UKRI
Trustworthy
Autonomous
Systems Hub

UKRI TRUSTWORTHY AUTONOMOUS SYSTEMS (TAS) PROGRAMME

ANNUAL REPORT 2022

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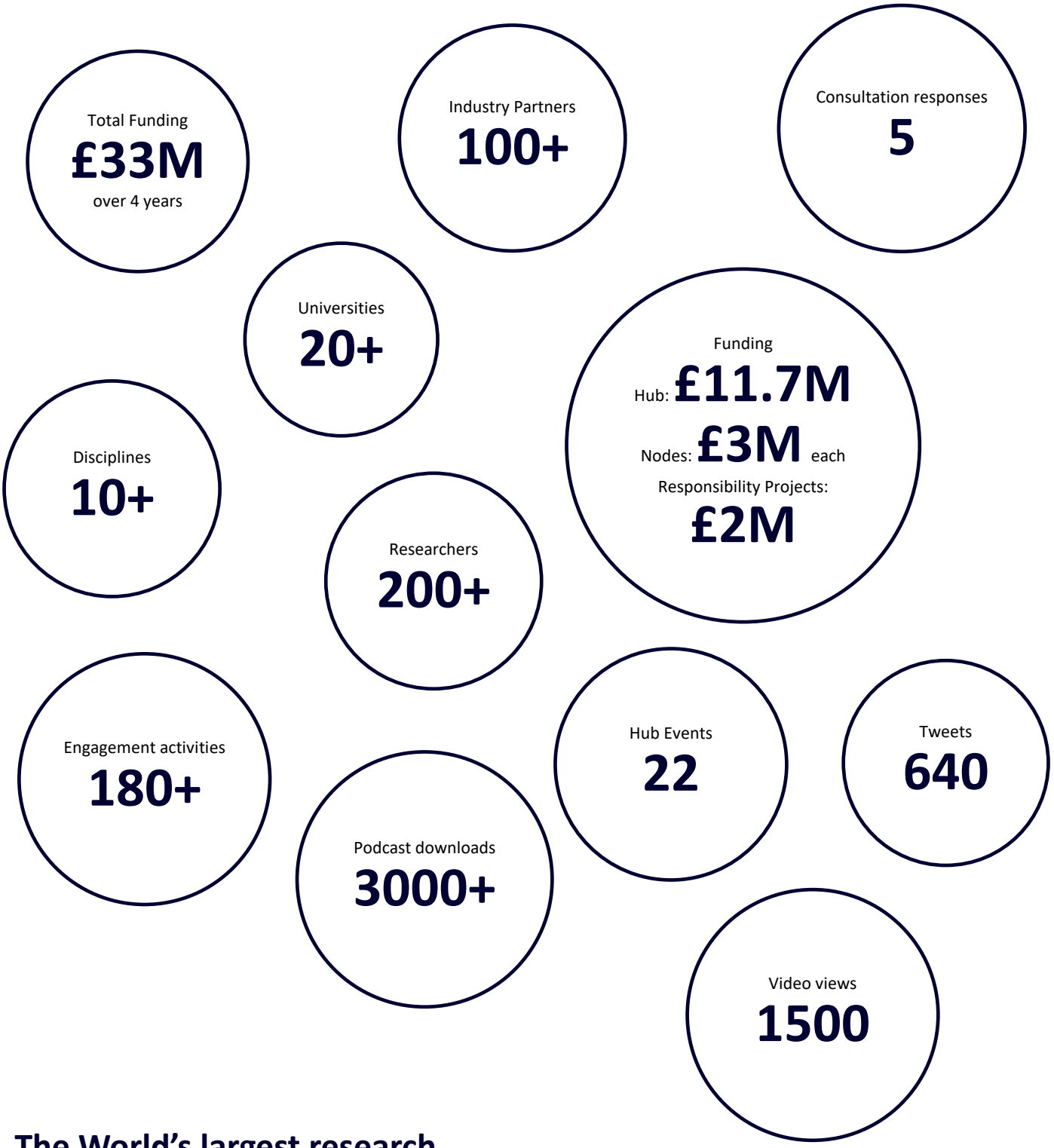
TAS AT A GLANCE

The TAS Programme includes one hub, 6 nodes, 4 responsibility projects and 20 Pump Priming Projects. The TAS Hub also initiated 6 Agile research projects in 2021 with more to be announced.



The World's largest research programme in Trustworthy AI and Autonomous Systems

DIRECTOR'S NOTE

I am very excited to present to you our second TAS Hub annual report. This report details some of our achievements working with the TAS network, including not only our research outputs but also our approach to creating an inclusive community through outreach, collaborations with local and international research programmes, and government and industry. Over the last two years our team has learnt to address the challenges of creating a research community. This was not made any easier by having to work remotely due to the pandemic. Starting with bringing together foundational TAS research, we then steered the research community to focus on some of the most pressing global challenges: climate change, recovery from the pandemic, and social inclusion.. We worked closely with the TAS Nodes to create an identity through our vision and mission statements and then went out to establish new relationships with key partners. The TAS nodes have led on the organisation of industry workshops on Health and Social Care (TAS Resilience), Maritime Autonomy (TAS Verifiability) with more to come later this year.

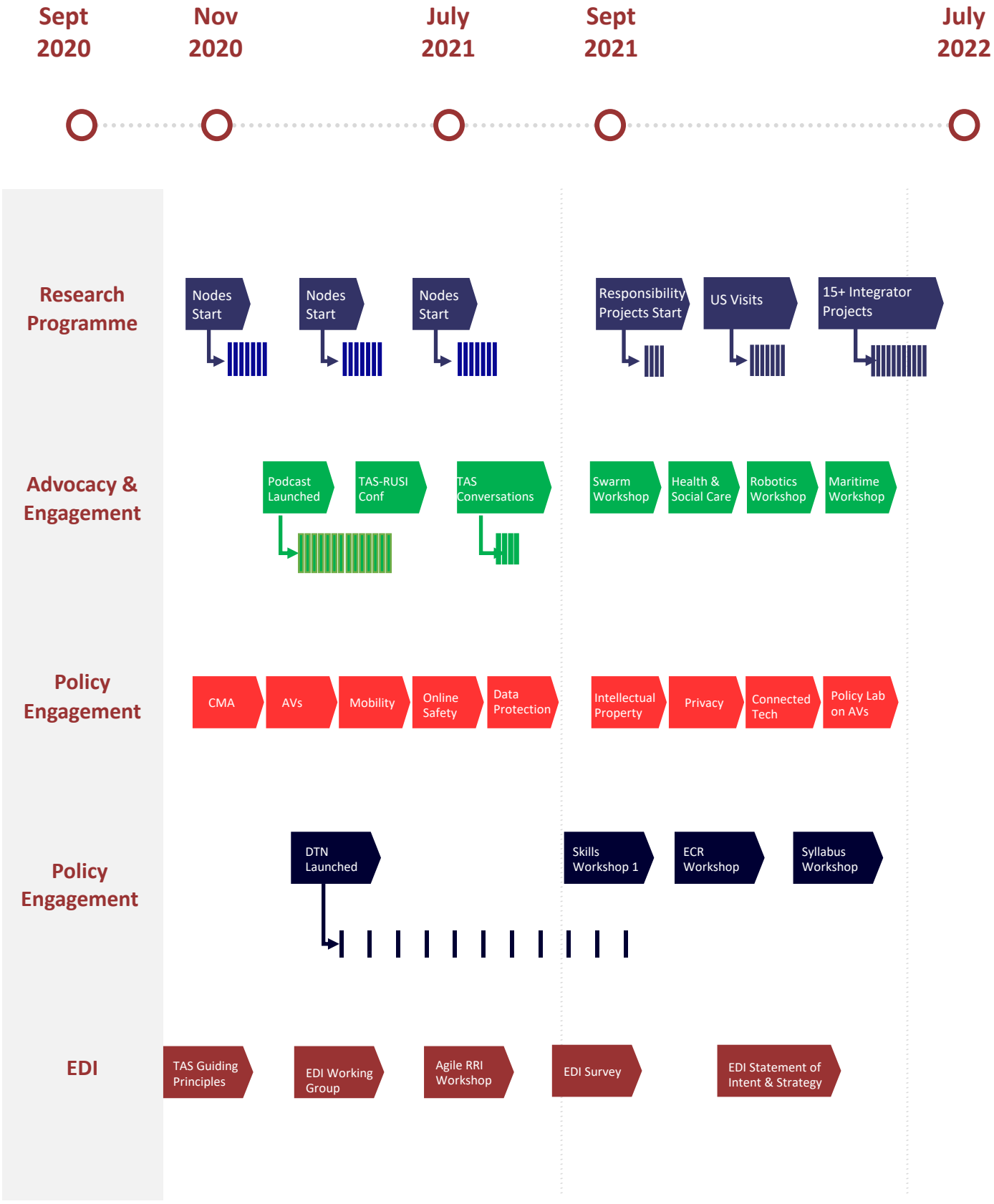
The TAS programme is gradually developing an identity centring on Responsible Research and Innovation (RRI), Equality, Diversity and Inclusion (EDI) and an inclusive approach to research that looks to support our Early Career Researchers (ECRs.) We placed EDI and RRI at the centre of our strategy, guided by Prof Sarah Sharples our EDI director and chair of the TAS EDI working group. We have embedded EDI and RRI principles in our funding calls, training activities, committees, and mentoring. This will ensure the TAS programme not only delivers best practices for the design of autonomous systems but also creates the right mindset for innovation. My hope is that the research community we create will embark on a path of continuous reflection on its approach to research, eventually translating to inclusive principles for design, implementation and governance of autonomous systems.

The next phase of the Hub's programme will look to work with the TAS network to expand our activities with our international partners, both academic and industrial. Our trip to the US earlier this year was only the beginning of a range of international collaborative activities and projects with other parts of the world. This will ensure that we complement the strengths of the UK's TAS research activities with those of our international partners, while also addressing arising global challenges. Our work with industry will accelerate, with a stronger focus on knowledge exchange and tech transfer activities as we translate TAS research into products, services, and new standards. We also aim to support our ECRs to grow and lead new spinoff projects that look to build on the foundational interdisciplinary research they have been part of over the course of the TAS programme.

If you are not already connected to the TAS network, I hope you will see this report as a starting point for a conversation with the TAS community. This report coincides with our first in-person All Hands Meeting, the first time the whole TAS community will come together in one place to reflect on our achievements so far and to plan for the future. As we near the mid-way point of the programme, I look forward to working with you all to ensure we fill any gaps in the programme and take advantage of new opportunities to make the TAS programme a success.

Gopal Ramchurn
Director, TAS Hub

TAS PROGRAMME STRANDS: PROGRESS TO DATE




UKRI Trustworthy
Autonomous
Systems Hub
AHM 2022

RESEARCH AND POLICY IMPACT

Aligning Our Research (Hub And Nodes Emphasis On Multi-disciplinarity)

The mission for the UKRI Trustworthy Autonomous Systems (TAS) Hub is "to enable the development of socially beneficial autonomous systems that are both trustworthy in principle and trusted in practice by individuals, society and government." The first objective of the Hub is to "deliver a coherent and responsive research programme for the TAS community to ensure the TAS programme generates world-leading research." In so doing, it aims to fulfil the following objectives set out in the original UKRI call:

Coordination and Collaboration - building a connected and multidisciplinary UK research community tackling the challenges of Trustworthy Autonomous Systems

Creativity and Multi-Disciplinarity - undertaking recognised world leading fundamental research in the area, with benefits to real world applications and adoption of autonomous systems

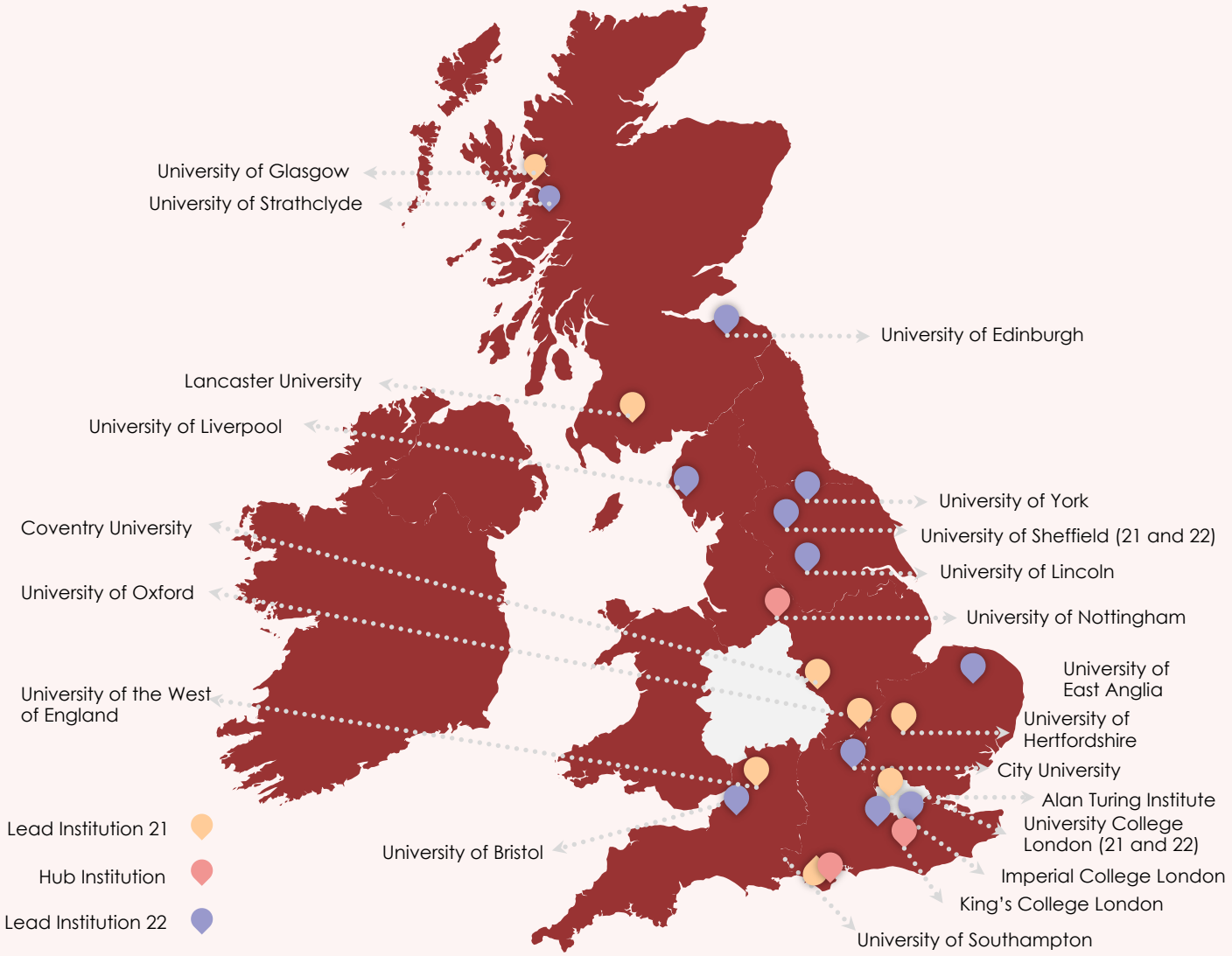
Our Research Programme consists of distinct programmes to deliver against these objectives through a coherent research programme for the TAS community. The aim is to bring together multi-disciplinary academic and stakeholder communities of experts through projects, supporting dialogues with a diverse set of stakeholders, and creating an inclusive environment for diverse views, creative, and responsible research.

This past year has seen the second round of the Pump Priming Programme, adding a further eight year-long projects to the twelve projects which were funded in the first round. The Pump Priming Programme provides up to £4M of competitive research funding open to the entire UK research community with targeted annual calls to fund research that complements and integrates ongoing research within the TAS Programme.

The eight new Pump Priming Projects mean that 22 UK institutions are now involved in the TAS Programme (see Figure below), across a range of domains that support both the Hub's Grand Challenges and newly identified priority areas: TAS to accelerate the path to net-zero; TAS to aid recovery from the pandemic; and TAS to contribute to the creation of an inclusive, fair and just world. Six of the eight funded projects are aligned with one or more of these priority areas. Seven of the eight funded projects are aligned with one or more of the TAS Nodes as well as TAS Industry Partners, from healthcare, creative industries, defence and security, and IoT (Internet of Things) at home and work. Other sectors also cited include environment, electronics, education, marine and insurance.

Around three quarters of the Pump Priming Projects are led by Early Career Researchers leading multi-disciplinary teams including but not limited to Computer Science, Social Sciences, Engineering, Medicine, Law, and Humanities. These new Pump Priming Projects, which commenced in April 2022, will be complemented by new Agile and Integrator projects which will commence in the Summer/Autumn 2022.

Distribution of pump priming projects



More than a dozen multi-disciplinary Agile/Integrator projects will go ahead from the Summer/Autumn this year; these are the result of a process of co-creation with partners and the wider TAS community, via a series of sandpits and subsequent proposal writing and peer review, within the new joint Agile and Integrator Programme.

The Agile/Integrator Programme brings together researchers and academics from the TAS Hub, Nodes, Pump Priming and Responsibility projects, and stakeholders from industry and the third sector to establish areas of common interest, explore collaborative ideas, and foster new research partnerships across the network. Agile projects bring together multi-disciplinary teams from the Hub to propose, develop and engage in focused research to complement and inform ongoing research in TAS. Integrator project teams have members from across TAS Network institutions to expand, integrate and enhance ongoing TAS research and establish new links across the wider TAS Network.

Overall, our research programmes to date have given rise to around 40 research projects addressing social, technical, and legal challenges surrounding Trustworthy Autonomous Systems. Most of these projects are ECR-led, and all span multiple disciplines, respond to our grand challenges and priority areas, and have a defined programme to address RRI and EDI issues.

Led by Professor Sarah Sharples and co-chaired by Dr Genovefa Kefalidou, the EDI Working Group has produced an EDI strategy for the TAS Programme and is now working to implement it across the Hub (and Nodes). From the start, EDI & RRI, led by Professor Elvira Perez, have been a key consideration in everything we do., e.g., criteria for awarding projects, selection of committee members, organisation of meetings/talks. A statement of intent should be announced later this year. Resources to support the EDI Working Group have been secured from Northrup Grumman.

Our research programmes are as much by you, the TAS community, as they are for you. We are grateful to you for volunteering to make our research programmes a success; without hours given to reviewing, participating in workshops, working groups, committees and helping organise events we would not be in the position that we are – thank you!

Landscape Mapping

One of the roles of the TAS Hub is to develop a multi-disciplinary community to address questions of trust in systems involving autonomous machines and artificial intelligence. While involving a significant proportion of the UK's research community who are engaged in trustworthy autonomous systems research, the TAS Programme aims to grow its engagements with those not directly funded by the Programme. It is therefore crucial for the TAS Programme to understand where and what the gaps exist in terms of disciplines and research areas in order to develop links with communities, researchers, and institutions that can fill these gaps and help develop a world-leading collaborative platform. To this end, through a procurement process, Digital Science (DS) Consultancy was contracted by the TAS Hub to carry out a landscape mapping exercise, using bibliometric analysis and keyword-based queries, and guided by TAS Hub and Node researchers. The analyses carried out by the DS Consultancy team aimed to show both the strengths and the gaps in research fields, and to list the most prolific authors globally and in the UK.

The initial work carried out included first defining a set of appropriate keywords from TAS research across 2005-2019. A total of 239,898 global publications were identified (of which 15,680 - 6.8% of the total - were UK publications). Across all six keyword-based search sets the total number of publications increased from 6,521 in 2005 to 36,255 in 2019. This general trend reveals a dramatic growth in publications in all result sets and comparable growth areas (each area between 5- and 10-fold increase from 2005 to 2019).

The compound annual growth rate (CAGR) was calculated and revealed more growth in the last five years than in the last 15 years.

Results sets varied in citation rates (18.5 for the highest average citations.) The field citation ratio (FCR), which allows normalisation of subject differences, revealed that two of the results sets had the highest citation rates.

Publications were identified in the Dimensions database using Fields of Research (FoRs) for TAS Hub researchers (PIs and Co-Is). FoRs in selected publications revealed that just under half (46%) of publications authored by TAS researchers (from the Hub and the Nodes) were published in Information and Computing Sciences globally. Of these, 27.8% of publications were published by UK TAS researchers.

Gaps in TAS Hub research were identified and comparisons made between the UK overall and TAS Hub researchers revealing in what areas TAS Hub researchers publish more than UK researchers overall. Of the 22 FoRs there were just three fields in which UK researchers publish more than TAS Hub researchers.

Find of Research	Percentage (TAS Hub)	Percentage (UK)	Ration (TAS/UK)
19 Studies in Creative Arts and Writing	0.3	0.1	3.0
01 Mathematical Sciences	5.0	2.3	2.2
21 History and Archaeology	0.4	0.2	2.0
10 Technology	3.1	1.6	1.9
08 Information and Computing Sciences	46.2	27.8	1.7
20 Language, Communication and Culture	1.7	1.1	1.5
13 Education	1.0	0.7	1.4
17 Psychology and Cognitive Sciences	8.5	6.3	1.3
03 Chemical Sciences	0.8	0.7	1.1
12 Built Environment and Design	0.7	0.7	1.0
09 Engineering	8.9	11.3	0.8
15 Commerce, Management, Tourism and Services	1.3	1.7	0.8
05 Environmental Sciences	0.2	0.3	0.7
11 Medical and Health Sciences	15.3	27.6	0.6
02 Physical Sciences	0.6	1.0	0.6
14 Economics	0.6	1.0	0.6
06 Biology Sciences	1.4	2.2	0.6
07 Agricultural and Veterinary Sciences	0.1	0.2	0.5
04 Earth Sciences	0.2	0.4	0.5
22 Philosophy and Religious Studies	1.2	3.4	0.4
16 Studies in Human Society	1.6	6.1	0.3
18 Law and Legal Studies	1.0	3.0	0.3

Creative Arts
Mathematical Sciences History
Technology ICT

Medical/Health
Economics
Philosophy
Studies in human society
Law and Legal studies

At the top of the table, and any ratio above 1, are the over-represented fields of research, where TAS Hub researchers publish more than the UK researchers; while **at the bottom are gaps in TAS Hub researchers compared to UK researchers**.

We used the 127,417 publications that had identified researchers, created a co-authorship network, and kept only branches where authors had co-authored at least 2 publications in our corpus. We then used the Leiden algorithm to identify communities.

Using the titles of the publications in these communities, we associated each community with the 10 most frequent terms used in the titles; excluding stop words and common terms in titles.

	UK	Intl	Ratio	
32	93	113	82.3	Algorithmic data accountability human decision making decision making internet model things
7	182	261	69.7	Robot autonomous robots verification human systems vehicle based robotic trust
13	121	226	53.5	Autonomous control vehicle autonomous vehicles driving path tracking automated
12	97	231	42.0	Robot soft based control robots model robotic simulation arm autonomous
8	95	259	36.7	UAV networks based allocation resource wireless power enabled systems resource allocation
22	48	149	32.2	Robot control based robotic locomotion humanoid time walking design
11	61	246	24.8	Based networks UAV data trust multi learning model blockchain communication
28	21	120	17.5	Based design systems mobile control robot data computing trust dynamic
0	99	629	15.7	Control based robot multi systems adaptive robots time aerial robotic
5	41	282	14.5	Robot control based planning learning humanoid robots robotic multi motion
29	17	117	14.5	Based social trust algorithm networks search swarm system network data
9	37	258	14.3	Robot autonomous control multi based planning driving systems robots multi robot
23	20	143	14.0	Based energy smart robot system data control management optimization multi
10	34	249	13.7	Control based robotic cooperative tracking planning aerial vehicles
14	28	216	13.0	2017 global countries burden global burden 195 territories 195 countries territories 2015
3	34	300	11.3	Learning robot based robotic deep human control multi planning real
16	19	193	9.8	Control multi based system robot agent multi agent planning agent systems distributed
25	11	133	8.3	Networks based UAV multi power trajectory mobile allocation computing data
6	18	275	6.6	Control multi system agent multi agent systems consensus based time distributed
20	10	160	6.2	Control system multi agent multi agent systems based adaptive consensus nonlinear
4	18	298	6.0	Control based robots multi autonomous mobile planning vehicle adaptive

Data accountability
Human decision making
Autonomous system
Verification

Multi-Agent Systems
Control systems
Adaptive robots
UAVs

Through this exercise, we have thus developed a fundamental understanding of the key areas where the TAS community should focus its efforts in the next two years of the Programme. We expect these results to guide researchers in thinking about who they engage with and how they collaboratively develop their research within the Hub, Nodes, and beyond. These results also establish a baseline against which we can now measure progress in growing breadth and depth of the TAS research community.

The full report, with accompanying datasets, is available on our website.

Research Project Highlights

In 2021 we invested £1.4M in 12 multi-disciplinary pump priming projects, in addition to 6 agile projects, across a range of domains including autonomous vehicles, defence and security, health and care and AI ethics and governance. Fuller details of each project may be found on our website.

Highlights from recent projects include:

The development of research tools and methods such as a 3D environment for simulated driving (Dr W Payre, Coventry University) and the Open Dome platform for the control of microscale agents using light (Dr S. Hauert, University of Bristol.)

The development of models such as the 'Circles of concentric trust,' which considers 'trust' as a two-way process moving from the central object (robot) to successively broader configurations (Dr de Saille.)

The use of the COTADS (Codesigning Trustworthy Autonomous Diabetes Systems) platform in the NHS (Dr M. Boniface.)

The RoAD (Responsible Autonomous Vehicle Data) project providing the foundation to successfully apply for a larger TAS 'Responsibility' project – RAILS – which will extend this work from data to processes and from autonomous vehicles to autonomous robot systems (Dr L. Kunze, University of Oxford). RAILS will also build out from AMLAS (Assurance of Machine Learning for use in Autonomous Systems) framework developed within the Assuring Autonomy International Programme (AAIP) at the University of York.

Discussions with the Law Commission of England and Wales on new standards for Autonomous Vehicles (Prof. M. Jirotka, University of Oxford) and contributions to other consultation responses such as the right to privacy (Dr. I. Omoronyia, University of Glasgow.)

The increasing networking between research teams, hub and nodes, and commitment to the development of the TAS community. For example, former pump priming researchers acting as advisors for current pump priming projects (Dr de Saille for the 'Empowering Future Care Workforce' project.)

Increasing public engagement with TAS, with a special mention to Open Labs (Professor T Prescott, University of Sheffield). You may watch their Open Labs video here: **Open Lab**

“

TAS researchers have given numerous invited talks and keynotes, in a broad range of venues, in the last year including at the IET Conference on AI in Transport, where Professor Ramchurn was asked to discuss trust issues in the design and deployment of Autonomous Vehicles. Multiple engagements followed including meeting with the Institute of Safer Autonomy in York.

“

Dr B Anvari received the best paper presentation sponsored by BMW Group at RoboTAC21, which includes a six-month paid internship at BMW Group as well as $400 sponsorship from Wiley and one free of charge publication in an Open Access Journal.

“

Dr A Kucukyilmaz, Hub Co-Investigator, has recently taken up post as Associate Editor of the International Journal for Social Robotics. Dr S Middleton became a Turing Fellow and TAS Hub researchers, Drs M Divband Soorati, S Tuncer, M Galvez Trigo and Pump Priming Project researcher Dr V Yazdanpanah successfully made the transition to lecturer.

“

Notably, Professor Dasgupta, a Hub Co-Investigator, was awarded a Padma Shri. The Padma awards are one of the highest civilian honours in India. Professor Dasgupta’s was awarded for his outstanding contribution to the field of medicine. Professor Dasgupta was also awarded the King James VI Professorship by the Royal College of Surgeons, Edinburgh.

JOURNAL OF RESPONSIBLE TECHNOLOGY

TAS Hub researchers Elvira Perez Vallejos, Liz Dowthwaite, Pepita Barnard, and Ben Coomber have been invited to coordinate a special issue of the Journal of Responsible Technology, titled “Reflections on Responsible Research and Innovation for Trustworthy Autonomous Systems.” This special issue focusses on how responsibility in the context of research and innovation need to be applied to the development of socially beneficial trustworthy autonomous systems.

The TAS community and researchers in related fields were asked to submit articles that consider what it means to be responsible and responsive within the context of beneficial trustworthy autonomous systems, and to focus on responsible research and innovation (RRI) in practice. In addition to original research articles, colleagues were also invited to submit short reflective articles that discussed RRI in practice, critically reflecting on barriers and facilitators of ‘doing’ RRI. Our vision for this special issue is to provide the TAS community with a set of case studies that objectively evaluate RRI practices in real research situations.


Southampton

Further Funding

Across the TAS community, researchers have secured a further £1.86m of funding across six new projects in the last year. These are:

£25k

Vice Chancellor's Prize - £25k (Dr J.Lindley, Lancaster University) To conduct participatory research with local sight loss charities around using sound-based user interfaces for computer gaming.

£112k

Innovate UK: SBRI UK National Robotics Proving Ground Feasibility Study - £112k (Dr A Kucukyilmaz, University of Nottingham.)

£125k

EPSRC Smart Solutions towards cellular-connected unmanned aerial vehicles system - £784k (PI, Prof. S.D. Ramchurn, University of Southampton and Dr Y. Deng, King's College London.) The project will engage with the end-users to exploit Cellular-UAV applications in surveillance and emergency services in urban areas.

£831k

EPSRC Next Generation Rehabilitation Technologies - £831k (Co-I, Dr A Kucukyilmaz, University of Nottingham.) This network will focus on developing the next generation of advanced technologies for rehabilitation, targeting musculoskeletal, cardiorespiratory, neurological, and mental health conditions. It will be connected to the new £70 million National Rehabilitation Centre (NRC), a major national investment in patient care, innovation, and technology, due to open to patients in 2024.

Membership Of Advisory Bodies

The TAS Director was appointed to the Ministry of Defence (MOD) AI Ethics Panel in 2021. This panel is influencing the policy and shaping a set of ethical principles the MOD have developed.

The TAS Director has also been appointed to the Technology Advisory Panel of the Investigatory Powers Commissioner's Office. Its role is to advise the Government on matters of privacy protection, with a specific focus on the use of AI technologies by Government Law Enforcement organisations, in collecting and using data in investigations. This engagement with law commissioners has resulted in the formulation of an approach to the adoption of AI based technologies such as speech recognition.

Policy Impact

One of the TAS Programme's key aims is to support informed policy setting in Trustworthy Autonomous Systems and we are actively monitoring the UK Parliament and other bodies to contribute evidence and develop recommendations for decision-makers.

The Hub, in collaboration with The Policy Institute at King's College London, are creating a policy series of landscape reviews of the sectors that we are working in. These reviews are available and may be downloaded from our website.

TAS Researchers are also provided with policy support, via dedicated guidance published on the website.

The TAS community has responded to a further five Government consultations between September 2021 and June 2022, including the draft online safety bill, with a citation on page 36, the AI and Intellectual Property: call for evidence from the Intellectual Property Office and The Right to Privacy: a call for evidence from UK Parliament.

Policy Lab

Changes in policy and practice often fall down when built on an inadequate understanding of the communities and challenges they seek to address. However, marshalling the research evidence, and appreciating wider social and financial implications of policy options can be a complex challenge in itself. To bridge the gap that often exists between research evidence, policy and practice changes, the Policy Institute at King's College London will run a series of 'Policy Labs' for the TAS Community; these are collaborative sessions that bring together research, policy, and practitioner expertise to assess the evidence, understand barriers and constraints to change and use this understanding to inform policy options that can help improve outcomes.

The Hub's first Policy Lab, a half-day event held on 29 June, brought together researchers, policymakers, and industry in a dialogue on the topic of social inclusion in the project development lifecycle of autonomous vehicles. The full brief and outcome may be found on the Policy Impact area of the website.

SKILLS AND CAPACITY BUILDING

Tas Doctoral Training Network (DTN)

The TAS Doctoral Training Network (DTN) connects transdisciplinary PhD students across the TAS Programme and is open to doctoral researchers from UK institutions whose research is focused on any aspect related to Trustworthy Autonomous Systems. The aim is to bring together a diverse group of students from different disciplines, sectors, and backgrounds. The DTN was launched in February 2021 and to date has over 70 members from 19 different institutions.

The TAS Hub co-ordinates a DTN seminar series aimed at doctoral researchers but also open to the wider TAS community. Three seminars, detailed in the table below, have been held this year.

Date	Title	Speaker	Institution
20/01/2022	Medical Robots on the Battlefield	Professor Burkhard Schafer	University of Edinburgh
08/02/2022	Incentives in Citizen-Centric AI Systems	Dr Sebastian Stein	University of Southampton
22/03/2022	Catch Me If You Can: Doping Detection in Autonomous Systems	Professor Mohammad Mousavi	King's College London

The three TAS partner CDTs have also shared additional training opportunities with the DTN Network, such as a guest lecture, a summer school, academic writing training and a robotics workshop.

The TAS All Hands Meeting in September 2021 included a Skills Day, which provided a range of skills-related workshops, poster sessions and mentoring sessions for Early Career Researchers and PhD students.

Internship Programme

The TAS Hub offers opportunities to match industry partners and PhD students with relevant skills and interests who wish to undertake three-month internships during their studies. Please contact us for further details of this scheme.

Industry Fellowship Programme

The TAS Industry Fellowship Lead, Dr Siddartha Khastgir, is developing a programme of secondments for postdoctoral researchers to work with key industry partners. The first fellowships will be awarded in 2022. If you would be interested in sponsoring a TAS fellow, please contact us.

Syllabus Lab

The Syllabus Lab aims to contribute to the development of future academic and professional training programmes and is led by a subgroup comprising researchers and industry partners. Members have carried our an analysis of existing AI Skills Frameworks as a starting point for developing a TAS-specific Skills Framework, which will subsequently define interdisciplinary core topics for training courses and curricula. An open workshop at the All Hands Meeting in September 2021 led to the successful submission of a paper to the IEEE (Institute of Electrical and Electronic Engineers) EDUCON Conference (March 2022.) A workshop with Early Career Researchers was held in February 2022 to develop TAS use cases and personas, followed by a further workshop at the EICS international conference in June 2022.

ADVOCACY AND ENGAGEMENT

Creative Programme

One of the guiding aims of the TAS Hub is to support dialogues with a diverse set of stakeholders, including those from government, industry, creative fields, and the public. We do this via a number of routes: through academic conferences and industry summits, with public-facing events for all, by producing online resources and materials, and by means of our podcast.

Cat Royale

Working with our Cultural Ambassadors, Blast Theory, the TAS Hub is developing Cat Royale. Blast Theory make interactive art to explore social and political questions. Their work places the public at the centre of unusual and sometimes unsettling experiences, to create new perspectives and open up the possibility of change.

The artists Blast Theory and the TAS research team will design, deploy, and study a high-profile interactive artwork called Cat Royale that will engage the public with issues of trust in autonomous systems – especially in relation to the wider societal challenge of health and wellbeing – in a compelling, provocative, and yet safe way. The work will involve the public in creating and running a paradise for cats in which AS technologies, including computer vision, robotics and IoT, will monitor and tend to the wellbeing of a small community of cats that inhabit it.

This will be displayed as a public installation at a prestigious arts venue, while a parallel social media campaign will engage the public in the design of the work, in supporting the AI in its tasks, and in debating the wider significance of the work, specifically its relationship to future human wellbeing.

Artists in Residence

A number of artists in residence have been exploring how trust works with TAS researchers. One example is Autocar led by Dr Richard Ramchurn. Richard has taken depictions of autonomous cars in popular culture, grouping, theming, and conducting a meta-analysis of them and using these to foster discussion amongst TAS researchers with the question 'What does it mean to trust an autonomous vehicle?'

Design fiction is a type of speculative design which can be used as a way of exploring people's attitudes to and implications of future technologies. The fictional designs of autonomous cars give us an insight upon what the desires and fears are and how they have changed over the years. By analysing these designs, and that of current autonomous cars Richard hopes to discover gaps in the narrative around future self-driving cars to inspire new questions. From these questions Richard plans to extrapolate a design for an interactive creative product.

The following insights have been collated from transcripts made during workshops where researchers discussed movie and TV depictions of self-driving cars. It was noted that a lot of the challenges in the examples were also current challenges.

There is a contradiction that we want to be free, we want to be powerful, and we want to have control. So that is the reason we are off loading activities to the machines. But at the same time, we want to use that freedom for something we want, not what devices are trying to tell us. So that is the contradiction; that we want to offload but at the same time we want to have the control, it spans across the various narratives.

We are giving over not only the control but also the skillset. The control is one thing, but the skillset makes a lot of people uneasy.

A few of these clips show people overriding the autonomous car. They do not trust them to do what they want, or they are challenged that the car might be better than them.

If all cars were to change to autonomous vehicles, then it would be easy to make something in that space, but tesla and others are talking about the challenges of stepping up to automation and that is where it becomes difficult.

Alexa will listen for inflections of frustration in the user's voice and try a different tact, it has learned over the years. The fact it has been given a female voice and how that fits in to emotions and how we react to things; Do we react differently to something with a female voice and why?

When the topic of emotion comes up the hurdles of all sorts of dependence on these technologies come with it. The users' interactions become something expressed almost involuntary as they get used to the technology. Then, if that technology has set out to create an emotional connection what happens when it breaks down, becomes unsupported?

The examples where the cars have the most agency such as Christine, or Herbie, they are not autonomous cars, they are magic cars rather than technological, that says something. Just how much agency do we want from the technology?

The end goal of Richard's research is to write an interactive script that can be used to explore this space and encourage critical engagement with the question: What does it mean to trust an autonomous vehicle? A complicated system of human agency vs automation comes into play as Richard grapples with this question to create an experience which engages thought, conversation and may challenge preconceptions.

TAS Artists in Residence Workshop

TAS Artists in Residence, Makers of Imaginary Worlds, and Dominic Price (TAS Researcher, University of Nottingham) ran an interdisciplinary workshop "A Theatre of Robots: Performing Autonomy." The workshop was in partnership with the AHRC (Arts and Humanities Research Council) Network on Theatre, Artificial Intelligence and Ludic Technologies (nTAIL – Co-Directed by Dr A. Chamberlain – TAS Creative Sector Lead). Hosted at the CoBot Maker Space at the University of Nottingham.

Partners and networking

Thought Pieces (sponsored by Thales)

The TAS Hub and Nodes ran a series of workshops, sponsored by Thales, and facilitated by Dr Mark Pickering, around six themes – Functionality, Governance and Regulation, Resilience, Security, Trust, and Verifiability. Following the workshops Mark produced a series of reports that will form the basis of a white paper and other materials to explain and promote the development of Trustworthy Autonomous Systems.

Delivering the AI Strategy – the use of new AI technologies in industry and the public sector

The Foundation for Science and Technology (FST) hosted a joint event with the TAS Hub at The Royal Society on 23 February entitled "Delivering the AI Strategy – the use of new AI technologies in industry and the public sector." In September 2021, the UK Government published the National AI Strategy. Part of this Strategy is to support the transition to an AI-enabled economy. This event looked at how AI technologies are being deployed in the public and private sectors, and future expectations.

We are grateful to the panellists: Lord Clement-Jones (via video link from the House of Lords), Professor Dame Wendy Hall (Regius Professor Computer Science, University of Southampton and TAS Skills Director), Professor Tom Rodden (Chief Scientific Adviser, Department for Digital, Culture, Media and Sport) and Professor Geraint Rees (Pro-Vice-Provost, AI, University College London), ably chaired for the evening by John Neilson, for an interesting and thought-provoking discussion (the recording and FST report are available on our website.)

Knowledge Transfer

The TAS Hub has made a good start to its knowledge transfer activity and the aim is to intensify this activity in line with the increased development, understanding, and demonstration of Trustworthy Autonomous Systems and their applications. This has drawn on the outcomes of the TAS funded research projects, presented at international conferences such as AAMAS (Autonomous Agents and Multi Agent Systems), Stanford AI Symposium and CHI, as well as engagement with Industry via, for example, participation in the Dstl's AI-Fest, supporting TAS Node hosted sector specific workshops in areas such as Health and Social Care (Resilience) and Maritime Autonomy (Verifiability) and the development of a series of thought pieces sponsored by Thales.

The TAS podcasts and conversations have increased public awareness of trustworthy autonomous systems and the challenges and opportunities they present. TAS researchers have continued to respond to consultations, such as the Draft Online Safety Bill in which the Hub was cited (p36), increasing the awareness of TAS within Government agencies and hopefully influencing policy though robust and demonstrable research. In addition, interactions with organisations such as the Royal Academy of Engineering and Foundation for Science and Technology, have led to the identification of further knowledge transfer opportunities.

The main objectives for the next year are to consolidate the TAS Hub as a truly national Hub for Trustworthy Autonomous Systems research, to stimulate the adoption of TAS technology in industrial demonstrators and systems and to develop suitable outreach materials, via the Syllabus Lab and other means, to both educate and inform the public in as an engaging manner as possible. Finally, as TAS' research becomes increasingly validated via experiments and field trials, we shall seek to engage further with policy makers when we think there is an opportunity to influence policy in relevant areas.

Other Outreach

Early Career Researcher (ECR) event

We held our first in person ECR event at Prince Philip House, London on 23 February. Over 50 post-doctoral researchers and PhD students joined us for an afternoon of networking. They also took part in a skills workshop, developed as part of the Syllabus Lab.

US-UK visits

The objective of these activities was to establish a strong international network to deliver world-leading research and innovation that is relevant globally. TAS, as we found during our visits, is a unique national programme in terms of its research focii and the multidisciplinary community it brings together. Being part of such a national programme gave us direct access to decision makers in a range of universities and companies. Our visits also served to develop the TAS 'brand' as an internationally leading research programme.

Health and Social Care Workshop

This workshop, planned and hosted by the Resilience Node in York on 7 and 8 June, brought together health and social care practitioners, researchers, developers, operators, end users, policy makers and regulators, to discuss challenges and solutions for the trustworthy adoption of autonomous systems in health and social care.

The workshop included keynotes from leading experts, presentations, demonstrations and poster sessions, panel debates, guided tours of the **Institute for Safe Autonomy**, a new £45m flagship research centre at the University of York, as well as ample opportunities for networking.

Maritime Autonomy Infrastructure Workshop and Networking Event

This workshop was planned and hosted by the Verifiability Node, with the Connected Places Catapult, in London on 27 June. The workshop addressed the challenges and opportunities of autonomy around net zero, regional growth, and inclusion. The intention is to develop collaborative project ideas and work to identify future funding opportunities.

CogX 2022

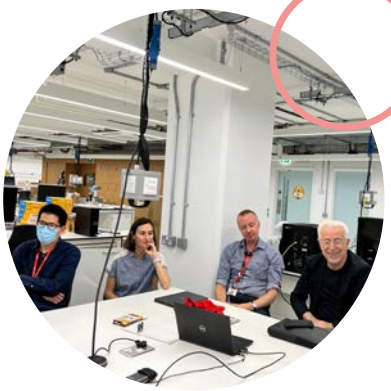
CogX is the world's biggest and most inclusive Festival of AI and the latest transformational technologies. It showcased 1,000 speakers across 22 inspiring topics from leadership to health and our planet, with 20,000 in-person participants and a broadcast reach of 5m watching online, addressing the question "how do we get the next 10 years right?"

TAS Advocacy and Engagement Director, Dr Kate Devlin, took part in the panel "Mental health and metaverse." Kate also chaired a CogX panel featuring Professor Dame Wendy Hall, entitled "Regulating the metaverse: Can we govern the ungovernable?"

One Tech World 2022

One Tech World is an annual conference hosted by WeAreTechWomen, aimed at global female technologists. TAS hosted a panel at this virtual event, "Trust and AI - Trusted Autonomous Systems Hub," featuring our research. Dr Bani Anvari (PI of the SAAVE Pump Priming Project at University College London), Dr Justyna Lisinska (TAS Hub Policy Researcher at King's College London), and Rosamund Powell (Alan Turing Institute Researcher on the Digital Mental Healthcare Pump Priming Project) spoke about their role in facilitating and delivering AI – from self-driving cars to mental health support – and shared what their hopes are for women in the sector.

TAS Robotics Day



Following the recent US visits the TAS Hub, along with the Institute for AI at King's College London, was delighted to welcome Professor Khatib, Director of Stanford Robotics Lab, to London to deliver a keynote and discuss the challenges of human computer and human robot interaction

All Hands Meeting (TAS AHM)

The TAS AHM 2022 was a hybrid event, in person at BMA (British Medical Association) House, London on 12 July. The event brought the TAS Community together to showcase our research, forge new multi-disciplinary networks and see the scope of trustworthy autonomous systems on a global scale.

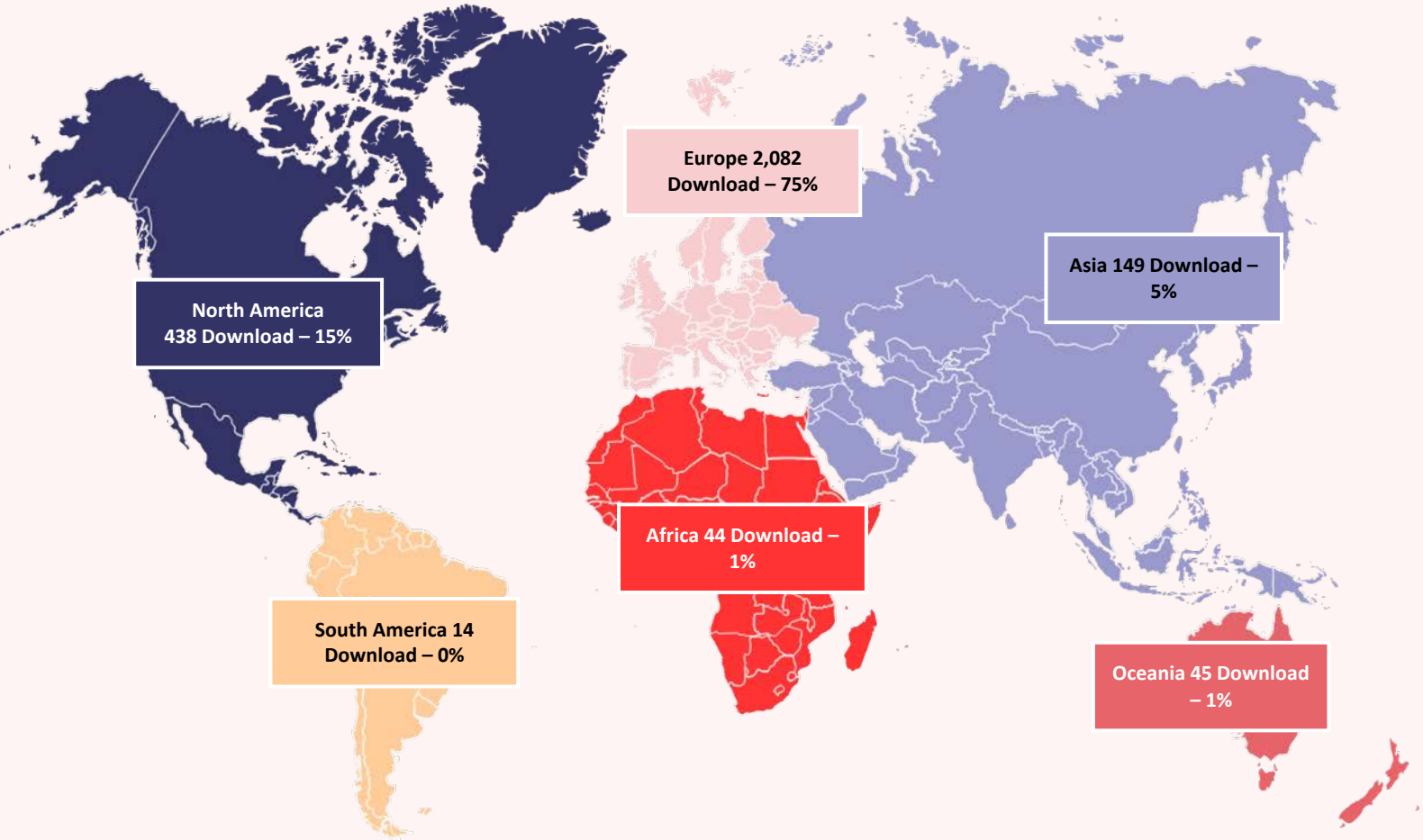
With a live exhibition space, attendees were able to interact with TAS project demonstrations, in between presentations and panels addressing research, translating this research into key impact areas (policy, skills, public engagement, and industry) and TAS on a global scale.

Social Media

In support of the Hub's ambition to create a 'one stop shop for all things TAS' our social media audience has increased significantly, with growing engagement across all channels – Twitter, LinkedIn, and the website. On average the Twitter account gains 50 new followers each month and traffic to the website has doubled in the last year. Referrals have shifted from predominantly direct to organic, indicating greater awareness of the TAS Hub beyond the reach of our communication channels.

Podcasts

The Living with AI podcasts, which feature a speaker and panel drawn from the TAS Community have covered such diverse topics as Track and Trace, virtual assistants, drones, driverless cars, music, robotic surgery, and legal and ethical issues of autonomous systems. All episodes are available on our website. By March 2022, the podcasts have had over 3,000 downloads from around the world. A second series showcasing the 21/22 research projects was released in June 2022. A further series of podcasts is planned to showcase the 22/23 research projects.



Professor Mohammad Mousavi, Principal Investigator for the TAS Verifiability Node, has used the Living with AI Podcasts as auxiliary material in different modules at two different institutions. He used the podcasts in his Foundations of Artificial Intelligence (3rd year, undergraduate, academic year 2020-2021) module at the University of Leicester to motivate the deeper (ethical and policy-related) challenges behind using AI in critical applications. He has subsequently also used the podcasts in his Software Measurement and Testing (3rd year undergraduate and 1st year postgraduate, academic year 2021-2022) module at King's College London to motivate the modern applications of software testing and verification techniques to autonomous and AI-enabled systems.

An example of feedback from the module evaluations and the numerous messages received after the completion of the latter module at King's College London is reproduced below:

"The SMT module has been one of the most interesting semester 1 modules I've taken in university. Despite the challenges of studying remotely, Mohammad and Laurence's teaching and prepared materials have been fantastic, especially when real-world relevance is discussed. ... Keep up the great work! " Undergraduate

TAS Conversations

TAS Conversations are a series of fireside chats on topical matters. The recordings of these events may be found in the TAS media gallery on our website.

EU AI Act

AI is changing the world we live in – how do we prepare for that? What are the risks? And how do we make sure that we create trustworthy AI? This expert debate and discussion, hosted by Sean Riley (Computerphile), on the EU AI Act – the first-ever legal framework on artificial intelligence, considered these questions and implications for the UK. It featured: **Professor Dame Wendy Hall** (Regius Professor of Computer Science, University of Southampton and TAS Skills Director); **Professor Barry O'Sullivan** (Professor of Constraint Programming, University College Cork and founding Director of both the Insight Centre for Data Analytics and the Science Foundation Ireland Centre for Research Training in AI. From 2018-2020 he served as the Vice-Chair of the European Commission's High-Level Expert Group on Artificial Intelligence); **Carly Kind** (Director, Ada Lovelace Institute and Chair, TAS Board); and **Professor Subramanian Ramamoorthy** (Professor of Robot Learning and Autonomy, University of Edinburgh, and Director of the Institute of Perception, Action and Behaviour as well as Principal Investigator, TAS Node in Governance and Regulation).

The conversation ranged widely and freely following Carly's excellent introduction, overview, and analysis of the draft Act. Comments by the panel include:

"Adopts a risk-based approach, which gives primary responsibility for compliance to the developers of AI products.
Carly Kind, Director, Ada Lovelace Institute

"There is a sweet spot between regulation and audit – they are two sides of the same coin – and it is what you regulate and what you audit to show that you are complying with the regulation.
Professor Dame Wendy Hall

"The definition of AI is not exactly clear.
Professor Barry O'Sullivan

"Regulations are different between IEEE standards and if you had an international law…. We have had 25 years of trying to get common sense into machine learning. What the AI Act could do – not so much for AI itself but for how AI businesses are run. There is a lot of burden if you cannot be sure what is expected of your product.
Professor Subramanian Ramamoorthy

"(The TAS Hub) is looking to training people to understand these issues… and if you think about the AI that will be evolving in the future, they are even more complex, having this interdisciplinary approach (is) needed to think about sociotechnical issues when dealing with these types of systems.
Professor Dame Wendy Hall

"My priority would not be regulation but education. The way that we get people to trust and believe in technology is to really help them to understand.
Professor Barry Sullivan

Climate Change

Climate change is a pressing issue with major implications for societal wellbeing. What do we need to do so that industry and the general population will trust the tools and techniques that we are developing so that they can be adopted at scale? This conversation, hosted by Sean Riley, featured **Professor Lynn Kaack** (Co-founder, Climate Change AI and Assistant Professor of Computer Science and Public Policy, Hertie School), **David Dao** (ETH Zurich, Co-founder or GainForest, Climate Change AI), Buffy Price (Co-founder and COO at Carbon Re), **Priya Donte** (Co-founder and Chair, Climate Change AI. PhD student, Carnegie Mellon), **Pete Clutton-Brock** (CEO at Radiance International Consultants, Co-Founder Centre for AI and Climate), **Stewart Dodd** (Co-CEO, Empati.)

Following Sean's preamble and introductions, Priya provided an overview of the current technologies and set the scene for the discussion.

"These technologies have huge potential, but they are not without risks, and it is incumbent on all of us working in this space to build that trust.

"One of the big barriers we have seen in the application of AI in climate change is often people working in climate change don't know what kinds of problems it can solve.

Pete Clutton-Brock

"Climate change is complex, and AI is complex…AI is not the solution to climate change….You need to understand where AI is usable... The right models are usually the simplest ones….We need to train models that are fair and effective in every country on this planet.

David Dao

"If the AI community can figure out how we get some kind of traceability, verifiability into carbon accounting that would be amazingly useful.

Stewart Dodd

"Currently all of the information and communication technologies, everything we are using for the internet, data streams, everything all together is around 1-2% of greenhouse emissions, so compared to other sectors relatively low…only a fraction of that is attributable to AI.

Professor Lynn Kaack

"Sharing learnings is going to reduce carbon emissions by applying best practices…being mindful of consumption.

Buffy Price

PLANS FOR 2023/2024

The TAS Programme intends to continue to deliver impactful research for industry and government, grow partnerships with key stakeholders, initiate spin off projects and enterprise activities, and establish partnerships with international research centres.

Later this year there will be a third call for the Pump Priming Programme (deadline November), a Logistics and Manufacturing Workshop (led by the Functionality Node), a TAS Skills Day and a TAS Global Sandpit is also planned. The sandpit will help develop new international collaborations and support our ECRs in their careers.

Plans to deliver best practices in the form of case-studies, training materials and school outreach activities, a legal toolkit, creative outputs and establish TAS leadership across international venues (UN, academic and industrial conferences) continue.

Further ahead, a second policy lab and TAS Conference 2023 are being planned, as are future series of podcasts and TAS Conversations, as well as TAS visits to Australia and Japan.

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