University of BRISTOL | Bristol Digital Futures Institute

# Bristol Digital Futures Institute Impact Report

Our 24 months to March 2024


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# Directors' Welcome

## Welcome to our third Impact Report, highlighting the last 24 months to March 2024.

It's been a significant time for BDFI (Bristol Digital Futures Institute) with our infrastructure, academic cohort and projects developing at scale.

Since March 2022 we have led or supported £80.9m successful research proposals. This includes significant growth in our networks innovation and telecomms portfolio, where BDFI is at the heart of driving an ambitious agenda for human-centric, sociotechnical, and values-oriented innovation. We've also supported new initiatives in Gambling Harms and Cyber-Security, and have added projects on human-robot trust, 6G networks and prototyping to our sociotechnical portfolio.

In line with this growth, Professor Susan Halford launched the BDFI-Affiliated ESRC Centre for Sociodigital Futures alongside Professor Dale Southerton. As she focusses on supporting the Centre, we are delighted to welcome Professor Daniel Neyland as BDFI Co-Director to continue leadership from the social sciences.

Our academic capabilities have been strengthened with a stream of new academic appointments, and the establishment of our Affiliate Network. BDFI has attracted engineering and social science talent from institutions across the world to Bristol.

Alongside this, we've welcomed a new partner, LV = General Insurance.

We look forward to continuing conversations with existing and potential partners, developing the specialist spaces and celebrating new research findings as the next 12 months unfolds.

**Professor Daniel Neyland**,
Academic Co-Director

**Professor Dimitra Simeonidou**,
Academic Co-Director

**Dr Jenny Knapp**,
Director of Programmes
and Operations

**Our new headquarters at 65 Avon Street, St Philips in the heart of the Temple Quarter Enterprise Campus is now an operational building with a thriving program of events and visits with our colleagues, partners, local communities and funders. These engagements have generated huge interest in utilising our inspiring spaces and facilities to support bold new collaborations. Now we look forward to collaborating with our academics and partners on the opening of our specialist research facilities – including the world's first Reality Emulator, our XR suite and Neutral Lab.**

**We have also installed new Net Zero facilities funded by a £2.5 million Research England capital award which allows us to reduce our carbon footprint further and carry out exciting new research. This includes a smart energy mircogrid system employing used e-vehicle batteries, an experimental AI-driven datacentre energy management platform, sophisticated tree sensors and biowalls to improve air quality.**

# Our achievements in a snapshot

building handed over from contractors to the University of Bristol

5 new seedcorn funded projects announced

53 research proposals submitted

8 new academic appointments

44 academic papers published

2 patents filed

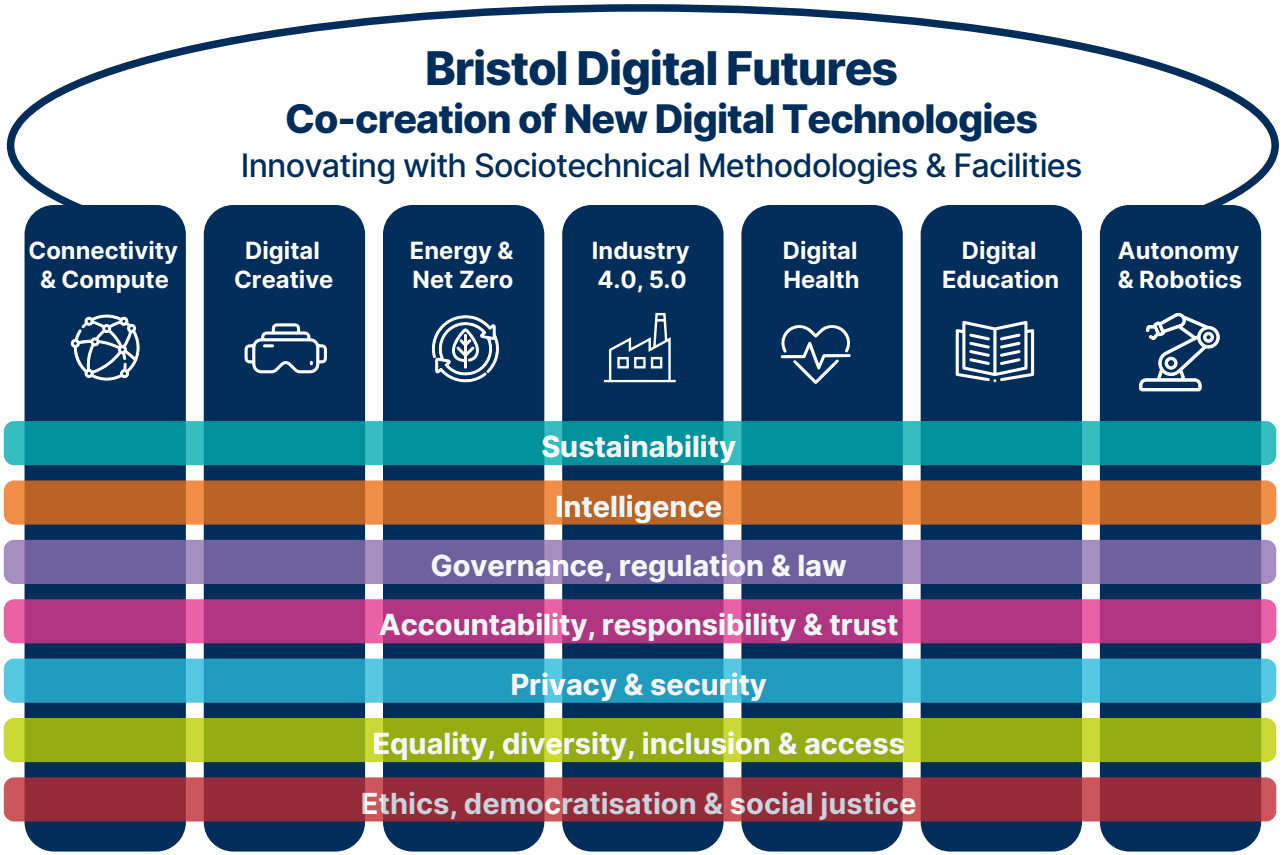
£80.9m new research funding won by BDFI or our academics

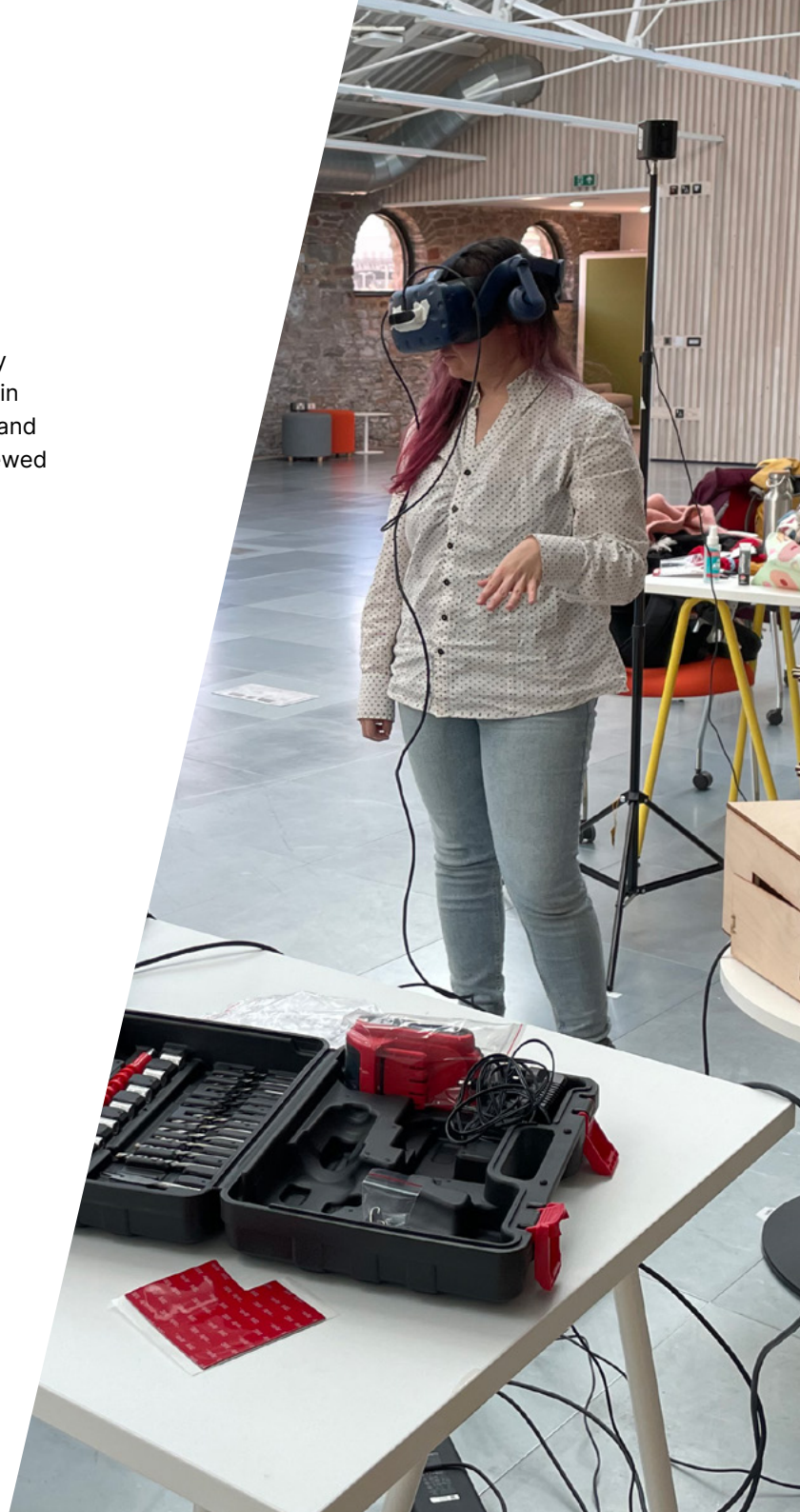
126 members of our affiliate network

1 new honorary fellow

# Research portfolio

The last 24 months have seen us build on our strengths and develop a new research strategy. Our research strategy is represented by the following diagram that sets out a series of vertical pillars (these comprise areas of application in which we are, and will be, working) and cross-cutting horizontal research themes. In the coming years the verticals and horizontals will be combined in different ways in each of the projects we develop. The strategy diagram will be reviewed each year:



We've added a diverse range of projects to our portfolio during the last two years. Each of the items below are either led by BDFI academics or were submitted for funding with support from the Institute.

These build on our areas of active research across sectors such as telecoms, security, transport and manufacturing to transform digital innovation.

| Project | Sector | Aims | Partners | Funder |
|---|---|---|---|---|
| UK Telecoms Innovation Network (UKTIN) | Connectivity and compute | Boosting creativity in the telecoms supply chain. | Digital Catapult, Cambridge Wireless, West Midlands 5G | Department for Culture, Media and Sport |
| Realising Enabling Architectures and Solutions for Open Networks | Connectivity and compute | Developing solutions for 6G mobile networks across the entire research and development supply chain. | Ericsson, Samsung and Nokia | Department for Culture, Media and Sport |
| Satisficing trust in human-robot teams | Security<br><br>Autonomy & Robotics | Developing trustworthy human-robot security teams that can act within legal, ethical and operational constraints. | Led by the University of Birmingham, with University College London and University of Birmingham | EPSRC |
| Net Zero Sustainable Campus Testbed | Energy & Net Zero<br><br>Education | Net Zero facilities at BDFI contribute to testing energy use and storage, carbon capture and pollution reduction for research centres. | | RPIF |
| 21st Century prototyping | Manufacturing | Mixing physical and virtual product testing for quicker, more efficient and accessible processes. | Ultraleap<br>AMRC<br>Autodesk<br>The Product Partnership | EPSRC Fellowships |
| Future Communication Platforms<br>1. Network of Networks<br>2. Wireless and wired systems and spectrum | Networks | 1. Interface research to deliver **seamless, open and fully integrate**d network of networks.<br>2. High-level, low latency **access** to internet services for fixed and mobile users. | TITAN consortium – 17 Universities with BDFI, Digital Catapult, the Compound Semiconductor Centre and the Fraunhofer Centre for Applied Photonics.<br><br>Eight university teams. | EPSRC |
| Connected Living | Energy & Net Zero | Improving **household efficiencies** by detecting water leaks using smart sensors. | LV = General Insurance | LV = General Insurance |

In addition to the new projects we've contributed expertise to the Temple Meads Station Innovation Zone and supported two new research centre start-ups – the Research Hub for Gambling Harms and the Research Institute for Sociotechnical Cyber Security.

We have supported BDFI affiliate Dr Ola Michalec in the national Research in Residence (RIR) competition to produce an innovation project in partnership with the Catapult Network, researching Energy and Democracy in Digital Twins.

We have also helped to kick start five new seedcorn projects thanks to a new round of BDFI competitive funding.

## Research reports

Research outcomes have included the publication of a collaborative report with Knowle West Media Centre into experimenting with hybrid technologies as we come out of the pandemic and an industry graduate talent survey on behalf of TM Forum.

Professor Colin Gavaghan, alongside four other academic colleagues, submitted a detailed response to the Government's AI white paper consultation.

| Project | Sector | Aim | Partners |
|---|---|---|---|
| Exploring digital futures through play | Health/education | Harness the power of play to imagine futures in more inclusive, accessible and collaborative ways | Coney |
| Profiling the energy consumption of video streaming over 5G | Telecoms/mobile networks | Explore the sustainability and carbon footprint of video streaming over 5G | |
| Cognition – making mixed reality experiences accessible | Health/inclusivity | Make virtual reality more accessible and inclusive for people with disabilities or impairments | Pervasive Media Studio<br>Knowle West Media Centre<br>Ultraleap |
| Wearable robots for enhancing embodied communication | Health/inclusivity | How wearable robot technology can help enhance communication, particularly for those with complex communication difficulties. | Air Giants<br>Neon Dance |
| Against digital fatalism: resisting technology hype through hopeful artful interventions | Health/digital creative | Counter the fatalism and anxiety some people feel when thinking about the future, by using artful interventions to empower diverse audiences to engage in critical thinking about emerging technologies. | |

# Events and Visitors

## We have hosted numerous tours, workshops, events and seminars in our building over the last two years.

### Some highlights include:

- Hosted two Open House events for partners and academics, attended by over 200 people to see our facilities and hear from academics and operational colleagues
- High profile delegations have visited us from Taiwan Ministry of Digital Affairs, 32 technology companies from India and Japan
- In September 2023 we brought together all our academic affiliates for a networking event to explore research themes and opportunities for collaboration
- In October 2023 we co-produced the Sandbach Tinne Conference with Malik Al Nasir and colleagues from University of Cambridge.
- The conference explored the history and archives of the Sandbach Tinne family and Company, a conglomerate that was deeply involved in the slave trade. The conference showcased latest research alongside how the use of digitisation of archives can make history more accessible.
- In March 2024 we hosted one of our corporate partner BT's residential Leader Lab 2-day workshops, bringing together 50 BT leaders and academics to explore future technologies and sociotechnical approaches to innovation.
- We continue to engage with our partners and grow our affiliates community, and have a busy programme of events, visits and seminars scheduled for 2024 and beyond.

## International Digital Futures Network

In July 2023 we hosted an inaugural meeting to establish and lead a global network of digital futures institutes with participants from Australia, Edinburgh, London and Manchester.

Academics from Monash University, University of Edinburgh, Kings College London and University of Manchester gave presentations on the work of their institutes and we held discussions on network development. We are continuing to develop this network by creating terms of reference and broadening membership to other institutions, holding a further event and running a series of visitor exchanges.

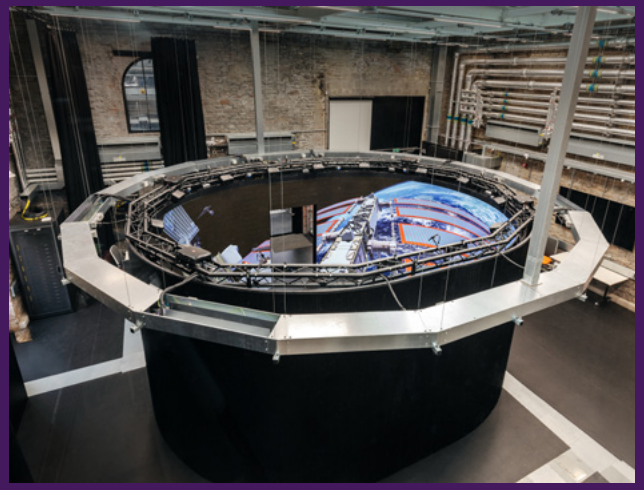

# Focus on our home

Our stunning new home, The Sheds, at 65 Avon Street, is the first University building to open on the University's new Temple Quarter Enterprise Campus. The restoration and conversion of a 200 year-old stone Retort House and Coal Shed is being transformed into a home for pioneering research, innovation and collaboration.

While building work on Phase 1 was completed in June 2022, work continued on Phase 2 installing and commissioning our new state-of-the-art specialist facilities and equipment. Phase 2 became fully operational in October 2024.

The Sheds is being built to BREEAM excellent standards; and in addition we have enhanced it with further Net Zero technologies and facilities. As well as helping reduce our carbon emissions, this gives us the ability to do unique research and use it as a Sustainable Campus Testbed.

# Facilities in progress



## The Reality Emulator

BDFI is home to the world's first large-scale multi-sector digital twin emulation facility.

It will allow teams to co-create digital technologies and solutions through novel experience-based, iterative and immersive approaches.

We have worked closely with Fujitsu and Mechdyne to build the facility which will shortly be fully operational.

Fujitsu have installed and commissioned the Reality Emulator's advanced high performance compute, data, and network hardware platforms in our data centre. The high performance network infrastructure will allow for cutting edge network research, such as using Quantum Key Distribution and even adding neuromorphic devices into the fabric.

Connections to our local autonomous 5G research network and the wider University campus network and beyond are provided by two communication rooms. The Reality Emulator will also be connected to local and regional research test beds (Smart City, Highways & Ports, Museum, and Advanced Manufacturing testbeds and make these available to researchers and partners. Our connection with the UK's National Dark Fibre Facility (NDFF) and, as the only UK site connected into the US National Science Foundation's FABRIC network infrastructure, we will be able to bring in collaborators, data and tools from numerous sites across the UK, US, Europe and Japan.

By early 2025 we will be able to extend our UK connectivity via JOINER, the UK's first national accelerator programme towards 6G and beyond. This is a national R&D platform interconnecting academic institutes, research labs and industrial partners to enable innovation within a collaborative experimental environment.

Mechdyne have delivered and installed the Reality Emulator's immersive front end and platforms. This will support high quality 2D and 3D visualisation with integrated computer vision applications, for example 3D and VR applications around object recognition, gesture recognition, and real-time scene analysis. It will also support 2D applications such as image viewers, video players, web browsers and 360-degree video playback.

The arrival of Isambard AI, the UK's fastest supercomputer, based at the Bristol & Bath Science Park in the summer of 2024 gives us enormous processing power to train our digital twin AI-driven emulation models.

Researchers, partners and collaborators will be able to bring their digital models, experimental hardware and software and perform experiments, and together iterate their designs and interventions in real time. It will enable powerful interdisciplinary, cross-sector co-creation of new digital technologies. The Reality Emulator is also an experimental platform in itself and will be pushed to its limits, developed and enhanced over time.

The Reality Emulator can be used to research a wide range of challenges; from city planning, education, manufacturing and cyber security, to gaming, AI regulation, health, transport and commerce in the virtual world. It is open to all sectors and we welcome enquiries from interested parties.

## The Neutral Lab

The Neutral Lab is a fully flexible space to host cross-sector project teams who will co-create their own shared working environment and deliver ambitious new collaborations.

Following consultations to understand the range of needs, opportunities and potential barriers with our academic colleagues, our partners and community hubs, we have refined our processes and equipment to be able to support the broadest range of projects possible. These were tested during our pilot phase where we hosted Seedcorn funded projects.

The Neutral Lab is equipped with mobile furniture – fully reconfigurable to support a diverse array of activities and needs. Resident teams have access to 'The Cupboard' full of digital tech, creative materials and resources to support their collaboration.  During the pilot phase the Neutral Lab was used to host numerous diverse range of events and partner workshops – from sociotechnical project showcases, partner themed workshops, digital archives from slave trade exhibits; to convening the BDFI-led International Digital Futures Networ with partners from across the globe.

The Neutral Lab, as with all our specialist facilities, is also a research project in itself.

## XR suite

Our bespoke designed facility, in use since 2023, is equipped with four of industry's highest resolution, state of the art, Varjo XR3 Virtual and Mixed Reality headsets. The facility can support four independent users having separate experiences or two or more sharing and interacting within the same experience.

Varjo headsets employ integrated hand and eye tracking technology to provide a more intuitive and natural experience, enabling the use of hands and fingers rather than hand controllers. These headsets can also be connected into the Reality Emulator. The XR Suite is also equipped with a range of other VR headsets which can be used on site or off site for research purposes.

## Net Zero: Sustainable Campus Testbed

Thanks to a £2.5 million Research England UKRPIF (Research Partnership Investment Fund) Net Zero award, BDFI can both reduce the carbon footprint of our building and research, as well as enabling new net zero research.

Over the last year we have been installing our Sustainable Campus Testbed capabilities, embedding carbon reduction technologies and practices into our new home.

**The testbed features:**

- A smart energy system including a used car battery energy storage facility together with a microgrid demand control system. We will store our building's roof-top solar energy and low carbon intensity energy from the national grid and use it in the building at times when the energy available from the grid is at high carbon intensity. A digital twin of this energy system is being developed and will be visualised and experimented

with in the Reality Emulator.

- An experimental artificial-intelligence-driven data centre energy management platform to research how to reduce the energy consumption of the Reality Emulator and its data centre hardware.
- Installation of biowalls in our public realm and air quality monitoring sensors inside and outside our building to investigate if biowalls can improve air quality inside our building. Early results already show an improvement.
- Installation of different species of native trees in our public realm equipped with sophisticated tree sensors that give us data on their physiology, health and the level of carbon they each capture.

All our net zero initiatives are being included in a wider net zero digital twin model of our site so we can experiment in the Reality Emulator with the aim of optimising our carbon reduction efforts, provide education and public engagement on net zero and catalyse further research.

## Cyber Range - Security Infrastructure Suite RPIF BDFI funded

The Cyber Range, part-funded by BDFI-UKRPIF, forms part of Bristol's Cyber Security Group's (BCSG) world-leading cyber infrastructure testbed. It consists of servers and networking equipment to host virtual machines, software and network simulators, and traffic generators which enable a more realistic environment for modelling cyber attacks, countermeasures and digital twins at scale. The Cyber Range is VPN-enabled making remote access and confederation with other Cyber Ranges and physical equipment possible.

Pending the opening of the main academic building on the University's Temple Quarter Enterprise Campus, the Cyber range has been installed in Engineering's Merchant Venturers Building, and will be transferred to Temple Quarter in 2026. Researchers and industry collaborators are using the Cyber Range for experiments and replicating large environments with complicated inter-connectivity. The facility is also used for teaching and training. For example, it was used in the UK's first Capture-The-Flag style event focused on Critical National Infrastructure. The event included academic and industry teams from across the UK who pitted their skills against themed challenges.

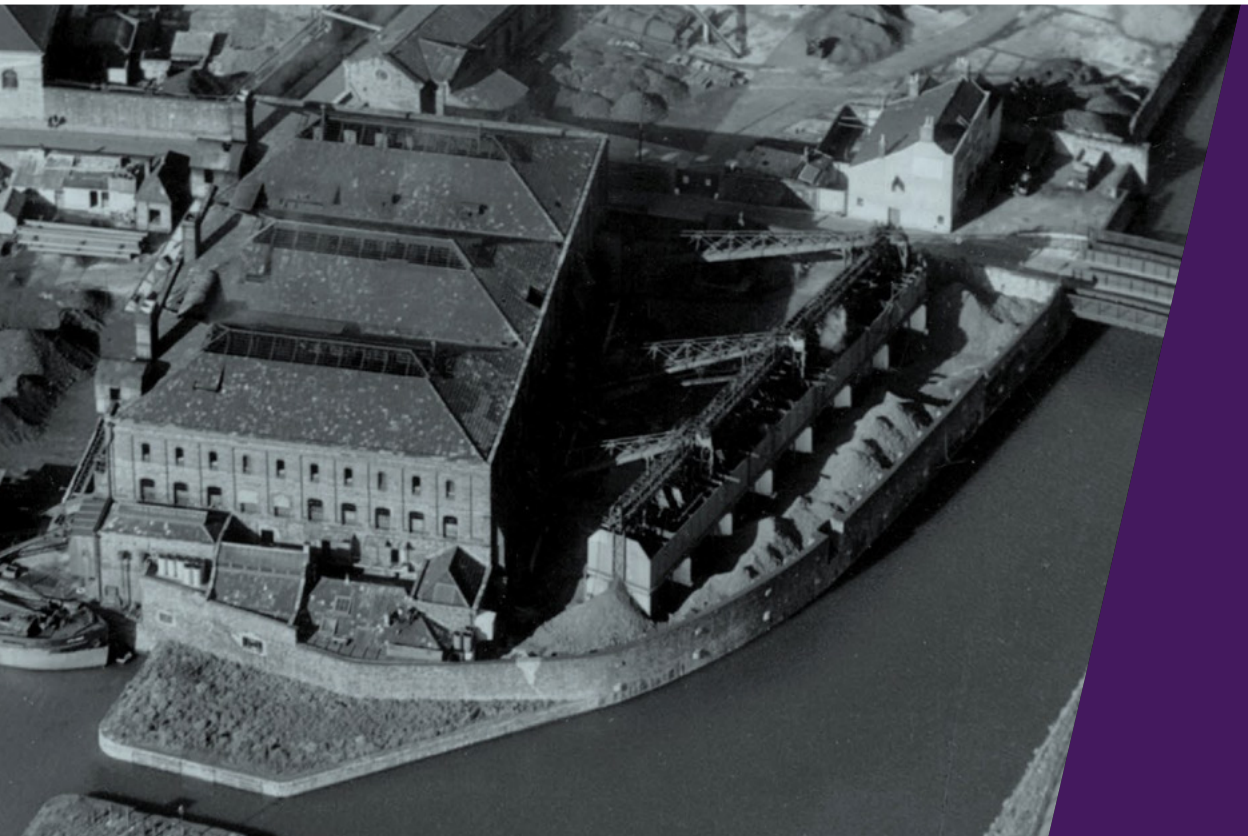
## Creative Continuum

Construction and fit-out of the UKRPIF-BDFI funded adjoining Coal Shed has completed, with its creative sector focussed specialist facilities, hosting the MyWorld programme. Contracts with Megahertz and Lux Machina have allowed the fit out and installation of the specialist equipment in the Production Studio and Smart Cinema (previously the Instrumented Auditorium) which opened in late 2024.

The Coal Shed has also seen the opening of 'The Hub' - a space where partners and researchers are able to join us, work, engage and talk in comfortable, inspiring surroundings.  We are enjoying expanding into our additional work, meeting and workshop spaces and becoming one united building.


## CM1 update

The construction of the 'CM1' building, the flagship Temple Quarter Enterprise Campus university building, is well underway and on course to be open by September 2026. A number of BDFI-UKRPIF funded facilities will be housed in this building including the Cyber Suite, Digital Health Node, engineering research labs, public engagement spaces, a prototype fabrication facility: the 'Design Factory', and formal enterprise spaces for industry partners.



# History

We took the opportunity to celebrate and share the historic and sociotechnical significance of our home as the headquarters of the Bristol Gas Company, the industry that brought light to the streets of Bristol from 1821 and changed the way citizens lived and worked. ‘The History of the Sheds’ project brought together historians (James Watts, University of Bristol, and Gary Allerton, Barton Hill History Group), local artists (Ellie Shipman) and members of the local community to explore, create and share memories of the former gas works.

# Our growing academic community

## We're proud to introduce six new BDFI appointments from both social science and engineering backgrounds.

### Colin Gavaghan

**Professor of Digital Futures, University of Bristol Law School**

Colin's research looks at the relationship between law and emerging technologies. He explores how existing laws can be applied to new technologies, whether we need new laws, and if so, how to make sure those are 'future-proof' in the face of fast-moving regulatory targets. He is particularly interested in rules around AI and robotics.

### Angeliki Katsenou

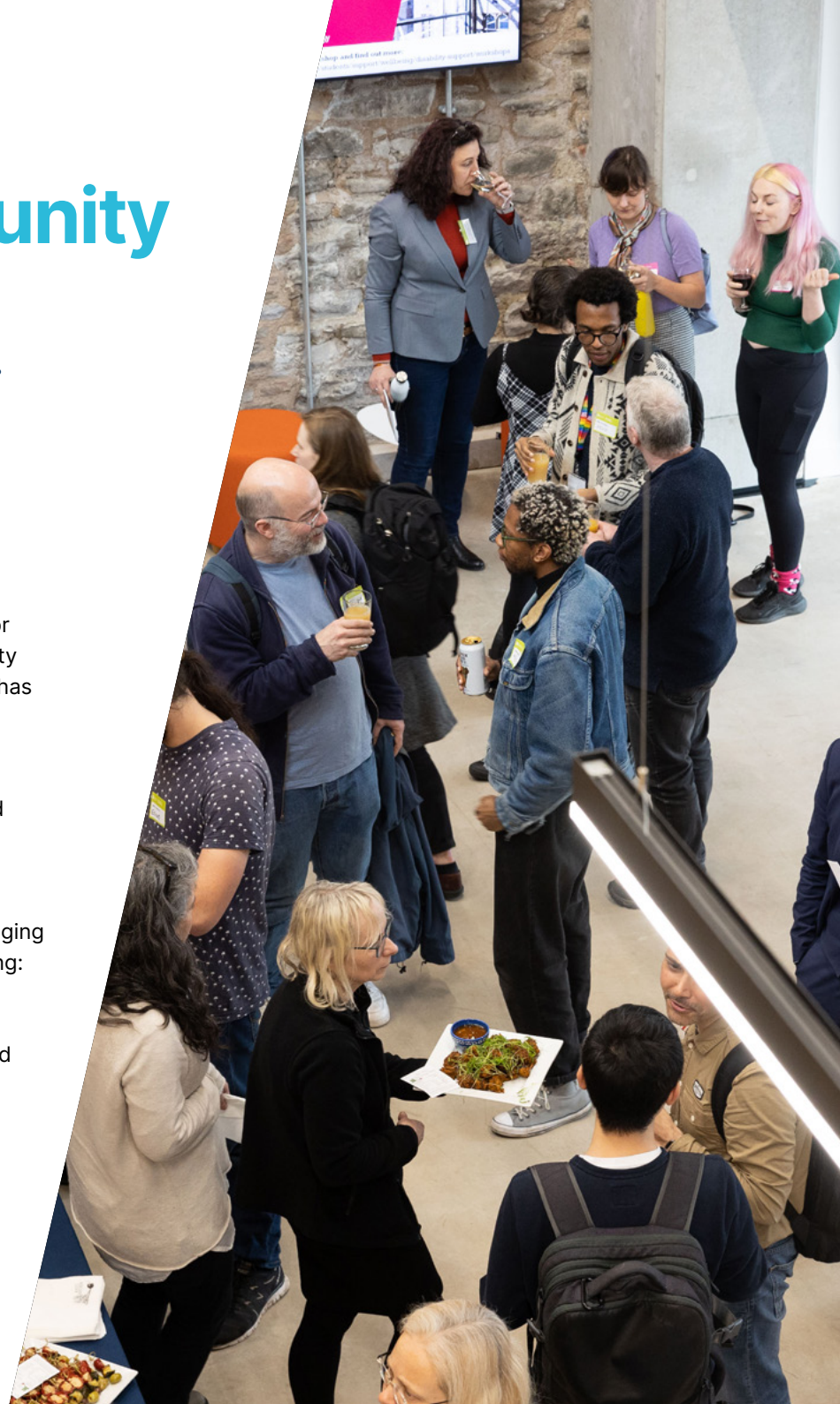
**Senior Lecturer in Networked Media (BDFI and MyWorld), Faculty of Engineering**

Angeliki's research interests include topics around the media processing and experience pipeline: acquisition, analysis, compression, communication, understanding perception, and quality of experience. Important aspects of the engineering and the societal impact are also of interest, such as sustainability. Other side research activities include working with interesting data for biomedical engineering (e.g. proteomics).

### Daniel Neyland

**Co-Director Bristol Digital Futures Institute**

Daniel is a social scientist and Professor of Digital Futures in the Bristol University Business School. For over 20 years he has worked on collaborative sociotechnical research projects, often working with computer scientists and engineers to come up with new ways of working and thinking. From studies of the everyday life of algorithms through to research on markets for digital data, he has demonstrated a commitment to challenging taken for granted assumptions regarding: the relationship between problems and solutions; what it means to govern and distribute relations of accountability and responsibility; and how we ought to go about the process of doing research.



### Devika Narayan

**Lecturer in Digital Futures, Business School**

Devika's research focuses on the transformation of markets, firms, and the structure of work. She is interested in the relationship between emerging technologies and industrial change. Her current work investigates how cloud computing arrangements restructure the corporate computing sector. Devika holds a Ph.D in Sociology from the University of Minnesota and an M.Phil and M.A. in Sociology from the Delhi School of Economics.

### Yulei Wu

**Associate Professor, Department of Electrical and Electronic Engineering**

Yulei's current research focuses on network digital twins, AI-powered networks, connected systems, and edge intelligence. He continues this research with BDFI, particularly focussing on applying AI to improve the performance of future networks and developing technical solutions to address relevant ethical and social issues.

### Shadi Moazzeni

**Lecturer in Networks at the School of Electrical, Electronic, and Mechanical Engineering.**

Shadi specialises in the Native-AI 6G networks. Her research focuses on the orchestration and optimisation of next generation intelligent networks, multi-access edge computing, and intelligent multi-objective profiling towards zero-touch network and service management. At BDFI, she continues her pioneering work on Native-AI networks to enhance future network performance and develop innovative, human-centric networking solutions.

## We've also strengthened our operational team

**Jenny Bobroff**
Senior Communications Officer

**Nick Hall**
Facilities and Services Manager

**Karen Howard**
Events and Projects Officer
(Claire Parnall, Maternity Cover)

**Sam Hume**
Business Development Manager

**Guy Lowin**
Technical Architect

**Kobi Merrikin**
Senior Operations Administrator

# Our ambitions for 2024/25

## Our targets for the coming year include:

- Launch a series of thematic initiatives with partners, researchers and collaborators
- Grow our co-investor partner ecosystem, strengthen and broaden our sector reach and ensure ongoing sustainability
- Grow our BDFI Affiliates network to broaden our interdisciplinary reach, research and collaboration capabilities
- Establish a BDFI Associates programme, which enables external non-academic individuals working in aligned and complementary fields to apply for associate status.
- Complete our recruitment of academic and operational colleagues
- Commission and open the Reality Emulator and have pilot projects underway
- Fully launch the Neutral Lab and welcome in new resident project teams
- Open the new spaces and facilities in the Coal Shed, unite our building and welcome MyWorld
- Launch the 3rd round of seedcorn funding to help kick start tomorrow's sociotechnical research
- Continue our seminar series, showcasing in particular ideas from our newly appointed BDFI academics, Honorary and Visiting Fellows
- Publish the first edition of our sociotechnical innovation playbook
- Establish a Net Zero research network for engagement with the Sustainable Campus Testbed facilities.
- Establish and grow the International Digital Futures Network

## Work with us

We welcome new partners and collaborations

Get in touch: **bdfi-enquiries@bristol.ac.uk**

**BDFI Newsletter sign-up**

**BDFI Affiliates sign-up**

**BDFI Associates sign up**

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