Engineering and Physical Sciences Research Council

A CELEBRATION OF 15 YEARS

horizon

DIGITAL ECONOMY RESEARCH

Contents

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Foreword

As December 2025 approaches, we prepare to mark the end of Horizon's incredible 15-year journey. I have been reflecting on my time as Director of Horizon's third programme 'Trusted Data Driven Products', its milestones, innovations and impact in the domain of digital economy research - and feel proud that we have achieved so many great things.

This final brochure reflects on Horizon's diverse research portfolio, celebrates successes achieved throughout the years, and provides details about our final research projects.

Horizon was one of the original founding Centres of Excellence for Digital Economy (DE) research, funded by UK Research and Innovation through a Digital Economy Theme introduced in 2009. Horizon's journey continued in 2020 when it became one of the 'Next Stage Centres of Digital Economy' along with DigitLab, Future Places Centre, DECaDE, CAMERA 2.0 and the Centre for Digital Citizens. In 2024 representatives from the six centres came together to deliver DE-Nexus, an event showcasing the impact from their UKRI EPSRC funded research. De-Nexus is highlighted later on in the brochure.

Professor Boriana Koleva

A consistent theme throughout Horizon has been the commitment to nurturing future generations of researchers and academics. We successfully achieved this through a Transitional Assistant Professor programme, which provided valuable opportunities for emerging talent to develop their skills. We feature some of our successes in a later article.

In line with our Responsible Research and Innovation theme, a reflective and flexible approach was adopted throughout all research activity. This empowered us to identify and tackle real-world digital challenges in the fast evolving physical and hybrid online environment. Projects engaged with various sectors of society to explore areas such as responsible innovation, product design, safety, robotics, artificial intelligence and welfare.

As we rapidly advance into an era in which Artificial Intelligence and autonomous technologies become embedded into our lives, the insights gained from Horizon research will support and drive future advancements in addressing privacy and security concerns associated with these technologies.

As we approach the end of Horizon, one of our key priorities has been to ensure that our digital legacy is carried forward into future technological revolutions. To support this, we have been actively collaborating with colleagues working across several research programmes and initiatives. Notable collaborations includes Turing AI Fellowship Somabotics: Creatively Embodying AI, Bridging Responsible AI Divides (BRAID), Responsible Ai (RAi) UK, the Trustworthy Autonomous Systems (TAS) Hub and the Responsible Digital Futures research group.

And finally, I would like to personally thank everyone who has joined us on Horizon's journey and contributed to the success of the Programme – your support has been truly invaluable.

Over the last couple of decades, the remarkable integration of the internet and the emergence of a dynamic digital economy have changed our lives, creating substantial increases in online businesses and services. This has transformed traditional models and given rise to new, innovative types of business and services to consumers, one example being the generation of media services that enable us to access, create, upload and share content. This shift has unlocked tremendous commercial potential, highlighting the value of personal data, through its sharing, mining and use to understand and influence human behaviour.

In 2009, UKRI ESPRC introduced a Digital Economy Programme to fund a number of Centres for Excellence to address the challenges and benefits of the rapidly evolving online world. The Horizon hub, spearheaded by the University of Nottingham, became a prominent research institute, addressing challenges such as sustainability, inclusion, creativity and safety with consideration to growing concerns about use of personal data, in particular privacy, trust and security. The hub introduced a unique multidisciplinary approach, bringing together over 50 researchers, working with colleagues from several disciplines across partner universities and over 200 partners from industry, regulators, policy makers, charities and third sector organisations.

As the digital economy matured, a second phase of Horizon 'From Human Data to Personal Experience' explored how technologies capturing and analysing human data could be utilised to deliver more powerful and meaningful experiences. Research explored the collection of human data in a more transparent way and the understanding and design of technologies which offered new kinds of experiences and promoted wellbeing and sustainability.

Having established itself as a well-renowned Centre of Excellence and building a Digital Economy research portfolio amounting to over £25.7M, Horizon's third programme 'Trusted Data Driven Products' considered the notion that products would be both digital and physical, exploring user centre design and creation of data-driven products.

Throughout its lifecycle, Horizon initiated a unique approach to research by introducing a model which involved several innovative delivery mechanisms:

To build capacity within the Digital Economy research environment a Transitional Assistant Professor programme was introduced to attract and support talented research fellows to the academic career track. The Horizon Centre for Doctoral Training was established, an internship programme supported undergraduates gain value experience of the research environment, and an Artist in Residency scheme reached out to new communities.

A series of 'Impact Campaigns' were introduced to encourage a **wider thematic, cross sectorial** approach to impact. Campaigns were broad enough to identify and encourage new synergies, whilst being sufficiently focused to address and drive forward challenges in the areas of Media, Services, Products, Co-Production, Fast Moving Consumer Goods and Welfare.

The introduction of a **Translational research programme** enabled a growing multidisciplinary team of researchers to introduce short, agile projects working with partners to address real-life challenges at pace.

Notable success has been achieved within the **policy** arena. Horizon established itself as a key player in policy discussions through actively contributing to public consultations and inquiries, compiling research submissions and participating in government committees. Former Horizon director, Derek McAuley was invited to join the Furman Committee and his involvement was instrumental in producing recommendations aimed at reforming competition and pro-competition policies to capitalise on opportunities presented by the digital economy.

A commitment to embedding a culture of **responsible research and innovation (RRI)** within the academic environment earned Horizon a distinguished reputation as an ambassador within this important field. We are delighted that our RRI legacy is being taken forward by several colleagues and research programmes to enhance the integrity and support the accountability of academic work carried out in the future.

We thank everyone who joined us on this journey and contributed to Horizon's success along the way.

Trusted Data Driven Products (EP/T022293/1)
8/12/2020 – 7/12/2025
(£4,075,505)

From Human Data to Personal Experience (EP/M02315X/1)
1/8/2015 – 31/7/2020
(£4,062,954)

Digital Economy Hub (EP/G065802/1)
1/10/2009 – 30/9/2015
(£12,610,085)

Horizon's Impact Campaigns

MEDIA

Our Media Campaign addressed the integration of digital media assets into everyday services and physical products and how to transform mass media platforms into personalised experiences.

Thresholds used virtual reality technology to restage one of the earliest exhibitions of photography held in 1839 when British Scientist William Henry Fox Talbot presented his photographic prints to the public at King Edward's School in Birmingham. Thresholds launched in Spring 2017 at Somerset House in London and toured to prestigious venues in the UK and across Europe until 2019, engaging with audiences totalling over 10,000.

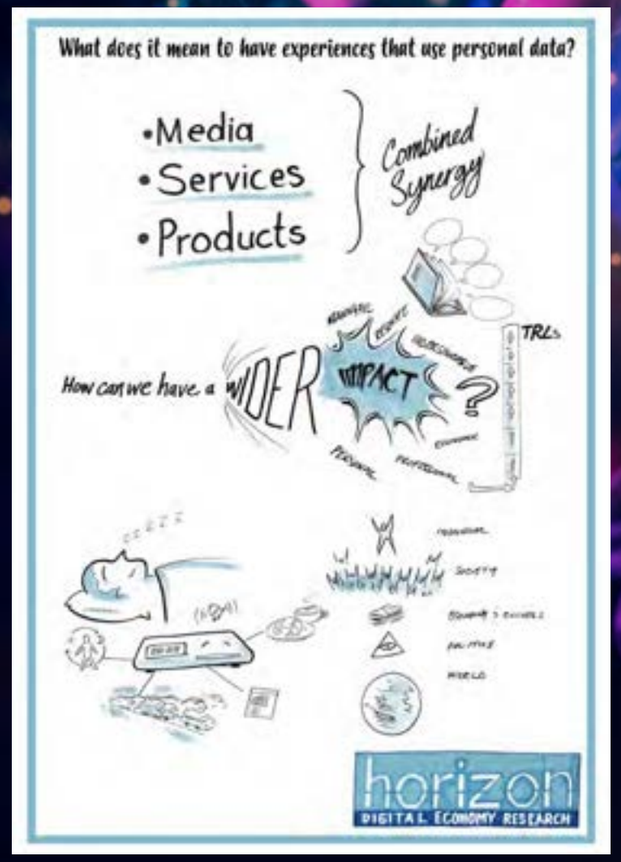
SERVICES

We explored how online services that exploit personal data, might take on increasingly experiential qualities through deeper connections to the physical world or to digital media in our Services Campaign.

The Memory Machine (MeMa) project developed a unique system called Chronicle which contextualised personal memories into a core 'timeline' of other shared and public media content. The first phase of MeMa focused on the potential of a memory machine health application for dementia care.

PRODUCTS

Our Products Campaign spurred a fundamental transformation in product design and manufacturing, particularly additive manufacturing and AI-driven design. The campaign facilitated three projects that were instrumental in establishing University of Nottingham's Smart Products Beacon. The Beacon went on to establish the Cobot Maker Space, a state-of-the-art robotics facility within the School of Computer Science at the University of Nottingham.



CO-PRODUCTION

Recognising the huge challenges COVID-19 presented to creative industries, our Co-Production campaign was able to support creative partners with the design and delivery methods of new types of experiences in novel ways.

Future Festivals supported several hybrid festivals, developed and released a unique platform which enables the staging of festivals in online virtual environments, sharing 3D worlds in which performers and audiences gather and interact with each other.

FAST MOVING CONSUMER GOODS

Our Consumer Products Campaign worked with partners to explore the creative design and manufacturing of digitally enhanced fast moving consumer goods, defined by their limited shelf life. Research explored how technologies such as virtual and augmented reality might enhance the consumer experience.

Unpacking the Current Value of Digitally Augmented FMCGs developed a digitally augmented snack-bowl embedded with simple game mechanics. The bowl superseded the usual rituals of shared snacking and regulated turn taking and served as a good ice breaker in a group of strangers.

WELFARE

Our final campaign focused on welfare and successfully partnered with several health and social care providers, charities, and third-sector organisations. Work resulted in the creation of data-driven products supporting consumer wellbeing, alongside a deeper understanding of the regulatory and economic landscapes governing products designed to differentiate and enhance care for consumer wellbeing.

Supporting the next generation of Innovators

The Transitional Assistant Professor (TAP) programme was established as part of the 'Horizon Hub' to attract and cultivate talented researchers to the academic career track. Core to Horizon's values around identifying, nurturing and supporting new talent, the programme provided researchers with dedicated time and resources to focus on developing their individual portfolios and leadership skills, whilst building professional networks.

Through the TAP programme, 12 researchers received invaluable support as they transitioned into senior roles. The programme equipped them with essential assistant professor responsibilities, facilitating a smooth progression into higher academic positions and contributing to the growth of the academic community. The success of Horizon's TAP programme is evident by its implementation within the School of Computer Science at the University of Nottingham, where several Transitional Assistant Professors have been appointed, benefiting from dedicated protected time for research and a gradual integration of teaching and administrative duties.

Sitting alongside Horizon Digital Economy Research, the Horizon Centre for Doctoral Training (CDT) - established in 2009 - has successfully supported the graduation of over 190 students in the digital economy and computing fields. The CDT has played a key role in providing in-depth knowledge and skills essential for future careers, within both academia and industry. With a total of fifteen cohorts, the final intake of CDT students are on target to graduate in 2029.

Helena Webb

The TAP programme enabled Helena to develop and consolidate her areas of research interest. Working on Everything in Moderation sparked an interest in methodological issues related to the study of online communities and mechanisms to support researchers and others dealing with online content as part of their professional work. She was able to further explore these topics in subsequent projects Effective, Responsible and Safe Research on Online Communities (EFRESH) and Workplace Wellbeing and the Internet (W-WATI) whilst also developing leadership and management skills by serving as Principal Investigator (PI).

Additionally, Helena has had success with externally funded projects. She was PI of the TAS Hub project, Trustworthy and Useful Tools for Mobile Phone Extraction and the RAi UK project TAS Hub-Good Systems Strategic Partnership. She has also been involved as Co-Investigator on two Arts and Humanities Research Council (AHRC) Bridging Responsible AI Divides (BRAID) projects, focusing on responsible artificial intelligence (AI) in creative works, as well as two National Institute for Health Care and Research (NIHR) projects related to AI supporting decision-making in surgical transplantation.

Helena has taken on a senior role in the School of Computer Science EDI committee, has taught on several undergraduate modules and successfully persuaded the School of Computer Science at the University of Nottingham to add a Software in Society module to their curriculum.

"Being part of the TAP programme has been a highly beneficial experience, significantly supporting my career development and offering a structured pathway into administrative responsibilities and teaching. Horizon provided an exceptionally supportive research environment, with colleagues readily available to offer advice on funding applications and project development. I greatly benefitted from this support, which contributed to my success in securing externally funded research"
Helena Webb

Following the TAP programme, Iker spent two years centred on mathematical research, focussing on probability and statistics. He produced research outputs on the study of stochastic jump processes and Bayesian methods and was named an 'outstanding' reviewer by the International Conference on Machine Learning in 2019. Iker now works at Feedzi as a data science manager with a strong background at the intersection of research, software engineering and finance, and manages a team of research data scientists who design innovative solutions to prevent and fight financial crime.

Iker Perez

Horia Maior

In the first few years of being appointed a TAP, Horia focused on securing and delivering internal and external grants, successfully contributing to and leading projects amounting to over £1M. Horia became an integral part of the Trustworthy Autonomous Systems (TAS) programmes' Operational Management team, gaining valuable experience within a major national grant initiative. During this time Horia organised a wide range of activities from Early Career Researcher events to international conferences and contributed to programme committees.

His research expanded into Human-Robot Interaction and Responsible Innovation, with a strong publication record in Human Computer Interaction and presentations at leading conferences such as the ACM Conference on Human Factors in Computing Systems (CHI). Horia was named a Future Leader by the Foundation for Science and Technology, a Rising Star at the University of Nottingham and a finalist for the university's Best Public Engagement Award, following his team's participation at national engagement initiatives such as the Royal Society Summer Science Exhibition. He now co-leads the Brain and Physiological Data Group within the Mixed Reality Laboratory.

Outside academia, Horia co-founded Inspire Foundation Nottingham, a registered charity dedicated to science public engagement, and became the first Early Career Researcher Trustee of the Foundation for Science and Technology, a national charity fostering debate and policy in science technology.

Mercedes joined the TAP programme in 2016. She published her research in top peer-reviewed papers and conferences, and obtained several funding grants (InnovateUK, Huawei and Nottingham City Council) before leaving academia to follow a career with B-Hive Innovations. Mercedes is currently Head of Machine Learning, managing a vast portfolio of commercially and publicly funded projects tackling agricultural problems, one example being potato growth modelling using drone imagery.

Mercedes Torres Torres

Horizon Hub.....**3 TAPs**

From Human Data to Personal Experience.....**4 TAPs**

Trusted Data Driven Products.....**5 TAPs**

Industry

Rachel Jacobs

After completing her PhD, Rachel continued work as a consultant at Mudlark, an interactive company that brought together the skills of TV production, games development and cross platform innovation. The projects she worked on include the award winning Heartlands and Chromaroma and Such Tweet Sorrow, nominated for the British Interactive Media Awards and the Royal Television Society awards and as Artistic Director of Active Ingredient, an award-winning artist-led collective creating interactive artworks that toured national and internationally. She began to work as an independent artist/researcher in 2015, was a Visiting Research Fellow at the University of Arts London (Central St Martins), Associate Lecturer at Birkbeck College and has published regularly about her research. She is currently a Research Associate with the Mixed Reality Lab at the University of Nottingham and lead artist on 'When the Future Comes and the Future Machine' a 30-year national art/research project involving a mysterious interactive device that witnesses change across five curious places in England.

Roma Patel

Roma is an associate artist and has worked on projects led by the Mixed Reality Lab and Horizon at the University of Nottingham. She was also an Artist in Residence with the Trustworthy Autonomous Systems (TAS) Hub. Roma's PhD was the foundation for establishing Makers of Imaginary Worlds (MOIW) a company dedicated to creating interactive, sensory-rich theatre and installations for children. Her research brought together insights from Education, Theatre and HCI to propose a new model for interactive scenography in early years theatre and this resulted in several outcomes, including The Enchanted Forest, which attracted over 17,000 visitors and The Undiscovered Island, which received a Telling Tales Engagement Award from the UKRI EPSRC. MOIW has continued to evolve with growing expertise in digital storytelling, robotics and audience co-design evolving through close collaboration with researchers from Horizon and partnering three CDT PhD students to date.

Richard Ramchurn

Richard is founder of AlbinoMosquito Productions, a creative agency that has showcased work around the world, touring in the UK at the BBC, TATE Modern, the National Gallery and internationally at BRIC Brooklyn, Copenhagen and Hong Kong. He was an Artist in Residence with TalentLab and the Trustworthy Autonomous Systems Hub (TAS Hub) and now, as a Research Associate, takes forward his knowledge and learnings into programmes, such as the Turing AI Fellowship: Somabotics Creatively Embodying AI.

Academia

Ewa Luger

Ewa earned her PhD in 2014 and was the first CDT candidate to achieve the rank of Professor. She is now a leading expert in artificial intelligence (AI) and data ethics based at the University of Edinburgh. Having successfully achieved £15.9 million funding from the Arts and Humanities Research Council, Ewa is now co-programme director of Bridging Responsible AI Divides (BRAID) and co-director of the Responsible Natural Language Processing CDT at the University of Edinburgh.

Lachlan Urquhart

Lachlan obtained his PhD in 2017 from the Horizon CDT and joined Horizon as a Research Fellow to explore how IT Law and HCI could conceptually be aligned. Lachlan led research investigating 'privacy by design' during which he developed card-based tools in translating law and ethical principles into accessible forms for design teams. Now working at the University of Edinburgh, Lachlan holds the position of Associate Professor in Technology Law and Human Computer Interaction in the School of Law. He founded the Regulation and Design Lab within the Institute of Design Informatics, and co-directs two research Centres at Edinburgh, CRISP and SCRIPT. His time at Horizon was formative in shaping his interdisciplinary approach to research and he has continued to work closely with colleagues at Horizon over the years. This includes on numerous EPSRC projects such as Defence Against Dark Artefacts on smart home cybersecurity, the Trustworthy Autonomous Systems Governance and Regulation Node, within Horizon Agile projects like hoRRIzon and Memory Machine, and most recently leading the Fixing the Future project on the right to repair for the Internet of Things.

Adrian Hazzard

Adrian was a member of the 2010 cohort achieving his PhD in 2015, and has remained at the University of Nottingham as a Senior Research Fellow in the Mixed Reality Lab. Adrian's work focusses on Human Computer interaction, in particular how interactive technologies can be used in creative practice. He also remains actively involved in Horizon CDT as Training Programme Manager, designing and delivering training to PhD candidates.

Start Ups

Vanja Ljevar

After completing her PhD in 2022 Vanja co-founded Kubik Intelligence, a consulting company that blends customer data analytics with psychology insights to increase sales and loyalty. Kubik Intelligence works across various industries including fast moving consumer goods, entertainment, fashion, health and telecommunication.

Anthony Brown

Prior to joining the 2010 cohort, Anthony was a software developer. He graduated from the CDT in 2014 and followed a successful academic career as Research Fellow at Horizon and the Mixed Reality Lab before co-founding BlueSkeye AI Ltd, an AI-focused digital health company leading the way in the field of behaviomedics.

Leaving a legacy of Responsible Research and Innovation

We have aspired to champion a responsible approach to all Horizon research activities. Efforts to encourage and support a culture of 'Responsible, Research and Innovation' (RRI) escalated during the 'Trusted Data Driven Products' award, with a series of projects (hoRRIzon, hoRRIzon2 and hoRRIzon3) introduced to more fully explore what it meant, the principles behind it and how to practically apply it within a research environment. We developed guidance, introduced protected time to run facilitated sessions for open discussion and reflection, and developed tools to support our academics, researchers, support staff, collaborators and external partners.

We spoke to Virginia Portillo, Horizon Research Fellow and Co-ordinator of RRI and EDI with UKRI-funded Responsible AI UK (RAi UK)

"Our first project focusing on RRI (hoRRIzon) involved setting up a specialist team in collaboration with ORBIT and the Trustworthy Autonomous Systems (TAS) Hub, to better understand and support RRI practice across all Horizon-led projects. We investigated experiences of researchers, support staff and academics and identified several facilitators and barriers to RRI practice. Those included conflicting priorities, time pressures and difficulties in identifying practical tools to help them to embed RRI within their work (Portillo et al., 2022). A clear need was highlighted around bridging the gap between theory and practice, which led us to the development of a set of cards (Portillo et al., 2023) to help researchers and innovators start to engage with the process.

During hoRRIzon 2.0, we tested a preliminary version of the cards. These were taken out to various settings to trial them among different groups including Undergraduates, PhD students, early career researchers, community groups and the public. We identified a growing community of people interested in exploring a Responsible Digital Future (RDF) and set up a Network to engage with interested people who like ourselves were interested in addressing how current and future digital technologies could be designed, developed, used and retired in ways that are acceptable, desirable and sustainable.

In collaboration with colleagues from the TAS Hub, hoRRIzon 3.0 addressed impact and legacy activity required to support a continued culture of RRI and involved further work to refine the first public release of the cards (version 2.1, August 2022). The team worked with stakeholders, including researchers, PhD students, academics, and industrial partners, to produce the second (version 3.1, June 2023) and the third most polished version (3.1.1, November 2023) of the cards.

To date, over 350 physical decks of cards have been disseminated across Europe (UK and France), North America (USA), South America (Colombia and Brazil), Asia (India) and Australia. The cards have been used to promote and encourage responsible innovation practice within academia, public and private sectors, and have been used in more than 50 workshops, events and conferences, both nationally and internationally.

Horizon's RRI projects have laid the groundwork and provided opportunities to engage with diverse audiences, contributing to a strong and recognised reputation for responsible innovation within academia.

Recognising the ever-growing need to reflect on social and ethical concerns, the Responsible Digital Futures Network continues to grow, exploring new opportunities for collaboration and has been recognised by the School of Computer Science at the University of Nottingham as a new research group to practice, promote and provide a new home to carry forward Horizon's legacy of this important stream of work."

Horizon and TAS Hub legacy activities led by TAS Hub are being taken forward by RAi UK. This work has enabled the development of 2 RRI resource websites:

https://tas.ac.uk/responsible-research-innovation/rri-for-ict-researchers

https://rai.ac.uk/toolkits/rri-toolkit

And in addition, the production of a video providing an overview of RRI, highlighting the prompt and practice cards and the EduRRI Toolkit

The RI Prompt and Practice cards were used at an RAi UK event in Delhi, India 'Builders of Better AI: Responsible AI Hackathon' which supported empowering young women to step into the world of artificial intelligence, emphasising the importance of responsible use of technology and AI

As part of our legacy, we take pride in our expertise within the digital landscape which has fostered successful partnerships and collaborations, with several esteemed initiatives as a result. Examples of these illustrate the power of collective expertise and have played a crucial part in enhancing Horizon's research capabilities:

University Research Collaborations:

We have partnered with several universities to facilitate joint research initiatives. Working with the University of Lancaster's Future Mundane project allowed us to trial a prototype adaptive podcast, developed in partnership with BBC R&D. The podcast was showcased to a broad public audience using a unique caravan equipped with smart technologies, designed to provoke discussions about the future, everyday objects, and daily practices.

Industry Partnerships:

Teaming up with key industry players such as BlueSkeye AI, Body Aspect, MHR and Beko has enabled us to drive advancements, through the development of new products and exploration of different working models to support practitioners.

A good example is our Adaptive Interactive Movies (AIM) project where we pushed the boundaries of interactive filmmaking. Film clips from 16 genre films were put through Blueskeye AI's novel machine learning technology 'Arousal' to generate facial expression captures. These supported the development of an open-source program which was shared with filmmakers who marked up what they thought the intended viewers emotions to the film clips were. The mark ups were then used to contribute to real-time edit decisions which were applied to a new film produced during the project 'Before We Disappear', enabling audiences' emotions to control different journeys and endings.

Hugh Barnard, a retired freelance developer with a long career in industry joined the Memory Machine (MeMa) project. He proposed new ideas for a different kind of approach to hardware and software. Hugh explained "there is quite a cultural distance between what I do, how I do it and the Memory Machine. Some of my contribution may be about being different and 'being aged'". The research team found Hugh's enthusiasm and commitment to the project were a delight!

Public Sector Collaborations:

Working with public sector organisations provided valuable insights into real-world societal challenges and enabled us to support their efforts in delivering essential services and providing vital support to the population.

Working on the Coronavirus Discourses project with Public Health England, Public Health Wales and NHS Education for Scotland enhanced our understanding of how public health messages are received across different geographical regions and by ethnic minority populations.

We partnered the TAS Hub project Trustworthy and Useful Tools for Mobile Phone Extraction, which explored the police use of mobile phone data in the investigation of criminal offences. In collaboration with software development experts Telemarq and cyber security experts HARGs Consulting, the project created an open-source tool which supports the analysis of mobile phone data in ways that are both efficient and privacy-preserving.

Domesticating Electric Vehicle Charging worked with the Department for Business, Energy and Industrial Strategy to explore the adoption of electric vehicles, seen as a potential solution to addressing a balance between security, affordability and sustainability in accessing and using energy. Findings from the research detailing barriers to smart charging adoption, enablers of adoption and policy recommendations were provided to project partners.

International Collaborations:

We supported research exchanges with other countries to broaden the scope and impact of research, tackling global data-related challenges.

We were invited to attend the Industrial University of Santander (UIS), Columbia to share the learnings from our responsible research and innovation themed research at the annual Academic Conference U24 fest. The event provided an opportunity to discuss ideas and expectations for caring and improving life by encouraging a collective culture of taking action for a better society for all.

The University of Nottingham joined a consortium with several partner universities funded by RAi UK, to deliver a series of activities designed to bring together researchers interested in responsible AI in the Trustworthy Autonomous Systems community in the UK and Good Systems in the US. A highly successful activity led by Horizon researchers in collaboration with the University of Texas at Austin was a Residency in Matlock Bath. The HEAD residency was attended by researchers from across the UK, US and Europe with a shared interest in health equity in AI decisions and led to the creation of long-lasting collaborations.

Community and Engagement:

Engaging with local communities and non-profit organisations has enabled the application of our research findings to impact real-world settings, supporting global challenges such as climate change, sustainability and well-being. The Fixing the Future project worked with repairers to uncover barriers to successful smart product repair in community-based Repair Cafes. As a result Elmo, a `Repair Assistant', was developed to address some of the key challenges faced by volunteer repairers in these settings.

Workshops and Conferences:

Through hosting workshops and conferences we have brought together audiences from academia, industry and the public sector. Our events have supported sharing and exchanging of knowledge and provided forums to discuss emerging trends and create new collaborations. At the launch of the Virtual and Immersive Production Studio in Nottingham, workshops were delivered to artists, designers and theatre practitioners interested in embedding interactivity into their own works. By combining technology and artistry, the workshops cultivated innovative storytelling methods resonating with the global issue of climate change.

Through working together, sharing knowledge and networking with colleagues across several national and international universities, industry and public organisations, we have built and nurtured long-term relationships, many of which are being taken forward into new areas of research.

Without the support of these collaborators, we would not have achieved anywhere near the real-world impact we have produced from the Horizon programme, and we are very grateful to everyone involved.

This section of the brochure outlines the significant impact of Horizon's **Spotlight on Horizon 'Trusted Data Driven Products'** programme.

Trusted Data Driven Products

OUR journey

2023

December 2023

Horizon Research Fellow Virginia Portillo talks to Notts TV about AI

2024

January 2024

FAILSAFE features in Robot Talk Podcast Episode 63

March 2024

Horizon Advisory Board Meeting

May 2024

Steve Benford interviewed by Robot Talk Podcast Episode 84

June 2024

DE Nexus Symposium

July 2024

Helena Webb, Anna-Maria Piskopani and Liz Dowthwaite participate in TAS Hub Living with AI Podcast

July 2024

Elvira Perez Vallejos named as RAi UK Champion and Chair of RAi UK Equities Pillar

August 2024

Neelima Sailaja talks InterNET ZERO in TAS Hub Living with AI Podcast

September 2024

Horizon's Welfare Campaign commences

September 2024

EFRESH and FAILSAFE papers presented at TAS Hub Symposium, Austin Texas

October 2024

Elvira Perez Vallejos and Neelima Sailaja participate in RAi UK 'Builder of Better AI: Responsible AI Hackaton' in Delhi, India

December 2024

Virginia Portillo presents learnings from hoRRIzon projects at U24 fest, Bucaramanga, Colombia

2025

February 2025

IEEE P70003 Standard on Algorithmic Bias published

February 2025

Responsible Innovation Prompts and Practice Cards Video released

February 2025

Elvira Perez Vallejos named in 100 Brilliant Women in AI Ethics by Women in Ethics AI

March 2025

Anna-Maria Piskopani talks to PodBean Podcast about the relationships between AI and Artists

May 2025

Final Advisory Board Meeting

46 new collaborations and partnerships have been established

We have developed **8 new open-source** software and technical products

84,550 people have engaged with us in over 345 activities

Our researchers, partners and students have delivered **258 publications** featuring in journals and conferences

13 new artistic and creative products have been released

Societal Impact

Navigating the growing complexities of the digital age, characterised by expanding internet connectivity and online interactions, presents significant societal challenges. This underscores the crucial importance of ongoing research to address the impact of these technological advancements on our environment and ourselves, particularly concerning matters of sustainability, safety, privacy and mental health. How do we develop technologies and concepts that integrate physical and digital realms into new products and services, and how can we ensure these are designed responsibility?

Horizon's Trusted Data Driven Products programme addressed these challenges by launching several projects that explored the societal impacts of autonomous and smart technologies. The programme culminated in a final Impact Campaign which focussed on welfare, examining issues such as the effects of online connectivity at work, gender exclusion in digital spaces and the potential of data-driven technologies to support mental health.

Climate Change

The importance of raising awareness and increasing understanding around sustainability, in the context of digital technologies, cannot be overstated. Equipping young people with knowledge about sustainable practices in technology use and design can support reducing ecological footprints and ensuring that digital progress benefits both society and the planet. In partnership with Makers of Imaginary Worlds, an immersive mixed reality installation Home:Zero served as a catalyst for encouraging family discussions about emissions and their impact on climate change. Throughout a tour across Nottinghamshire, we engaged with over 790 visitors including school children, students from a school supporting young people with special educational needs and disabilities, and families. Makers of Imaginary Worlds have since been successful in gaining Arts Council funding to support continuation of touring Home:Zero.

Robots working with Humans

As cobots (collaborative robots designed to work alongside human operators) become increasingly integrated into society, challenges related to acceptance, safety and trustworthiness of these applications are also rising. To support the safe, effective design and use of cobots, Open All Senses investigated people's feelings of safety and comfort during interactions with them. A key outcome of this project was the development of two specifically tailored environments - a nursing home and museum - within the Cobot Maker Space, a robotic lab at the University of Nottingham. These environments allow researchers to conduct studies in real-world settings, facilitating future testing of telepresence and robotic equipment in a controlled space. Additionally, the project produced a Soma Design toolkit offering guidance to operators and designers of telepresence and robotic systems. Findings from the research, including insights into human interactions, risks and accountability when engaging with cobots, have been widely disseminated through specifications, reports, academic publications and presentations, contributing valuable knowledge to the field of human-robot collaboration.

Health and Wellness

There has been a steady increase in the popularity of health and wellness technologies, with people seeking greater control over their health through the use of personalised technologies. These technologies enable users to track health metrics such as exercise habits and sleep patterns, manage health conditions through access to biometric data like blood glucose levels, and engage with digital health apps and platforms that offer wellness services. These innovations support better informed lifestyle choices, empowering people to take proactive steps towards improving their overall wellbeing. However there remains uncertainty around the governance and regulation of such technologies, it is not often clear what benefits they offer and, in some cases, they are difficult to use. Horizon Adoption of Wellbeing Technology (HAWT) Toolkit worked with charities and third sector organisations to ensure the health and wellness technologies they recommend to clients are designed responsibly and that they are trustworthy. Interviews and workshops with experts from healthcare, law, computer science and engineering gathered insights and contributed towards the development of a Toolkit to support community and voluntary sector organisations assess and select wellbeing technologies, in the absence of governance or IT expertise in-house.

Atypical Sensory Sensitivities

Individuals with atypical sensory sensitivities are at a higher risk of experiencing poor wellbeing, which can significantly affect daily functioning, emotional regulation, and overall mental health. Soma design—defined as the integration of diverse sensory qualities of physical and digital materials in the design process to create enriched and personalized embodied experiences—offers a promising approach to developing personalized technologies aimed at improving wellbeing for these individuals.

Soma Co-Designed Technology for Wellbeing evaluated Soma design as a method for exploring embodied sensory experiences by conducting workshops with participants diagnosed with Attention-Deficit Hyperactivity Disorder (ADHD). This approach supported a greater understanding on how tailored sensory interactions can support wellbeing, and provided valuable insights into designing inclusive, personalised tools that cater to the unique sensory needs of individuals with atypical sensitivities.

Workplace Wellbeing

The internet is a fundamental technology of the ‘information age,’ a period marked by the transition of traditional industries into digital environments driven by computers. While the internet enhances communication and collaboration in the workplace, excessive reliance on it and negative online experiences can adversely affect workers’ physical and mental health.

Workplace Wellbeing and the Internet conducted a range of activities to explore different aspects of wellbeing related to internet use, including maintaining a healthy online/offline balance, managing hyper-connectivity, and addressing harmful online content. The project also investigated internet-based technologies that could promote and support wellbeing at work.

A survey received responses from 248 paid and voluntary workers, revealing that 64% considered their workplace wellbeing to be somewhat or extremely good. Notably, those more confident in using internet technologies reported a better sense of wellbeing.

In addition, Nottingham-based MHR, a company employing over 800 staff, hosted Cheerbot— a bespoke designed, socially assistive mobile telepresence robot aimed at enhancing workplace wellbeing. Cheerbot featured interactive games, facts, a communal collage and mood board, and functions for ‘walk and talk’ interactions, along with film and song recommendations, all without collecting or storing personal data. Workers’ interactions with Cheerbot were generally positive, with suggestions for additional tailored features to support long-term impact. However, some concerns were raised regarding potential use for employer surveillance.

Gendered Exclusion

In May 2025, Amnesty International UK highlighted alarming levels of online misogyny across social media platforms, discouraging young people —particularly women — from engaging in digital spaces meant for connection and creativity. Gendered Exclusion and Wellbeing on the Internet aimed to foster safer, more inclusive digital spaces to uphold the wellbeing of all users. Research examined the efforts and practices that contribute to gender-based exclusion in digital environments, as well as its impact on wellbeing. Through workshops and interviews with civic and women’s organizations, social media representatives, and members of the public, the research identified areas where gender exclusion is more prevalent. The findings will inform the development of a suite of guidance ‘reels’ aimed at raising awareness about online behaviours that promote gender exclusion, as well as mechanisms to support individuals who have been targeted or have experienced such exclusion.

Impact on the Creative Sector

The creative industries are a significant driver of economic growth in the UK, contributing an impressive £124 billion in gross added value in 2023 and generating 2.4 million jobs. This reflects the sector's vital role in supporting the UK government's growth mission amidst ongoing technical advances and shifts in the digital landscape.

Horizon's commitment to addressing the evolving needs of the creative sector has built a substantial legacy in collaborative ventures, projects and new partnerships which have explored the challenges and opportunities presented by emerging technologies to this dynamic sector. Artificial Intelligence (AI) - one such technology - has rapidly become one of the most talked about, and is fast becoming embedded into the way we live, exerting a profound impact on society. Recognising the potential of creative AI - to extend and enrich human-driven creativity - and its increasing influence on the creative sector, Horizon took a significant step forward by integrating projects addressing responsible AI practices with several creative partners. This commitment has supported the ethical, sustainable and beneficial use of AI within the sector.

Interactive cinema, a concept involving interactive elements and audience choice first became recognised as a new technology in the 1960s'. Whilst its popularity has grown over the years, the methods used to generate such films have remained unchanged. Adaptive Interactive Movies (AIM) explored ethical challenges and culture opportunities of 'Affective Media', investigating the processes involved in the creation of adaptive films through the collection and use of audiences' real-time personal data. Using a unique machine learning system that measures social and emotional expressive behaviour - developed by partners BlueSkeye AI - AIM created a new method for detecting audiences' real-time reactions to film content and then used that data to steer storyline pathways and endings. A markup tool created during the project has been made available to the public, enabling filmmakers around the world to annotate their own productions. Another key output from AIM was the creation of a new adaptive film, 'Before We Disappear'. Produced by Richard Ramchurn and starring actress/writer Jessica M Milford, the film was screened at the Broadway Cinema in Nottingham and at Nottingham Contemporary.

Future Festivals was introduced during the Covid-19 pandemic to support creative practitioners who were facing challenges and having to seek out new ways to deliver their work to audiences and fan bases. Researchers from the Mixed Reality Lab and Horizon focused on how digital technologies could support the wider experience of festivals and music events in terms of performers, audiences and social interaction between those attending, to promote a sense of belonging to the wider crowd, and in support of producers and volunteers, key to running a successful event.

Researchers supported the development of Streampark, an innovative web platform designed to host online events where the audiences can watch performances and interact with live acts and other viewers in real-time. Streampark enhanced virtual engagement and created dynamic spaces for live entertainment and audience participation. Later work led to the creation of the *Bubbles* platform which further improved the audience experience of festivals and music events in a 3D environment. *Bubbles* is available for public use and has supported a range of events including Voxjam, an annual event organised by Oxfam, and an educational programme launched by the National Holocaust Centre Museum.

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"Over the years we have worked extensively with Horizon Digital Economy Research on several research projects supporting the creation of advanced digital technologies. Helping create a film which used our technology to capture, non intrusively, the audience's emotional response to the film as it progressed and provide the tools to create a truly interactive cinematic experience was a fascinating challenge. The fact that the film was also used to explore the very real ethical issues attendant on this technology was a bonus. All told we were very grateful to Horizon for bringing our two organisations together and creating something truly innovative."

Founding CEO of BlueSkeye AI, Professor Michel Valstar

Spotlight on Steve Benford

Steve Benford is Professor of Computer Science, co-founder of the Mixed Reality Lab, and UKRI Turing World Leading Research Fellow. A pivotal Co-Investigator with Horizon, Steve championed several practice-based, creative and artist-led research initiatives, which founded important connections and built long-term relationships with several diverse Creative Partners, including musicians, performing and visual artists, filmmakers and broadcasters.

Working in partnership with B3 Media, Steve introduced TalentLab, an Artist in Residency scheme which supported the development of raw talent from new and established ethnically diverse artists keen to embed digital art and performance into their works. As Lead for the Trustworthy Autonomous Systems (TAS) Hub Creative Programme, Steve embedded researchers from Horizon and the Mixed Reality Lab into landmark artwork projects such as Cat Royale. In collaboration with Blast Theory, Cat Royale became a landmark artwork which delivered an AI-driven 'cat utopia', at the centre of which a robot arm tried to enrich the lives of a small family of three cats, Ghostbuster, Clover and Pumpkin!

Steve took the lead and steered Horizon's first Impact Campaign which focussed on Media and included several innovative projects, such as Artcodes.

Artcodes was a programme of work which grew out of 'Aestheticodes', a collaborative project partnering designers from Central Saint Martins, Horizon and the Mixed Reality Lab. First developed in 2011, Artcodes has evolved as a tool that bridges the gap between aesthetics and interactivity, allowing visually rich, hand-drawn or custom-designed patterns to function as digital triggers. Led by Creative Technologist/Design Researcher Emily Thorn, Artcodes consisted of over 30 individual projects and events, each exploring the potential of the technology across diverse applications including design, education, heritage interpretation and interaction storytelling. An Artcodes Portfolio created by Emily brings together over a decade of creative practice, showcasing how the technology was developed and how it evolved from an experimental research tool into being used across cultural, community and public settings.

Steve's expertise working with practitioners and artists 'in the wild' supported many impactful projects. Expressive Personalisation of Consumer Products Through Dance partnered Candoco, a world-renowned professional inclusive dance company, and concluded with successful collaborations secured to further explorations into the topic of 'embodiment', taking research forward into externally funded projects including TAS Hub's Embodied trust in TAS:robots, dance, different bodies and the Turing AI Fellowship 'Somabotics: Creatively Embodying AI' project Different Bodies – Dancing with Robots.

Steve's pioneering research and his significant contributions to Horizon's successful impact on the creative industries represent a truly remarkable legacy.

> "The key thing about Horizon's approach to working with artists has been to deliver innovative artworks alongside cutting-edge research. For us, art is a research method as much as a route to public and industry engagement."
>
> Steve Benford

Sharing our Impact

DE Nexus Symposium

In June 2024 Horizon joined their counterparts in the five other UKRI Next Stage Digital Economy Centres (CAMERA 2.0, The Centre for Digital Citizens (CDC), The Centre for Decentralised Digital Economy (DECaDE), The Future Places Centre & DIGIT Lab), to deliver a national Symposium showcasing variety and impact from their digital economy focussed research.

DE Nexus took place at One Birdcage Walk in London and brought together over 200 people, including researchers, businesses, government, charity representatives and public organisations. The event began with an address delivered by Professor Richard Harper, followed by keynote speaker Professor Yvonne Rogers. Each centre provided an overview of their accomplishments, followed by a poster session. Watch Professor Koleva's presentation on Horizon's 'Trusted Data Driven Products' programme.

Lord Holmes of Richmond MBE opened the afternoons proceedings, setting the stage for a series of panel sessions addressing 'Trust, Identify, Privacy and Security', 'Beyond the Data Driven Economy', 'Content Creation and Consumption' and an 'Equitable and Sustainable Society'.

Day two of DE Nexus focused on empowering the next generation of digital economy innovators. It brought together early career researchers to break down silos, foster networking and ignite new collaborations to take forward ideas and produce new, cutting-edge research.

"One of the most exciting things about the digital economy theme is the collaboration across disciplines. It's not just people interdisciplinary working together, it's experts from different fields working together and teaching each other so that they can train the new generation of researchers to have expertise in multiple disciplines and so break down the silos you see in traditional academia or industry settings."

Professor Neill Campbell, PI, CAMERA, University of Bath

"Today has been a really good event and I'm pleased with the way that everybody has come together from the different centres. There have been some fantastic talks and it's nice to see all the different kinds of stuff that people are doing in the different centres, and the panels have been fantastic with some really rich discussions."

Professor Dave Kirk, PI, Centre for Digital Citizens, Newcastle University

Watch here: https://youtu.be/e_L2EcCtALI?si=W1CUm6PJidxyzIce

Beyond the Horizon celebrating the future

The world of technology is rapidly changing, moving into an era characterised by AI and autonomous systems capable of independent decision making, advanced analytics, predictive modelling and adaptation. This Agentic AI era is driven by advances in technologies such as large language models and robotics, moving beyond traditional rule-based AI towards more human-like intelligence and autonomy, setting goals and rapidly adapting to different environments. In addition, we have moved into 'Industry 5.0' which sees industry focussing on crucial and exclusive human strengths such as problem solving, value-adding creativity and a deep understanding of customers to improve products in a more personal and society-centric approach.

As systems become more advanced, the benefits to productivity, streamlining complex processes and driving innovation at unprecedented speeds are vast. New systems, such as Chat GPT which takes internet functions a step further from the 'searching' to providing 'doing' tools are saturating the market. Consumers need to understand what these new systems can offer, whether they are trustworthy and whether they are deployed responsibly, in a manner that is transparent and explainable, with guidance and regulation in place. Continued research to explore ethical concerns in relation to bias, fairness and accountability within digital AI and autonomous systems is therefore crucial.

Horizon's flexible approach in the 'digital' arena has enabled inclusion of research crossing several domains including AI, Robotics and autonomous systems. Some example projects are FAILSAFE, Open All Senses, Cheerbot, Expressive Personalisation of Consumer Products Through Dance and Robots Mediating Interaction.

The learnings from these projects have been carried forward into:

UKRI Responsible AI UK, aspiring to empower and connect a responsible AI ecosystem including research centres and institutes around the world.

Turing AI World Leading Researcher Fellowships which aim to retain, attract and develop the best and brightest AI international researchers. Horizon Co-Investigator Steve Benford leads one such Fellowship entitled Somabotics: Creatively Embodying AI.

The **Responsible Digital Futures** Research Group, led by Professor Bernd Stahl, based within the School of Computer Science, University of Nottingham

We are proud that the legacy we leave behind will continue to influence and shape research programmes and initiatives long into the future.

Engineering and Physical Sciences Research Council

For directions to Horizon's archive website please visit:
https://www.nottingham.ac.uk/computerscience/research/research-programmes.aspx

Hazel.sayers@nottingham.ac.uk

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