# horizon

DIGITAL ECONOMY RESEARCH

## Impact Highlights

# Contents





# Foreword

When I wrote the foreword to our 2019 Impact Brochure almost 18 months ago, the world was a very different place. No-one could have anticipated a global pandemic and being in the situation we now find ourselves within. Dealing with the unforeseen challenges Covid-19 has caused has taken a massive toll on society across the world. So, while already experiencing a rapid growth in the adoption of smart technologies and internet use prior to Covid-19, for many the pandemic has led to an inevitable surge in the uptake of digital technologies.

More so than ever in the digital space, it becomes increasingly important to carry out research that investigates technologies that collect and interpret our personal data, to ensure they do so in a privacy preserving and transparent way. This enables us to understand how to design new trusted experiences that embed these technologies to promote health, wellbeing and sustainability.

This brochure includes articles that evidence the impact of our research, key highlights and the vision of Horizon's next UKRI EPSRC funded programme '**Trusted Data Driven Products'**, led by our new Director Professor Boriana Koleva.

**Professor Derek McAuley**

**"The blending of the digital and physical in our future products will impact all aspects of our lives. It is important that we understand how such products can benefit society and industry by becoming more personalised and adaptive while ensuring they are trusted by consumers. We will work across disciplines and sectors, taking a user centred approach to make sure that the design, regulation, and operation of future products meet societal needs."**

**Professor Boriana Koleva**

# Track record

**The total overall value**

of multi-institutional projects which we have been involved in amounts

**to over £60M**

**Over 50 Researchers**

spanning computing, engineering, law, psychology, social sciences, business and the humanities

Hosts of the

**Horizon Centre for Doctoral Training**

through which **72** PhD's have successfully graduated to date

"what's very valuable is being able to mix with people in different areas, in different schools within the University who are at different stages of their PhD"

Pepi Bernard, PhD Graduate 2021

**1100 engagement activities**

have been delivered to audiences totalling over

**300,000 globally**

Our critical mass of researchers, partners and students has led to

**over 1000 publications**

featuring in journals and conferences

**crossing 15 different disciplines**

ranging from computing to politics

We have engaged with a wide

**network of 25 UK and 10 international**

research institutions in joint research projects

**A diverse network**

of over

**200 external partners**

involved in collaborative research

# Impact timeline

**OUR** journey

UKRI TAS Hub

## 2020

### June 2020

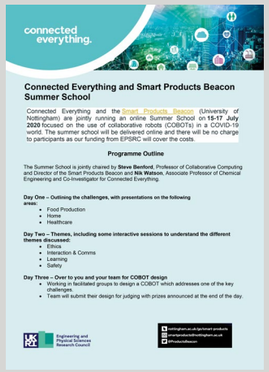
Launch of the UKRI **Trustworthy Autonomous Systems Hub**

### July 2020

Horizon participates in a Co-Bot focused **Summer School** hosted by the Smart Products Beacon and Connected Everything

### September 2020

UK Parliament POSTnote 'Edge Computing' launched - references Horizon **research**


connected everything.

**Connected Everything and Smart Products Beacon Summer School**

Connected Everything and the Smart_Products_Beacon (University of Nottingham) are jointly running an online Summer School on **13-17 July 2020** focused on the use of collaborative robots (COBOTs) in a COVID-19 world. The summer school will be delivered online and there will be no charge to participants as our funding from EPSRC will cover the costs.

**Programme Outline**

The Summer School is jointly chaired by **Steve Benford**, Professor of Collaborative Computing and Director of the Smart Products Beacon and **Nik Watson**, Associate Professor of Chemical Engineering and Co-Investigator for Connected Everything.

**Day One – Outlining the challenges, with presentations on the following areas:**
- Food Production
- Home
- Healthcare

**Day Two – Themes, including some interactive sessions to understand the different themes discussed:**
- Ethics
- Interaction & Comms
- Learning
- Safety

**Day Three – Over to you and your team for COBOT design**
- Working in facilitated groups to design a COBOT which addresses one of the key challenges
- Team will submit their design for judging with prizes announced at the end of the day.

Engineering and Physical Sciences Research Council

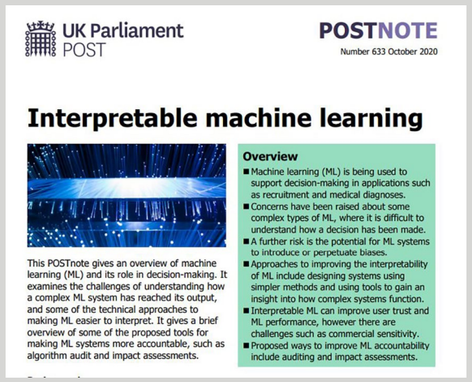
nottingham.ac.uk/go/smart-products
smartproducts@nottingham.ac.uk
@ProductBeacon


### October 2020

Announcement of EPSRC funding **'Horizon Trusted Data Driven Products'**

### October 2020

Launch of UK Parliament POSTnote **'Interpretable machine learning'** with input from Dr Koene, Senior Research Fellow


UK Parliament POST

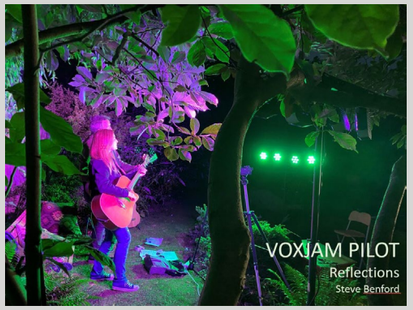
**POSTNOTE**
Number 633 October 2020

**Interpretable machine learning**



**Overview**
- Machine learning (ML) is being used to support decision-making in applications such as recruitment and medical diagnoses.
- Concerns have been raised about some complex types of ML, where it is difficult to understand how a decision has been made.
- A further risk is the potential for ML systems to introduce or perpetuate biases.
- Approaches to improving the interpretability of ML include designing systems using simpler methods and using tools to gain an insight into how complex systems function.
- Interpretable ML can improve user trust and ML performance, however there are challenges such as commercial sensitivity.
- Proposed ways to improve ML accountability include auditing and impact assessments.

This POSTnote gives an overview of machine learning (ML) and its role in decision-making. It examines the challenges of understanding how a complex ML system has reached its output, and some of the technical approaches to making ML easier to interpret. It gives a brief overview of some of the proposed tools for making ML systems more accountable, such as algorithm audit and impact assessments.




### November 2020

Horizon hosts **VOxjam**

### November 2020

**The Future Machine** performs in London bringing music, art, nature, climate and weather together

### December 2020

**ReEnTrust** host an online briefing session to the All-Party Parliamentary Group on Data Analytics

## 2021

### January 2021

**UnBias** awarded Best Policy Initiative by University of Nottingham Institute of Policy and Public Engagement

UNBIAS

The UK's Creative Industries employ over 3 million people and are growing at four times the rate of the economy as a whole. "They have been central to the UK's soft power, in driving tourism and exports, instrumental in bringing communities together."

**(Creative Industries Federation, Spring Budget 2021).**

One of Horizon's aims is to support the Creative Industries in delivering maximum impact into the digital economy. In collaboration with our creative partners, we investigate the use of digital technologies in the creation of unique, interactive cultural experiences. Our observations of how people interact with these experiences, enable us to develop approaches to interpreting the resultant complex and ambiguous human data, to help inform future cultural products.

We have worked with over 20 creative companies and 30 artists in collaboration with the **Mixed Reality Lab**, successfully introducing a "performance-led research in the wild" approach, which enables artists and researchers to co-create touring cultural products. These collaborations have inspired design concepts such as trajectories, uncomfortable interactions, digital wrappings and sensory misalignment, which in turn have been incorporated into decks of ideation cards to make them directly useful to creatives.

Our research has been used by artists and creative companies to develop new performances, installations, films and museum experiences. These creations have toured to 84 venues in 16 countries, were directly experienced by 87,000 people and indirectly by millions more, to critical acclaim. In addition, we have promoted diversity by partnering with B3 Media to deliver the Talentlab programme that trains young Black, Asian and Minority Ethnic artists in digital technologies and provides bespoke support to artists, many of whom have gone on to make new works and win awards.

Undoubtedly, the impact of the pandemic has been catastrophic to our cultural fabric, local economies, and those who work in creative industries - hardest hit through the closure of venues, cancelled concerts, festivals and stage productions, resulting in massive reductions in revenue. Identifying different ways to work and deliver events has become a key focus. We have been working to support **VOxjam**, Oxfam's virtual music festival that took place across the UK in 2020. The virtual event was built around a combination of socially distanced live music streaming that blended live and recorded performances, with breaks from different venues, and 3D content which included 360-degree videos that audiences experienced within their own homes using cardboard VR headsets!

Recognising the continuing challenges to this sector - brought about by restriction on movement and the introduction of social distancing measures - we will be introducing a **Co-Production Campaign** with a distinctive focus on directly engaging consumers in the making and distributing of hybrid products. Throughout the campaign, we will engage with partners from broadcasting, film, tourism & heritage, advertising and user experience design to support the rapid delivery, release and sustainability of co-designed prototypes.

An estimated one-in-three under 18-year-olds worldwide are active online, yet they are a markedly underrepresented demographic when it comes to online safety policy.

Young people are acutely affected by online services which continue to expand and play a fundamental role in social and economic development. Horizon has established a substantial portfolio of research addressing this complex issue, which has involved working with legislators and regulators to support informed policy making. Our findings have directly contributed to the UK's current position as a world leader in designing and implementing online protection for children through the 'Age Appropriate Design Code', which came into force in September 2020.

Our ESRC-funded research, Citizen-centric Approaches to Social Media Analysis (**CaSMa**) addressed the ethical challenges around the use of social media, designing tools and services to enable users to gain more control of their personal data. A key output from CaSMa was the report 'The Internet on our own terms', which provided recommendations for the provision of comprehensive digital education and more visibility, control & transparency online for young people. EPSRC-funded **UnBias** and **ReEnTrust** projects followed on from CaSMa and investigated user trust, algorithmic bias and privacy. Engaging over 250 young people in our research from the start enabled them to contribute their concerns and propose solutions to reach public debate. Throughout our work, we collaborated with **5Rights Foundation** – a charity founded by **Baroness Kidron** - a highly influential children's rights activist, striving to make systemic changes to the digital world, to ensure it caters for children and young people by design and by default.

Our research involved submitting **evidence** to the UK Government inquiry '**Children and the Internet**' and also presenting **evidence** at the House of Lords - which addressed age-appropriate design, accessibility of terms and conditions, privacy of age verification mechanisms, and education. The House of Lords report published following the inquiry '**Growing up with the internet**' cited our research seven times and included a key recommendation for sustained leadership from government, with a minimum standard for internet service providers and a commitment to child centred design. Following this activity, Baroness Kidron successfully lobbied for an amendment to the UK Data Protection Act 2018 (enshrining EU GDPR in UK Law) for the inclusion of child specific protection. This was approved and became amendment 123 of the Act which required the Information Commissioner's Office to introduce an '**Age Appropriate Design Code**'.

Horizon and 5Rights further collaborated to submit **evidence** to the Information Commissioners Office **call** to support the development of the **Children's Code** – a set of 15 standards for the protection of children's data. The code became UK law in September 2020, resulting in any organisation providing an online service having to make the necessary changes in the best interests of the child within a 12-month transition period. The expertise and outputs of researchers working on this complex issue has substantially influenced policy change to protect the rights of young people online nationally.

Smart devices and digital payment systems are examples of technologies which offer us more interaction and control using the internet and make our lives easier. It is therefore critical that they are designed to be trustworthy. We spoke to Jiahong Chen about working with the UK Government and regulators, who increasingly need to provide leadership in the regulation of digital innovations across all sectors.

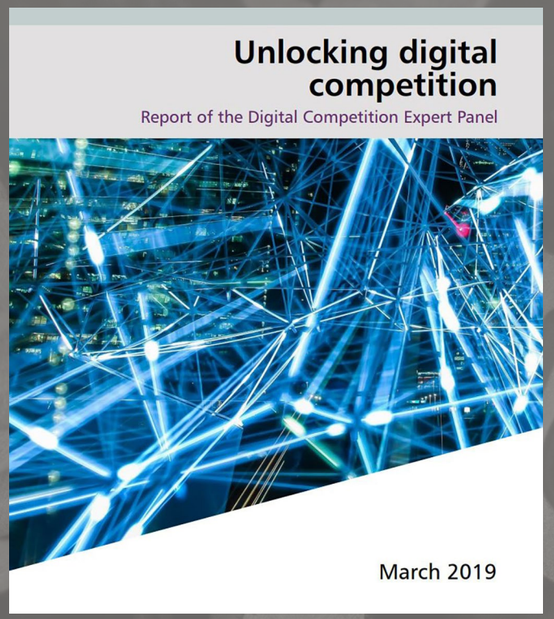
Horizon's challenge is to develop the right policies and regulatory frameworks to support data-driven technologies so that they are trusted in their use of personal data. This has become even more prevalent during the Covid-19 pandemic throughout which we are seeing increased engagement with digital technologies as they enable us to remain connected to family and friends, as well as to continue to work, shop and learn online.

Smart technologies, with all their privacy and security considerations, have been highlighted in the UK Government's **Secure by Design initiative**. Building on our research from EPSRC-funded **Databox** and **DADA** projects, Horizon has been working with policymakers to highlight the regulatory challenges surrounding these technologies. We have provided policy recommendations through submitting evidence to government reviews and public consultations, including the **Smart Data Review**, the **Cyber Security Incentives and Regulation Review**, and the **Consultation on Consumer IoT Security**. Our peer-reviewed article "**Who is responsible for data processing in smart homes?**" was cited in a **briefing report** - known as a "POSTnote"- prepared by the Parliamentary Office of Science and Technology (POST), with a view to making research evidence accessible to the Parliament.

Digital payment systems are a clear example of a technology requiring close regulation, especially as their adoption has been accelerated by the pandemic. Our **project** "Future Payment Systems: Data, Technology and Privacy after Covid" has addressed privacy and trust concerns around their use.

An important feature of our research is engagement with stakeholders such as the Competition Markets Authority (CMA), Financial Conduct Authority (FCA), the Payment Systems Regulator (PSR), and the Law Society. Through these conversations we have gained a better understanding of the regulatory challenges and gathered valuable insights, which in turn have formed the basis of our **submissions to relevant public consultations**, launched by UK and European regulators including HM Treasury, the FCA, the European Central Bank (ECB) and the European Data Protection Board (EDPB). Our Co-Director Derek McAuley was appointed to the Digital Competition Expert Panel, which published the influential "Unlocking Digital Competition" **Report** ("Furman Review"). The government accepted the report's six strategic recommendations, leading to the Competition and Markets Authority market study on online platforms and digital advertising, and the launch of the Digital Markets Unit (DMU) - which marked a critical step forward in improving the pro-competition regulatory environment for UK digital markets.

Our continued, targeted efforts in translating research outputs into evidence that can truly inform policymaking, have made Horizon a recognised, direct source of reliable expertise for policymakers.




**"Boosting competition in the digital and wider economy – The government will accept all six of the Furman Review's strategic recommendations for unlocking competition in digital markets."**

(Budget 2020)

**"The Horizon Digital Economy Research Institute questioned the impartiality of consumer tests conducted by search engines and suggested that 'the dominance of Google in the general search engine market is not necessarily an indication of its overall better performance'."**

CMA Market Study Final Report on Online Platforms and Digital Advertising




We spoke to Jocelyn Spence who told us: “The past year has shown us more than ever how important digital platforms are for maintaining personal connections with people”.

Horizon researchers have been working with the Mixed Reality Lab at the University of Nottingham to deliver a project partnering a locally based chocolatier, **Studio Chocolate**. The work is part of the EPSRC Hybrid Gifts **project**, which was initiated through Horizon pump-priming funding. It explores mechanisms for combining the physical and digital into hybrid artefacts and aims to create opportunities for UK companies to innovate new products and services into the global marketplace.

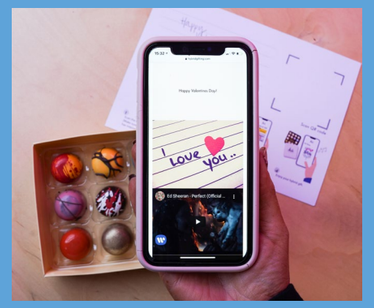
Christmas 2020 saw Studio Chocolate launch the first iteration of a **Hybrid Gift**: a box of 12 signature bonbons delivered with a card inviting the gift receiver to scan the attached QR code to access a unique gift of digital items – a written note, special photo, favourite song, or video/audio recordings, in any combination – made or chosen just for them by the gift-giver.

The process was made easy for giver, receiver, and seller by using a bespoke web platform with a simple user interface, created by University of Nottingham researchers, to select up to four pieces of content. The Hybrid Gift proved so popular that it sold out very quickly, and customer feedback showed that the digital element really did turn the chocolates into an even more special, and deeply personal, gift experience.

Ellie Wharrad, Le Cordon Bleu trained chocolatier and owner of Studio Chocolate, wanted to continue to refine the process for their next big gifting push: Valentine’s Day. The result was the Hybrid Chocolate **Gift**. She told us,

“Chocolates are always a popular Valentine’s gift, whether it’s for a DIY date night, a Galentine’s Day treat, or for anyone else you want to show some lockdown care to. It’s been exciting to be able to offer the Hybrid Chocolate, which has allowed our customers to add a truly personal touch to their gift. During these difficult times this has provided an extra special treat.”

“Digital gifting online is still in its infancy”, explained Jocelyn, “but is a rapidly growing sector of the market. Feedback from our collaboration with Studio Chocolate will help refine the Hybrid Gifting platform, integrate it into a more streamlined workflow, and support further development of alternative concepts to create, gift, sell and study to understand their use and value. Studio Chocolate is looking at creating a specially themed bonbon collection for the next occasion, and until then the Hybrid Chocolate Gift is still for sale – watch this space!”




It is still possible to opt out of the Internet of Things (IoT) in our homes, however, it is getting harder. The services and support we require for everyday living are increasingly connected to the products that we fill our homes with. This presents a critical security and privacy challenge that many of us, if not already affected, will have been made aware of by frequent reports in the media of data breaches and IoT cyberattacks.

At Horizon we are deeply invested in research that will drive radical new approaches to the challenges of keeping our data private and our devices secure in our homes. Our work began with the design and creation of the Databox; a 'privacy preserving' solution that limits the transfer and potential leakage of personal data, to help build trust between householders and service providers. Databox responds to only a part of the larger puzzle that is a trustworthy, secure and reliable internet of things.

With the Horizon Defence Against Dark Artefacts project (**DADA**), we have focussed on the need for secure and reliable interactions between devices in our homes. This is no more important than when these interactions result in unexpected or malicious actuations that cause significant inconvenience or even harm. Our network and system researchers at Cambridge and Imperial are profiling and modelling IoT devices to recognise abnormal behaviours and security problems. In tandem, our usability researchers at Nottingham are investigating how these problems can be exposed to householders, alongside lightweight but effective control mechanisms. These mechanisms will tackle malfunctioning and malicious device behaviours, whilst at the same time causing minimum disruption to the services they support.

Whilst DADA considers interactions between users and devices within the home, the Tangible Security (**TanSec**) project aims to offer a more secure and accessible means to control IoT devices from outside the home. A common approach to securing end-to-end connectivity between devices on the Internet is to use a cloud-based intermediary to manage communication. With this reliance upon a third-party comes a set of security, privacy and compliance concerns that are difficult to mitigate. TanSec explores how new protocols can be exploited to support direct encrypted communication between householders and their devices.

A core challenge of secure peer to peer communication is how to enable the secure exchange of the keys necessary to encrypt traffic. Making physical interactions a requirement of exchange has the potential to mitigate a whole class of online attacks. TanSec is therefore investigating the viability of a solution that utilises semi-fixed features within a household to authenticate and enable key exchange between devices. These semi-fixed features may either be dedicated devices or mundane household objects, such as shelves, lamps or chairs, enhanced with new interactional capabilities. Our solutions are intended to smooth the burden of configuring and establishing secure connections between homeowners and their IoT devices. In addition, our research will investigate the threats posed from *within* the home - untrusted friends, family, visitors or passers-by - by utilising 'hidden in plain sight' secrets alongside location constrained, tangible interactions.

When taken together, our work on the Databox, DADA and TanSec projects represent our mission both to refocus domestic IoT on edge-based computation and to engender greater consumer trust by bringing privacy, security and resilience to the data, devices, networks and interactions that comprise it.




Edge-based computing optimizes Internet devices and web applications by bringing computing closer to the source of the data. This minimizes the need for long distance communications between client and server, which reduces latency and bandwidth usage, while increasing resilience and security.

The measurement of how and when people utilise public spaces has perhaps never been more important than in the management of a global pandemic. We have taken technology designed for parks and applied it to the built environment.

Horizon has been working with Nottingham City Council since before the pandemic to measure and understand the flow of visitors to their parks. We have developed bespoke technology which 'sniffs' for WiFi signals from passing devices and uses the information received to build a picture of the parks busyness across the **day**. Previous work has used WiFi signals to track visitors, but our approach minimises the storage and usage of personally identifiable data - we avoid tracking park users - either over the space of the park or over time and multiple visits – so as not to invade their privacy. We used technology that produces only counts of visiting WiFi enabled devices within range of sensors. When data from the visitor's device is received, the identity is immediately disguised, 'hashed', and stored, while everything else is deleted. Every five minutes the number of unique devices seen since the last count is recorded and the hashed device identities are discarded. This means that it is impossible to track individual users, or monitor their visiting patterns, using our data. We introduced 'WISEBoxes' in Nottingham parks in early 2019 and during that time we have seen footfall at some sites increase fivefold since the start of the pandemic. We have seen seasonal variations and the occasional midnight celebration event. Our data has complemented other work including park user surveys, manual counts and engagement with community groups who have an interest in the parks.

Nottingham City Council has used our data to evidence the effect of large park investments (for example the Highfields Memorial Garden), to understand the impact of the pandemic on visits and to support bids for future investment; one being proposed improvements to Nottingham Embankment.

The **WISEParks** project is currently expanding to deploy sensors in four core cities across England. So far, we have deployed 25 devices and are working with the relevant public bodies to understand how they interpret and use the data the WISEboxes produce.

When the pandemic struck, we started working to adapt our technology to the indoor environment. In the SoDis project we are taking the methods and equipment developed in WISEParks and deploying them on an urban campus. In this setting we can combine the WiFi 'sniffs' with other contextual data. For example, most campus buildings generate data in the form of card swipes at secured doors or connections to the campus WiFi network. The aim of SoDis is to provide 'live', publicly available, occupancy density information to the users and managers of working academic buildings, in a privacy preserving way.

The **SoDis** project is an example of Horizon enabling a quick and flexible response to an emerging situation. Within six months we have adapted our technology and expertise to a new environment and have moved from supporting local government to assisting a safe return to workplaces.

**"Using WISEParks monitoring to gain a better understanding of park user numbers is helping us to build business cases for further investment."**

James Dymond Parks & Open Spaces Development Manager, Neighbourhood Services, Nottingham City Council


Elvira Perez updates us on the **Memory Machine**, a project focusing on preserving people's identities through memories.

The Memory Machine is a multidisciplinary project funded by Horizon. The aim of the project is to co-design with users a solution to capture people's memories, with a specific focus on those that are important and meaningful, and to develop and capture individual '**identity**'.
Our goal is to create **a repository** of memories that help people experiencing dementia or cognitive decline to remember who they are. We know from working in the first phase of the Memory Machine that preserving people's identity is a key issue for this group of people. Not to be able to remember who you are and to not remember those you love is extremely distressing. When we think about dementia, we often associate it with short-term memory loss - not remembering what we did 10 minutes ago - but it is more emotionally upsetting than that. We want to ensure that the Memory Machine is able to capture how people would like to be remembered by others and how they would like to remember themselves.

Gathering memories from someone once they are no longer there or missing the opportunity to ask them if it is okay to use or share specific photographs, brings very important research questions for afterlife data management. The Memory Machine builds within its own structure, mechanisms for people to **consent** and to be aware, and in control of how their personal data is going to be curated once they are no longer around, or no longer have the capacity to consent.

Initially it is a solution to gather individual-relevant photographs, and other **media** (notes, audio, video and music) files. However, our aim is to personalise all those memories with factual data, for example news and important events specific to the user and the wider historical situation at the time. We are looking forward to contextualising personal memories, being able to share those memories with family and friends, but also to have control over who is accessing that data. The first phase of the Memory Machine project highlighted issues around **privacy**, so this is one of the areas we are testing during the second phase - **MeMa 2.0**. We are engaging with older adults who are experiencing cognitive decline and who have an assistive user to help them use the Memory Machine.

We will also be trying to understand how the Memory Machine may be placed in complex social settings, for example families with children, and consider the consequential access control and management that the Memory Machine needs to support.

Our work is highlighting lots of interesting research questions around legacy, the value of reminiscence for wellbeing, and the value of creating pieces of technology that can be used by people that do not altogether feel confident using technology.

We are keen to ensure that the Memory Machine is extremely inclusive, so we are collaborating with experts from IT law, media, art, psychology, dementia and user centric research, to support engagement with the end users. In doing so, this will enable us to fully understand the user requirements and ensure the technology we develop will satisfy specifically vulnerable users.

Our focus will be on usability, accessibility and the **meaning of memories**. We are used to seeing photographs in albums or on our walls, so what happens when that photograph becomes a digital artefact – does the meaning change? What about memories that users do not want to share? We will consider, within a hypothetical context, how to better protect these types of memories and how to destroy them when the main user is no longer around. Gifting of the Memory Machine and how other forms of media (e.g. a song from childhood) can trigger memories that were dormant and forgotten, will also be explored. Understanding the complexity of memories and their different layers is key.

Elvira is very excited by the possibilities: "We hope that by addressing the emotional meaning of reminiscence and the value of memories - and more specifically the link between memories, identity and wellbeing - will enable us to enhance and promote good mental health through the Memory Machine."

Modern media experiences are becoming increasingly personalised and tailored to suit the audiences' interests and lifestyles. However, the underlying use of personal data brings about a number of challenges around transparency, control, privacy and accountability that could undermine trust.

There is a clear need for digital innovation, particularly within media (broadcasters, publishers and internet platforms), to embody and champion products and services that generate user trust. Equally important is advancing the study of digital technologies beyond simplistic use cases that assume users' digital identities and data interactions are neatly encapsulated in single user profiles. We need to investigate the inherent social nature of these technologies. Horizon works with the BBC on a number of projects around Human Data Interaction to investigate this landscape in a multi-disciplinary manner, centered on real-world applications.

Design of Data Dialogues in Media Recommenders, a **project** funded by the Human Data Interaction+ Network, involved the study of a Cross Media Profiler prototype. The new media content discovery service was built on a personal data store that allows the user to 'link' their media profiles from different digital media platforms such as Spotify, Instagram and BBC. This allows the creation of a combined media profile under the users' control, to retrieve recommendations based on their media interests across different media platforms - all done on the edge of the network.

The findings of this research were integrated into the next phase of work with the BBC around privacy preserving, data sensitive media experience design and production. Co-funded by the **PETRAS** National Centre of Excellence for IoT Systems Cybersecurity and the BBC, New forms of Public Value at the **Edge**: Designing for HDI and Trust in Media IoT Futures involved an audience-led trial to test personal edge technologies.

We are now extending this focus and our partnership with the BBC to study the social subtleties associated with digital identity management, particularly shared profiles, or multiple accounts on media service platforms. Currently most digital identity management is restricted within a single service and constrained by provider-set assumptions around the users' social contexts. We intend to explore this space from the viewpoints of the users, service providers, practitioners, technologists, policy makers and designers, to identify the challenges, opportunities and expectations around these digital experiences.

These initiatives become part of a cutting-edge research partnership between media and the digital economy to support the everyday, practical concerns of the general audiences by creating and responding to the real-world challenges, confronting the move to personal data use by modern media.

**"It was fantastic to partner with Nottingham on this project, building on our history of collaborative work around privacy enhancing technologies and human data interaction. The project provided a timely opportunity to combine our respective areas of academic and industry expertise and experience to shape an emerging and ongoing research and innovation area."**

Rhianne Jones, Research Lead, BBC R&D

# success stories

In recognition of the strength and breadth of research in digital technologies and personal data at Nottingham – championed by Horizon – the University established a Smart Products Beacon - one of six Beacons of Excellence designed to drive significant inward investment in our internationally renowned research areas and address the key challenges of our age.

"Exploring how we can create smarter products in smarter ways through the development of intelligent digital platforms to underpin future industrial societies, and addressing how humans and intelligent systems can collaborate in rich and productive new ways, is an area we are particularly interested in" Explains Steve Benford.

The Smart Products Beacon fused Horizon's personal data agenda with the design, manufacture and use of products, and brought together a diverse community to address the key challenges and gaps between manufacturing, computer science and the creative industries. As research progressed, the need for a unique facility to 'create, connect and collaborate' became apparent.

The foundation of a bespoke research and engagement facility for collaborative robotics will provide the technical capabilities and infrastructure to comprehensively probe and capture how people interact, communicate and learn with robots and intelligent systems. Equipped with an array of mobile robots and state-of the-art human sensing technology, the Cobot Maker Space will facilitate collaboration enabling researchers to study how people and robots interact. The facility features a readily reconfigurable lab, providing flexibility to create and tailor environments, and a workshop for prototyping and assembling novel devices. Furthermore, a fully equipped domestic space will provide an area for deployment of digitally enhanced products and enable researchers to explore interaction between people and intelligent systems within the home environment.

COBOT MAKER SPACE

The Cobot Maker Space comes at an exciting time and provides new opportunities to collaborate and explore new emerging areas of interest, knitting together the research agendas of Horizon 'Trusted Data-Driven Products', the Trustworthy Autonomous Systems (TAS) Hub and the LEADD:NG programme.

**TAS HUB**
A UKRI initiative set in place to deliver world-leading best practices for the design, regulation and operation of 'socially beneficial' autonomous systems.

**LEADD:NG**
A project supporting the cultural sector with the development of new immersive technology and techniques to help businesses attract audiences and customers.

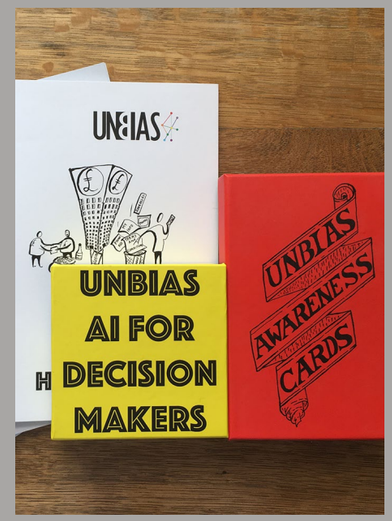


At Horizon success is recognised in many ways. We are proud to highlight a number of recent achievements.

The AI for Decision Makers toolkit was launched as a companion and an extension of the UnBias Fairness Toolkit. Commissioned by Ansgar Koene, Global AI Ethics and Regulatory Leader at EY Global Services and created and designed by Giles Lane, with illustrations by Alice Angus at Proboscis, the toolkit is a suite of critical thinking tools which enable stakeholders across organisations to join together to implement transdisciplinary ethical assessments of new or existing AI automated decision making systems.

"Quite frankly this is the best bit of communication in this area I have ever seen. It is the perfect complement to the UnBias Fairness Toolkit. Together they can be adopted by any organisation in business, charity, education, healthcare etc. Especially in the light of recent events I just wish that every member of the Government and the Civil Service had a set! I know how difficult it is to refine the language so that it really gets through. You have done a superb job."

Lord Clement-Jones CBE, Chair of the House of Lords Select Committee on Artificial Intelligence (2017–2018)




Professor Sarah Sharples, Horizon Co-Investigator and Pro Vice-Chancellor for Equality, Diversity & Inclusion at the University of Nottingham was appointed Chief Scientific Adviser to the Department for Transport. Sarah will be advising government Ministers and civil servants on all aspects of policy relating to science and technology.

Congratulations go to Dr Sarah Martindale, Co-Investigator at Horizon, who was awarded a Nottingham Research Fellowship in the Cultural, Media and Visual Studies department. Being part of this prestigious University scheme gives Sarah three years of support for independent research to study creative problems, innovative production practices and audience responses, before transitioning into an academic role. The Fellowship allows Sarah to serve as an interlocutor between Arts and Humanities, Computer Science and the creative industries.

Pepita Barnard, Horizon Research Associate and former Horizon CDT student successfully passed her PhD viva "Young Adults' Considerations for Whole Genome Sequencing" in January 2021

"Moving from Horizon CDT to join Horizon Research Team has offered many opportunities to do interesting research for social good. I continue learning while undertaking research I really enjoy with a great team I love working with!"

Pepita Barnard

Horizon CDT Alumni, Georgiana Nica-Avram joins us as Transitional Assistant Professor, based in N/Lab, Business School at the University of Nottingham

## Successful funding awards:

EPSRC SPRITE+ Network - Future Payment Systems - Data, Technology & Privacy after Covid

EPSRC HDI Network Plus - Trust in Home - Rethinking interface Design in the IoT (THRIDI)

EPSRC - ReEnTrust - a collaborative project between the Universities of Nottingham, Oxford and Edinburgh, following on from UnBias exploring new technological opportunities for online platforms to build and enhance user trust in algorithms in ways that are user-driven and responsible.

# What's next?

Horizon has been privileged to be selected as **one** of the six Next Stage Digital Economy Centres and has received £4.1m for the next 5 years from UKRI EPSRC.

Since Horizon was set up in 2009, we have seen a growing awareness of the economic importance of data and its link to future products, along with a growing crisis of trust in data handling. The challenge we are addressing in the next phase of Horizon '**Trusted Data Driven Products**' is to ensure that data-driven products can be trusted by consumers.

We envisage that future products will be hybrids - both physical and digital. Physical products are increasingly augmented with digital capabilities - from data footprints that capture their provenance - to software that enables them to adapt their behaviour. Conversely, digital products are ultimately physically experienced by people in some real-world context. The blending of physical and digital will drive the merging of traditional goods, services and experiences into new forms of product. Just as today's social media services are co-created by consumers who provide content and data – so will be these new data-driven products. Given the growing crisis of trust concerning the commercial use of personal data, it is important that products are built to be trusted by consumers and operate within an increasingly complex regulatory environment.

We are adopting a thematic, cross-sectorial approach to deliver impact and will cluster key projects into three successive campaigns each representing a different starting point for approaching future hybrid products:

- **Co-production** exploring new media and experiences.
- **Consumables** focusing on data driven consumer goods.
- **Welfare** focusing on products that actively promote personalised health and well-being.

We have commenced the Co-production campaign with project co-creation workshops, with participation from our co-investigators, researchers and our University and industry partners. Emerging projects will explore novel ways in which consumers might co-create, from directly producing content such as broadcasting local festivals, to indirectly shaping products through their personal data, for example using physiological interfaces to interact with films.

We have also introduced our Agile projects programme and held a co-creation workshop which provided the opportunity for multidisciplinary teams across Horizon to propose and develop short translational research actions. Emerging projects will explore timely opportunities around data driven consumer goods, use the newly established Cobot Maker Space, link with the Trustworthy Autonomous Systems Hub, and draw generalisable results around Responsible Research and Innovation processes and practices.



This report was written during spring 2021 and published in June. Therefore there will be numerous references to the COVID-19 situation from both 2020 and 2021.

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