aim of *Future Art Ecosystems 5: Art x Creative R&D* (FAE5) is to shift the status quo and to move towards codification by showing how artistic and cultural practices contribute to innovation and public value ecosystems through Creative R&D that is conducted in the context of AxAT. The briefing illuminates critical, but frequently undervalued, aspects of (creative) R&D: artistic experimentation that facilitates technological innovation, the cultivation of hybrid skill sets bridging technical and cultural domains, and the emergence of new organisational models enabling cross-sectoral

knowledge transfer. FAE5 also draws focus to how cultural organisations that host AxAT activity enable a critical societal response mechanism ☸ in rapidly changing technological landscapes while simultaneously supporting the emergence of a more nuanced understanding of art's role in driving innovation.

☸

With technical systems central to social, economic and political life - from AI reshaping information flows and the ways science is conducted to smart materials and geoengineering technologies restructuring our relationship with the physical environment - the democratic significance of spaces that overlap with, but remain adjacent to, the technology industry becomes paramount. These adjacent spaces provide critical sites for experimentation, and constructive course correction that can influence the trajectory of technological development. FAE5, therefore, examines how, through Creative R&D, AxAT practices serve as adaptation engines to increase institutional resilience ☸, develop experimental methods and tools, and improve technological and cultural literacy. Outside of conventional artwork commissioning and exhibition-making, the activities that drive this function can include cross-sector residencies and production

pipelines, new tooling experiments, and governance prototyping.

The perspective that FAE5 presents reveals the distinctive feedback loops ⚸ between cultural production, technological development, economic and public value creation ⚟ that currently are not captured, remaining generally invisible to policymakers. By mapping these connections, we articulate a case for Creative R&D as a distinct and expansive mode of cultural activity - one that serves not merely as a complement to conventional innovation but as a vital foundation for global leadership in sustainable, inclusive technological development and resilient democratic societies ⚘.

AxAT is fundamentally an international phenomenon. Previous Future Art Ecosystems briefings have reflected this global reality, drawing insights from practices and infrastructures across diverse geographies. However, FAE5 marks a strategic shift towards UK-focused analysis, recognising that while creative and

technological practices operate transnationally, policy interventions and the definitional frameworks that govern sectors and industries operate primarily at the state level. As the UK government has increasingly recognised the creative industries as a 'key plank in the UK's growth strategy' and launched substantial investments, such as the £75.6 million CoSTAR programme, there exists an opportunity for specific policy intervention and institutional codification.[5],[6] The Council for Science and Technology's recent advice that the creative industries 'remain under-represented' in R&D investment despite their economic contribution signals a critical moment for establishing Creative R&D as a distinct category of innovation activity.[7] While our examples remain international in scope - reflecting the inherently global nature of creative and technological communities - our analysis focuses on the UK context to support targeted policies and institutional frameworks that can serve as models for other national innovation ecosystems.

The Metrics Gap

Nationally and transnationally, the effects of Creative R&D are often most powerful at the ecosystemic scale, where multipliers and spillovers ✦ create value ⚎ that transcends individual projects and/or organisations.[8] The scientific and technological sectors benefit from well-established impact and innovation frameworks,

while humanities and cultural work - despite their crucial role in shaping ideas, values and public interest - often struggle for recognition and investment. When a digital artist develops novel techniques for AI-generated imagery, the 'output' extends far beyond the immediate artwork or technical innovation. Value ⌘ emerges through adoption by other practitioners, influence on design trends, shifts in public discourse about technology, and the cultivation of new aesthetic vocabularies that shape how society understands emerging technologies. Evaluation frameworks that are designed for linear innovation processes struggle to capture this networked impact ⌘ ⌘. Equally, while scientific and technological R&D frameworks explicitly acknowledge that risk of failure is inherent to the innovation process - with established protocols for managing and learning from unsuccessful outcomes - no such system has been devised for the process of Creative R&D.

These gaps have real consequences. They lead to an overemphasis on initiatives with easily quantifiable outputs - publications, IP, direct commercial applications - that follow predictable pathways from research to market, while undervaluing the long-term economic, societal and 'soft power' benefits ⌘ of a thriving creative ecosystem. The challenge for policy frameworks today is

recognising that supporting Creative R&D processes - rather than predetermined outcomes - may require different risk management approaches than those developed for traditional innovation ecosystems. This process-oriented investment model acknowledges that Creative R&D functions as a source of unique outputs as well as a means of catalysing innovation ✦ across other sectors.[9]

Navigating this Briefing

The FAE5 briefing is structured around four chapters. The first chapter locates Creative R&D as a technologically focused form of artistic and cultural activity cutting across different sectors and domains such as culture, academia and technology. Referencing the UK context, the chapter builds on existing work establishing Creative R&D within the policy context in order to propose an expanded framework precise enough for direct policy application, yet inclusive enough to support a broader diversity of practices that are currently captured by this somewhat elusive term.

The second chapter focuses on artists as critical agents driving Creative R&D within the AxAT ecosystem. Far from isolated creatives dedicated exclusively to self-expression, artists function as connectors, translators, and catalysts ✦ of innovation. Through case studies of artistic practices that exemplify R&D approaches, we illustrate how artists develop new tools, methodologies, and frameworks that generate value ⧓ beyond traditional artistic outputs. The chapter identifies the barriers that currently limit artists' capacity to fully realise their potential as R&D agents, such as misalignments with available funding structures, and expectations around IP and commercialisation, or equally, being relegated to 'public engagement' roles rather than acknowledged as genuine research collaborators.

The third chapter examines how different types of cultural organisations serve as vital anchors within the AxAT Creative R&D ecosystems. It examines how cultural organisations (i.e., the Galleries, Libraries, Archives, and Museums sectors (GLAM)) have evolved their relationships with technology, with some moving upstream in development processes to actively participate in creating prototyping environments, establishing cross-disciplinary ✕ research partnerships, and developing tools that inform technological

conception and construction. We evidence how various organisational forms - from established cultural institutions to artist-led studios to new specialist organisations - incubate Creative R&D processes that catalyse ✦ internal GLAM sector innovation and feed into the broader innovation ecosystems, plugging into larger civic, technological, research and policy contexts. The chapter proposes that by better understanding these dynamics, we can develop more effective strategies for supporting Creative R&D as a vital component of cultural, technological, and economic development nationally and transnationally.

The final chapter builds on the case for Creative R&D put forward in the first three to make a series of proposals to policymakers and public funding bodies. The proposals are the following:

1. Establish a Cross-Departmental Entity for the Advancement of Creative R&D

2. Broaden DSIT's Definition of R&D to Encompass Creative R&D

3. Adopt Ecosystem Measurement Models

4. Diversify Funding Mechanisms and Approaches to
   Account for the Full Spectrum of Creative R&D
   Activity

Methodology

FAE5 emerged from research conducted by Serpentine
Arts Technologies and its Future Art Ecosystems team
and combines qualitative insights from practitioners
and organisations across multiple sectors with a
structured analysis of the policy landscape.[10] We carried
out over 35 remote semi-structured interviews. The
interviewees included artists whose practices exemplify
innovative approaches to technological engagement as
well as representatives from public bodies, cultural
organisations, technology companies, academic
institutions, and civic technology organisations. . These
conversations were complemented by three roundtable
discussions that brought together stakeholders from
across policy, industry, and AxAT production contexts.
All quoted material in the briefing stems from the
interviews and roundtables. Together, these dialogues
revealed patterns of consensus and tension that inform
our strategic recommendations.

FAE also commissioned targeted research on the current
state of play for evaluating Creative R&D impacts. This
work is a starting point for the development of new

approaches that better capture both tangible and intangible value creation within Creative R&D ecosystems - a critical foundation for advocating for increased investment and policy support. While we provide extensive examples and illustrations throughout this briefing to build a robust case for Creative R&D activity, there remains a notable shortage of quantitative data that captures the full value and impact of these practices. This is precisely because there is no practice of gathering such data at scale.

The FAE5 briefing was written by the FAE team with assistance from Claude Sonnet 3.7 and Opus 4. All references to 'we' throughout the briefing are to the Future Art Ecosystems project.

1. The transdisciplinary approach was core to PARC and was further expanded through the Artist-In-Residence Program (PAIR). See Craig Harris, *Art and Innovation: The Xerox PARC Artist-in-Residence Program* (Cambridge: The MIT Press, 1999).

2. John Warnock (University of Utah) helped develop Interpress and other printing and page description systems at PARC which allowed the Alto to become the first WYSIWYG computer when coupled with Xerox's laser printer. Later Warnock founded Adobe Systems which, along with Apple, helped bring about the desktop publishing revolution of the late 1980s. This innovation eliminated the technical barrier between writing and design, allowing anyone to create professionally formatted documents without specialised training - a capability we now take completely for granted with modern word processors such as Microsoft Word or Google Docs. See https://ohiostate.pressbooks.pub/graphicshistory/chapter/16-1-xerox-parc/

3. Michael A. Hiltzik, *Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age* (New York: HarperBusiness, 1999).

4. Serpentine Arts Technologies, *Future Art Ecosystems 1: Art x Advanced Technologies*, ed. Serpentine Arts Technologies (Serpentine, 2020).

5. Department for Business and Trade, 'Invest 2035: The UK's Modern Industrial Strategy' (Department for Business and Trade, October 2024), https://www.gov.uk/government/consultations/invest-2035-the-uks-modern-industrial-strategy; 'Convergent Screen Technologies and Performance in Realtime (CoSTAR)', accessed 14 May 2025, https://www.ukri.org/councils/ahrc/remit-programmes-and-priorities/convergent-screen-technologies-and-performance-in-realtime-costar/.

6. CoSTAR itself is an outgrowth of previous momentum built by initiatives such as The Audience of the Future and The Creative Industries Cluster Programme.

7. Council for Science and Technology, 'Harnessing Research and Development in the UK Creative Industries,' 22 April 2024, https://www.gov.uk/government/publications/harnessing-research-and-development-in-the-uk-creative-industries.

8. Tarek E. Virani, 'Towards a Creative and Cultural Industries Ecosystem Perspective,' in *Global Creative Ecosystems: A Critical Understanding of Sustainable Creative and Cultural Production*, ed. Tarek E. Virani (Cham: Springer International Publishing, 2023), 1--20, https://doi.org/10.1007/978-3-031-33961-5_1.

9. Jason Potts and Stuart Cunningham, 'Four Models of the Creative Industries,' *International Journal of Cultural Policy* 14, no. 3 (August 2008): 233--47, https://doi.org/10.1080/10286630802281780. Patrycja Kaszynska, 'Why Cultural Infrastructure Deserves Public Funding,' *The RSA* (blog), accessed 29 May 2025, https://www.thersa.org/articles/comment/why-cultural-infrastructure-deserves-public-funding/.

25

10. Our research is particularly attentive to the UK context, drawing on analysis of key policy documents including the aforementioned Invest 2035 industrial strategy (2024); the DCMS Creative Industries Sector Vision (2023); research from the Creative Industries Policy and Evidence Centre; Nesta's reports on Creative R&D frameworks; Arts Council England's strategy documents; Creative UK's sector reports and provocation papers; and UKRI's strategic frameworks. This policy analysis was complemented by a comprehensive landscape mapping of how 'Creative R&D' is understood and operationalised across different sectors. For an international perspective see the forthcoming British Council report: Hannah Andrews and Aurora Hawcroft, 'International Arts and Technologies: Innovation, Growth, Resilience and Hope' (British Council, Forthcoming).

Introduction

27

1

Introduction

Creative R&D

> *Artists are in a perpetual state of discovery with a huge amount of knowledge to add to the R&D conversation.*
>
> - Sarah Ellis, Director of Digital Development, Royal Shakespeare Company

The purpose of this chapter is to focus a clearer lens on Creative R&D as a distinct category of art and advanced technologies (AxAT) activity. At once broadening its scope beyond association with the 'creative industries' and simultaneously creating a firm foundation for designating activity that bridges the cultural sector with innovation ecosystems.

Creative R&D and the Creative Industries

Formal definitions of R&D are institutionally tethered to the natural sciences and engineering as codified in the OECD Frascati Manual - the internationally recognised guidelines for collecting and using R&D statistics.[1] In 1976 the manual defined R&D as 'creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications'.[2] Over time the manual has broadened its scope to account for intangible innovations in areas such as computing, acknowledging the importance of the social sciences and humanities in the development of the service industries.[3] This framework, while robust for measuring R&D activity in science and engineering, has proved inadequate for capturing the innovation from the cultural and creative industries. Nevertheless, it has shaped government policies globally, including the UK's HMRC criteria for R&D tax relief, which still explicitly excludes the arts, humanities, and social sciences.[4]

In 1998, the Department for Culture, Media and Sport (DCMS) published the Creative Industries Mapping Documents, which codified thirteen creative industries sectors and positioned them as economically significant contributors to UK GDP, valued at £60 billion annually

and employing 1.4 million people.[5] This marked a decisive shift from viewing arts and culture primarily through the lens of public subsidy and cultural value toward recognising their commercial and innovation potential.[6] Yet, despite being celebrated for their economic contribution and innovative capacities, the creative industries remained systematically excluded from the formal R&D infrastructure that supported innovation in other sectors.

In response, the 2010 *Not Rocket Science* report made a strong case for redefining R&D to include the arts and culture.[7] The authors argued that many arts organisations already engage in activities that align with Frascati's categories of basic research, applied research, and experimental development - particularly when experimenting with digital distribution, audience engagement, or new forms of collaboration. However, this work is often excluded because its outputs are not always codified, reproducible, or framed in technological terms. They urged policymakers to rethink the science-and-technology bias in R&D frameworks and arts organisations to make their innovation processes more explicit and methodologically rigorous.

The 2015 edition of the Frascati Manual was the first to substantially address research in the arts, offering guidance on what arts-related activity could be classified as R&D.[8] However, Bakhshi and Lomas have argued for further revisions to broaden applicability across all knowledge domains.[9] Their research proposed a revised definition of R&D that explicitly incorporates the creation of cultural and social value ✠, addresses forms of uncertainty specific to creative practice, and

acknowledges that R&D can result in experiences or behavioural changes - not just products and technologies. This revised framing calls for recognising the legitimacy of R&D in arts, humanities, and social sciences; enabling more effective cross-domain collaboration; and measuring returns on investment with the same seriousness afforded to STEM disciplines. Their proposed unified definition maintains the Frascati's but adds dimensions including aleatory uncertainty and experience-led knowledge creation, challenging narrow interpretations of novelty, reproducibility, and systematisation that have historically excluded creative sectors.

The specific term 'Creative R&D' gained currency within the creative industries as advocates sought to bridge the gap between the economic importance of the creative industries and their lack of legibility within traditional R&D frameworks. The term served multiple strategic functions: it asserted the legitimacy of research and development activities in creative sectors, it challenged the science-and-technology bias in existing frameworks, and it provided a conceptual bridge between cultural policy and innovation policy.

While the creative industries have advanced recognition and support for R&D beyond traditional science and technology sectors, positioning Creative R&D solely

within this domain creates significant limitations for its full potential and impact. Creative R&D within the creative industries has typically prioritised research in technologies associated with distribution and presentation - particularly immersive technologies and digital interfaces - while giving less attention to other technological fields.[10] Furthermore, Creative R&D has often been situated within the 'soft' and 'downstream' aspects of innovation, focused on concept development, user experience, and design thinking that lead toward product development and go-to-market strategies. This positioning, while valuable, represents only one dimension of what Creative R&D can encompass. The broader exploratory research, critical inquiry, and social innovation aspects of Creative R&D - which may not have immediate commercial applications but which generate crucial insights about technological and cultural evolution - have received comparatively less emphasis.

Recalibrating the Scope of Creative R&D

Definitions matter and if we don't define and conceptually understand

The decoupling of 'Creative R&D' from 'creative industries' represents a necessary recalibration for understanding how experimental practices operate across diverse domains - from cultural institutions to technology companies, from independent studios to academic research labs. While creative industries have developed robust frameworks for measuring commercial success through audience engagement, market share, and revenue generation, which reflect some aspects of applied research and experimental development, Creative R&D requires a broader anchoring. This need becomes particularly salient when Creative R&D occurs at the intersection of multiple fields: e.g., artists working with biotechnology - which can involve cultural, academic and industry actors; cultural institutions developing AI capabilities - which can involve think-tanks, legal professionals and engineering teams; or, technologists exploring narrative systems - which can involve tech companies, philosophers and artists. In these contexts, 'creative' signals not a market sector but a mode of experimental investigation that prioritises emergent ✹ possibilities over predetermined outcomes.

Creative R&D often occupies an ambiguous position - neither purely upstream nor downstream, neither exclusively hard nor soft technology.[11] For example, artificial intelligence exemplifies this hybrid nature - requiring both foundational technical research in machine learning architectures (hard technology) and experimentation with generative systems, interaction design, and ethical frameworks (soft technology). Similarly, immersive technology development might involve both hardware innovations (display technologies, haptic systems) and experiential design (narrative structures, interaction models), requiring teams that can work across these traditionally separated domains. These inherited categories create particular challenges for activities at the intersection of culture and technology.

Furthermore, the separation of digital and cultural policy within the UK's governmental structure has created significant barriers to realising the ecosystemic potential of Creative R&D. Historically, digital policy was housed within the, then titled, Department for Digital, Culture, Media and Sport (DCMS) as part of a broader strategy to integrate technology and culture, aligning with the 2017 Digital and Industrial Strategies. These strategies envisioned the cultural sector as a testbed for technological applications, fostering new art forms,

modes of engagement, and collaborations with major technology companies. This alignment facilitated logistical efficiencies and enabled cultural institutions to pioneer AxAT projects that operated at the intersection of digital innovation and cultural production.

However, in 2023, digital policy was transferred to the newly established Department for Science, Innovation and Technology (DSIT), decoupling it from cultural policy.[12] This structural shift not only disrupted established collaborative frameworks but also compartmentalised digital innovation away from cultural strategy, hindering the flow of resources and policy coherence that previously encouraged cross-sector experimentation. This structural issue has been acknowledged, if not fully addressed, as a priority challenge in the recent Industrial Strategy Green Paper (2024).

AxAT represents a non-codified dynamic field where artistic practice intersects with technological innovation across a spectrum of sectors and domains.[13] Creative R&D activity might include artists developing custom AI systems that challenge conventional machine learning approaches, cultural institutions establishing laboratories for experimental work with emerging technologies, as well as cross-sector collaborations that reimagine technological applications through artistic

interventions . Although lacking formal recognition in policy frameworks, AxAT has emerged as a distinctive and fluid ecosystem � through which advanced technologies are investigated, reimagined, and transformed into materials, media, tools and infrastructural foundations to underwrite new forms of expression, knowledge, and social engagement. AxAT can be distinguished from other artistic work by its direct investment in the development and implementation of advanced technologies, rather than a focus on art historical representation and interpretation, and other non-technology specific Creative R&D work.[14]

Creative R&D within AxAT encompasses practices that use interdisciplinary methodologies to investigate advanced technologies, generating new knowledge and applications across cultural, social, and technological domains ⚏. Building on the OECD Frascati Manual's definition of research and development and Hasan Bakhshi's and Elizabeth Lomas' revisions, we propose the following definition:

Creative R&D as a systematic, transdisciplinary ✕ activity that investigates and develops advanced technologies through innovative methods, generating new knowledge and applications across cultural, social, and technological domains. It adheres to established R&D principles while emphasising exploratory approaches that may originate in artistic, design, and/or cultural practices.

Like all R&D, Creative R&D encompasses basic research (acquiring new insights without specific applications), applied research (investigation toward specific aims or objectives), and experimental development (creating new or improved outputs, processes, systems or services), thereby meeting the internationally recognised criteria for R&D: novelty, creativity, uncertainty, systematic process, and transferability.

- Novelty - R&D pursues new knowledge or insights.

- Creativity - based on original concepts and hypotheses that are pursued through non-routine

activity.

- Uncertainty - R&D is uncertain about the final outcome. There is a broad recognition of the possibility of not achieving the intended results and negative results are considered valuable.

- Systematic process - R&D is a formal activity that is conducted in a planned way, with records kept of the process followed and the outcome.

- Transferability - R&D should result in the potential for the transfer of the new knowledge ✵, ensuring its use and allowing others to reproduce the results.

What distinguishes Creative R&D is its capacity to operate across ✎ traditional boundaries, integrate diverse knowledge domains, and address complex challenges ✻ through approaches that complement other R&D methodologies. Its outcomes can be measured through both conventional R&D metrics and additional frameworks that capture cultural, social, and long-term impacts.

We propose to work within this existing definition in order to remain compatible with a recognised policy framework and within a definitional lineage that is legible to different communities.[15] This approach provides a foundation for better recognition, evaluation, and support of Creative R&D activities across an ecosystem that encompasses creative industries, universities, civic, technology and cultural sectors. The success of this ecosystem is critical. As advanced technologies increasingly shape all aspects of social, economic, and political realities in profound and often unpredictable ways, Creative R&D has the capacity to ensure that their development reflects diverse societal needs ⌘.