THE NATIONAL

ROBOTARIUM

PEOPLE CENTRED :: INTELLIGENCE DRIVEN

ANNUAL REPORT

2024

INTRODUCTION

The National Robotarium is a world-leading centre in robotics and AI at Heriot-Watt University.

Officially opened in September 2022, the National Robotarium is a Data-Driven Innovation hub, funded in partnership with The University of Edinburgh as part of the £1.5bn Edinburgh and South-East Scotland City Region Deal.

The purpose of the National Robotarium is to create innovative solutions to global challenges, working directly with industry to research, test and develop robotic, AI and automated technologies that have a positive impact on people's work, health and lives.

The National Robotarium is at the forefront of advancing the UK's robotics capabilities, developing talent, accelerating innovation and stimulating economic growth.

Through its globally significant work, the National Robotarium develops talent and shapes the future, having a positive impact on the economy and society.

FOREWORD

Professor Gill Murray,
Deputy Principal for Business and Enterprise,
Heriot-Watt University

It is my pleasure to present the 2024 National Robotarium annual report. As senior stakeholder for Heriot-Watt University, I've been proud to watch as the centre has continued to grow and mature in its operations over the last year, cementing its position as a fully-fledged centre of excellence for Robotics and Artificial Intelligence.

One of Heriot-Watt's first flagship Global Research Institutes (GRIs), The National Robotarium was created through support from the Edinburgh and South-East Scotland City Region Deal to **solve global challenges** through the application of robotics and autonomous systems.

The National Robotarium has provided a valuable blueprint that clearly demonstrates the positive societal and economic impact of merging ground-breaking science with new technologies for industrial application.

Our newer GRIs in Health & Care Technologies and iNetZ+ (Net Zero and Beyond), both of which began operating this year, complement the success of the National Robotarium as Heriot-Watt continues to build its credentials for centres for excellence and collaboration that leverage our global reach, our significant international collaborations and our **long-standing connectivity to business and industry**.

As Head of Enterprise and Business at the University, I take a particular interest in The National Robotarium's **thriving industry project portfolio**, as well as the business incubation and acceleration support it offers young and established start-up and spinout companies.

An example of this effective synergy I like to highlight is Frontier Robotics, a Heriot-Watt spinout from the ORCA (Offshore Robotics for the Certification of Assets) Hub. Frontier Robotics are advancing software for underwater robotic autonomy, working closely with global geodata specialists Fugro on the multimillion-pound UNITE project.

The National Robotarium has facilitated this partnership, with support from business experts and mentors from the University's GRID (Global Research Innovation and Discovery) team, helping them rapidly accelerate their technology and narrowing the gap from **scientific discovery to commercial application**.

Through this provision of business incubation and acceleration support, The National Robotarium is now **hosting 14 resident companies** who are benefiting hugely from being part of a major cog in the UK robotics machine. Some of these residents have already attracted significant backing from funders and angel investors, highlighting the importance of supporting emerging businesses, spinouts, and entrepreneurs in their innovation efforts—a central goal of Heriot-Watt's enterprise agenda.

In addition to its research and enterprise initiatives, the National Robotarium, in partnership with other universities, is **contributing to the growth of the UK's talent pool**. By offering transformative education that breaks down barriers within traditional student models, the National Robotarium is building understanding and skills in robotics, data, and AI for a diverse range of workers and learners. This work is crucial in ensuring that Scotland and the UK have the necessary skills and expertise in a future that will increasingly rely on automation and Artificial Intelligence.

The National Robotarium boasts an impressive and expanding team of engineers, scientists, business and project specialists, and technicians who are dedicated to demonstrating the many benefits that robots and AI can bring to people's lives.

Their outreach and engagement programme continues to manage huge demand from schools and community groups all over the country, **leading over 60 events in the past year**, spreading the positive message about robotics and highlighting the numerous opportunities that the future holds.

I eagerly anticipate the next phase of this journey.

FOREWORD

Professor Yvan Petillot and Professor Oliver Lemon,
Academic co-leads,
Heriot-Watt University

At the National Robotarium, it has been a pleasure to lead the centre's research agenda over the past 12 months, guiding the **growth and impact of science-led robotics** and fostering industry partnerships that focus on R&D, skills innovation, and commercialisation. This work is enhancing productivity and creating new, cross-institutional opportunities across various disciplines.

Academic staff at Heriot-Watt and The University of Edinburgh, as part of the Edinburgh Centre for Robotics, have continued to support this world-class, collaborative and multi-disciplinary research that underpins the next generation of robotic and AI technologies. Similar to other Global Research Institutes at Heriot-Watt, our research is challenge-led, working with experts and users from industry to ensure that the development of new technologies and robotic systems are fit-for-purpose in the real and commercial worlds.

Highlights from the past year have included reaching a milestone in the UNITE project, which has partnered with global geo-data specialists Fugro to develop autonomous and semi-autonomous remote-operated vehicles for underwater maintenance of offshore assets. The project team recently trialled the technology in the University's Ocean Systems Lab, moving the science once step closer from lab to market, which, if deployed on commercial vehicles, could not only remove humans from notoriously hazardous environments but also cut carbon emissions by up to 97%.

Another notable success this year was the installation of **generative AI-powered assistive robots** into an elder-care hospital in Paris. The ARI robots, programmed by researchers as part of the SPRING (Socially Assistive Robots in Gerontological healthcare) project, greeted patients, provided reassurance and advice, and were able to respond to questions, even within multi-party conversations. The success of the pilot has advanced us closer to a future in which robots can undertake tasks on behalf of humans, freeing them up to focus on more complex tasks and the things that humans do best; care, connect and empathise, all crucial characteristics, particularly within healthcare.

The impact and reach of these international studies has been global; with news of the UNITE project being picked up by over 100 news outlets, over four continents, and the SPRING project leading to features in TIME magazine and The Times newspaper, demonstrating the **global interest in accelerating robotic technologies** for the benefit of people, industry, health and the environment.

Significant progress has also been made this year laying the foundations for **more structured, collaborative research between Heriot-Watt and The University of Edinburgh**, with the publication of our nine key Research Themes, most of which are led in partnership between our institutions.

Many of our researchers at the Edinburgh Centre for Robotics are driving fundamental advances in topics such as **perception, planning, and language interaction**, thereby complementing our respective academic strengths to deliver richer, more robust scientific exploration and impact.

As for the year ahead, there are many exciting developments happening in the world of robotics and AI. The rapid adoption of generative AI models for robots, something our researchers have been testing for several years, will continue apace with robots utilising increasingly sophisticated large language models, such as Chat GPT, to improve communication and interaction with humans.

This progress in generative AI will also see a rise in interactive robots, making them much more capable and useful for **integration in people's homes and workplaces**. The costs of these robots will also likely reduce as manufacturing becomes faster and easier, scaling-up the development of lower-cost interactive robots.

However exciting this step-change is, handling it properly, and ethically, brings with it many new challenges. For example, how do we ensure that such new systems are safe? How should they be designed as to fit into human workflows and living spaces? And, perhaps most important, how can **generative AI robotic technologies be developed responsibly** so that they recognise and respect the diversity of human lives?

At the National Robotarium, we have been working on these challenges, and are well-placed to drive research and innovation in these areas. The National Robotarium's **state-of-the-art facilities** are also vital for data collection and evaluations with humans so that we can create the next generation of collaborative robots to support people in their work, and at home.

We are also looking forward to advertising the **first UK Robotics Summer School (UKRSS) in 2025**. Taking place from 2-7 June, the Summer School, supported by the partner universities and the UK-RAS Network, will cover a theme on each of the 5 days, from learning and reasoning to verification of AI. The full programme, available to view at **this link** once published, will be open to PhDs, Early-Career Researchers, seasoned academics and industry representatives.

We are looking forward to next year and remarkable progress expected in robotics and AI. It is now in our hands to educate, inform and ensure that the coming wave of robotics applications are safe, responsible, and of benefit to everyone in society.

WELCOME STATEMENT

Stewart Miller
Chief Executive Officer

Welcome to The National Robotarium's 2024 annual report. It's been another bumper year for us, with the team building upon last year in terms of outputs and achievements.

If our first year was focused on establishing The National Robotarium as a world-leading centre for robotics and AI, then Year 2 has concentrated on elevating that message to demonstrate how centres like ours are a **vital component to deliver growth and innovation on a national scale**.

The existence of The National Robotarium is thanks to government investment via the Edinburgh and South-East Scotland City Region Deal, signed 6 years ago alongside partners at Heriot-Watt University and The University of Edinburgh, to put the region on the global map of robotics, AI and data excellence.

Now the National Robotarium is **home to over 35 FTE staff, 14 startup and spinout robotics companies** themselves employing over 60 people, and a thriving portfolio of industrial engineering projects, a clear sign that this initial investment from government has led to a demonstrable blueprint for economic success.

It's imperative we don't lose this momentum. Which is why I've spent much of this past year engaging with policymakers from all sides, urging them to capitalise on that initial leap-of-faith and commit further investment into a **UK-wide network of Robotarium-like centres** that could propel us from a nation that's lagging behind other, comparable countries in terms of productivity and manufacturing capabilities to playing a significant role globally.

A turning point for this important work was the **launch of our 'Robotics Revolution' manifesto**, a 5-point plan to make the UK a leading player in the global robotics economy, predicted to be worth £283bn by 2032.

It was an honour to launch the plan at a special event in the Houses of Parliament in March, during which I, alongside speakers from science, government and our flourishing resident companies Touchlab, BioLiberty and Crover, outlined how the National Robotarium has delivered considerable return on investment so far and the **opportunity available to transform the UK economy** from robotics-buyers, dependent on foreign imports, to a leading robotics-producer.

Since March, conversations have been ongoing with decision makers in the Scottish Government on several fronts, including the potential formation of a 'super cluster' to provide infrastructure and expertise for growing robotics and tech companies to scale manufacturing and enter the supply chain, and Robotics Scotland, a developing industry organisation that would oversee and support the delivery of Scotland's burgeoning robotics sector.

These many discussions have been fruitful; in the latter part of this year, the National Robotarium was included alongside Scottish Enterprise and NMIS (National Manufacturing Institute Scotland) as exemplars for emerging tech and innovation in the Scottish Government's Programme for Government, which was subsequently backed-up with a commitment of £321 million in the Scottish Budget for enterprise agencies supporting emerging tech, AI and robotics.

Furthermore, my team and I have also been advising key stakeholders in the civil service and the new Labour-led UK Government, who are showing real commitment to stimulating the economy through increased capital investment, building the UK's science and innovation capabilities, improving efficiencies in the NHS (National Health Service) through digital transformation, and renewing its industrial strategic goals.

I was honoured to be asked to contribute to a recent report focused on the next wave of robotics by the Tony Blair Institute for Global Change. The policy recommendations published in the report aligned very closely with our call to create a UK Robotics Strategy alongside a network of robotics centres, with myself and the National Robotarium namechecked several times across the publication.

As well as our work this year informing policy – on which you can read more in this report – we have continued with the day job of developing robotic solutions to address industry challenges with our dedicated engineering team delivering several successful robotic prototypes, working closely with industry clients from sectors ranging from

pharmaceuticals and utilities to food and drink to improve safety, efficiency and productivity through robotics and automation.

Our outreach and engagement team have also been working tirelessly to extend and enhance our schools and events programmes, having engaged with around 20,000 school-aged children and robot enthusiasts of all ages since our inception, highlighting the positive benefits that robotics can bring to people's work, lives and health, and inspiring the next generation of programmers, engineers and STEM minds.

We're also excited to soon be **launching our 'Robotics Readiness' programme**, which will help industry gauge how robotics can improve their business, while reskilling and upskilling the existing workforce, plugging future skills gaps and ensuring that, in the Robotics Revolution, no-one gets left behind.

We are also fostering a number of research projects with colleagues from our partner institution The University of Edinburgh, highlighting the benefits of working across disciplines and HEIs, and cementing the success of ongoing joint ventures like the Edinburgh Centre for Robotics research and student programmes.

This year also included the successful delivery of our **first joint event with one of our Data Driven Innovation (DDI) partner hubs**, when our newly installed, highly sophisticated humanoid robot Ameca, and Head of Robotics Dr Ingo Keller joined renowned author Jeannette Winterson on stage for the official launch event of Edinburgh Futures Institute.

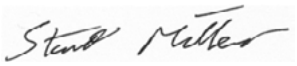
This marks the first of what I hope will be many more events with our DDI partners, showcasing the collective power of partnerships and synergy across our esteemed institutions.

Our global reach and engagement across our digital channels has maintained steady growth across the year with **our LinkedIn page now followed by 7600+ accounts**, a leap of over 30% since last year. And we've branched into new channels with the launch of the National Robotarium Instagram page, which showcases the people and robots that are making everything happen behind-the-scenes at our world-leading facility. Instagram is also where we'll share snippets from the wide variety of events hosted in the centre, which, this year have included supplier exhibitions, academic talks, government committee meetings and tours, schools and outreach visits, robotics competitions, and celebrations, including our 2nd birthday party!

It is ultimately the people in our team that make all of this happen and they continue to impress me with their dedication, innovation and hard work. It is through their efforts that after just two short years we are so advanced in what we set out to achieve.

I hope you enjoy reading about these and other developments from our second year in this report. As for the next 12 months, we will continue to work hard to deliver our goals, creating robotic innovations, forming new partnerships, inspiring and engaging the public and supporting the UK in realising its robotics potential.

I can't wait.



The National Robotarium celebrates its 2nd anniversary (September 2024)


THE NATIONAL
ROBOTARIUM

OUR MISSION

Our mission is to use robotics and AI to:

- **Help keep us safe;**
- **Help keep us healthy;**
- **Help us be productive;**
- **Help us develop talent;**
- **Help us shape the future**

OUR FACILITY

Our stunning £22.4m, purpose-built facility, located on Heriot-Watt University's Edinburgh campus, has unrivalled laboratories and collaboration spaces for the testing and development of robotics and AI solutions.

Our scientists and robot engineers work with s**pecialist, high-spec equipment** and technologies that facilitate cutting-edge research and development across **Robotics and Autonomous Systems** (RAS), **Human-Robot Interaction** (HRI) and **Precision Laser Applications** (PLA).

The physical presence of the National Robotarium provides access to a range of incubation and colocation spaces, test facilities – including a wave tank and outdoor testing area – lab spaces, makerspaces, 3D printing facilities and, of course, robots. In the past year, connectivity within the facility has been upgraded with a pop-up private 5G network installed to support robotic testing outdoors.

The layout of the National Robotarium was designed to promote **open collaboration** by placing our distinct research labs around an eye-catching and welcoming Atrium space.

The facility provides physical and visual transparency and connectivity for all building users, the mix of space types and finishes complementing the overall experience and has instantly become recognisably the **face of robotics in Scotland**.

The award-winning National Robotarium facility* was designed with **sustainability and energy efficiency at its heart** and boasts an intelligent facade, clean energy and EV charging points.

** Winner of the Learning Places Scotland Project of the Year 2023. Highly Commended for Architectural Excellence, Scottish Property Awards 2023.*

OUR LABS AND ROBOTS

Robotics and Autonomous Systems (RAS)

The Robotics and Autonomous Systems lab focuses on the application of robotics and automation for industry. Through the testing and development of a range of mobile robotics, quadrupeds, underwater ROVs (remote operated vehicles), co-bots and autonomous all-terrain vehicles, our team of RAS Engineers and researchers are exploring ways that companies, from SMEs to large international conglomerates, can adopt robotic solutions to improve efficiency, staff safety and reduce costs.

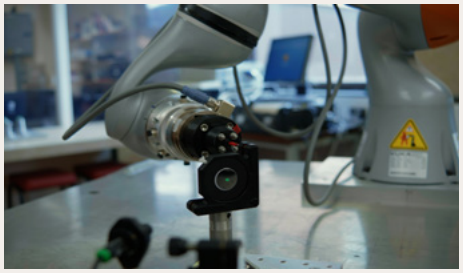
RAS Robots include:

Spot

Created by Boston Dynamics, the Spot quadruped is an agile mobile robot that can navigate a diverse array of terrains. Remotely-operated, Spot can be automated to undertake routine inspection and data capture tasks, and can also be used in hazardous environments such as construction sites or disaster zones.

KUKA lightweight robotic arm

The KUKA is the world's first co-bot. It takes on production steps can be dull, dirty or dangerous for people, working with them side-by-side to ensure processes are optimised for maximum performance and productivity.

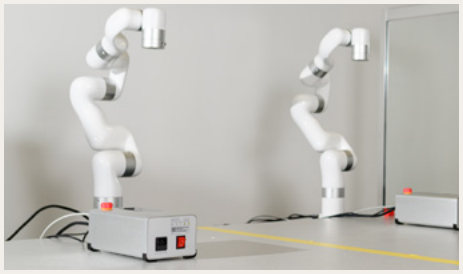


RB-Kairos

The RB-KAIROS+ is a mobile manipulator designed to offer unlimited movement within cobot workspaces. It has plug & play integration and can be programmed to undertake a variety of mapping, maintenance and pick-and-place tasks.

Mir - Mobile Industrial Unit

The Mir robot is an automated load-carrying system for use in warehouse logistics and transport. It uses in-built cameras, lidar scanners and sensors allow it to avoid collisions and navigate safely around people and obstacles in indoor areas. The Mir model's fleet management software allows multiple robots to work in synchronicity, each with the ability to carry a payload up to 250kg.



Robot Station

With multiple 'pick and place' robotic arms available, businesses can work with our robotics engineers to test and de-risk automation processes that could increase productivity and efficiency in a variety of different sectors.

Precision Laser Applications

The Precision Laser Application (PLA) labs research laser-based applications from a micro to macro scale. Research groups based within the labs are the Applied Optics and Photonics Group (AOP), with a focus on the development of novel processes ranging from **fibre-optic sensors**, **laser surgery** and **laser-based manufacturing**; and the Photonic Instrumentation Group (PHI), who investigate multidisciplinary light applications, including ultrafast laser inscribed waveguides, optical fibre probes, and single photon-sensing techniques. The PLA lab research can be applied to healthcare and astronomy, amongst other sectors.

HRI robots in the Laboratory for Assistive Robotic living

Human-Robot Interaction

Our Human-Robot Interaction labs are specially-designed reconfigurable experimental spaces for studying how humans interact with and respond to robots. HRI projects focus on the development of generative AI and Large Language Models (LLMs) to build **conversational robots capable of collaborating safely with humans**, as well as multimodal language learning, and the use of sensors and **IoT (Internet of Things)** to provide assistive living support and monitor wellbeing. The team address scientific and technical challenges that underpin the next generation of **user-centred healthy ageing** and independent living systems, including how to **build human trust in robots** to encourage adoption.

Our Laboratory for Robotic Assistive living (LARA) allows testing and development of these assistive robots and artificial intelligence technologies in a two-bedroom, fully accessible model home. **LARA provides a testbed to emulate and assess natural living habits**, leading to more practical and effective solutions for people with assisted living needs.

HRI Robots include:

Ameca

Created by UK company Engineered Arts, Ameca is one of the world's most advanced expressive humanoids. With sophisticated features, including facial recognition software, embedded microphones, cameras and articulated motorised components, Ameca's technology, powered by generative AI, enables next-level human-robot interaction in a natural and engaging way.

Tiago

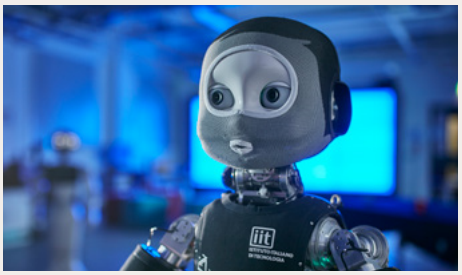
The assistive Tiago robot combines perception, navigation, and mobile manipulation for application in healthcare and other industry sectors that involve ambidextrous activities. It has recently been deployed to a Blackwood Homes and Care residential facility supporting staff and residents in cases where additional help or contact is required.

Temi

An autonomous AI smart assistant, Temi is being customised by HRI researchers to support assistive living. With telehealth, remote assistance and patient monitoring capabilities, Temi can provide a safe and secure platform to help people live independently, for longer.

iCub

iCub is a 1 metre tall open source robotics humanoid robot testbed for research into human cognition and artificial intelligence. It utilises embodied AI algorithms and supports research into neurorobotics applications.

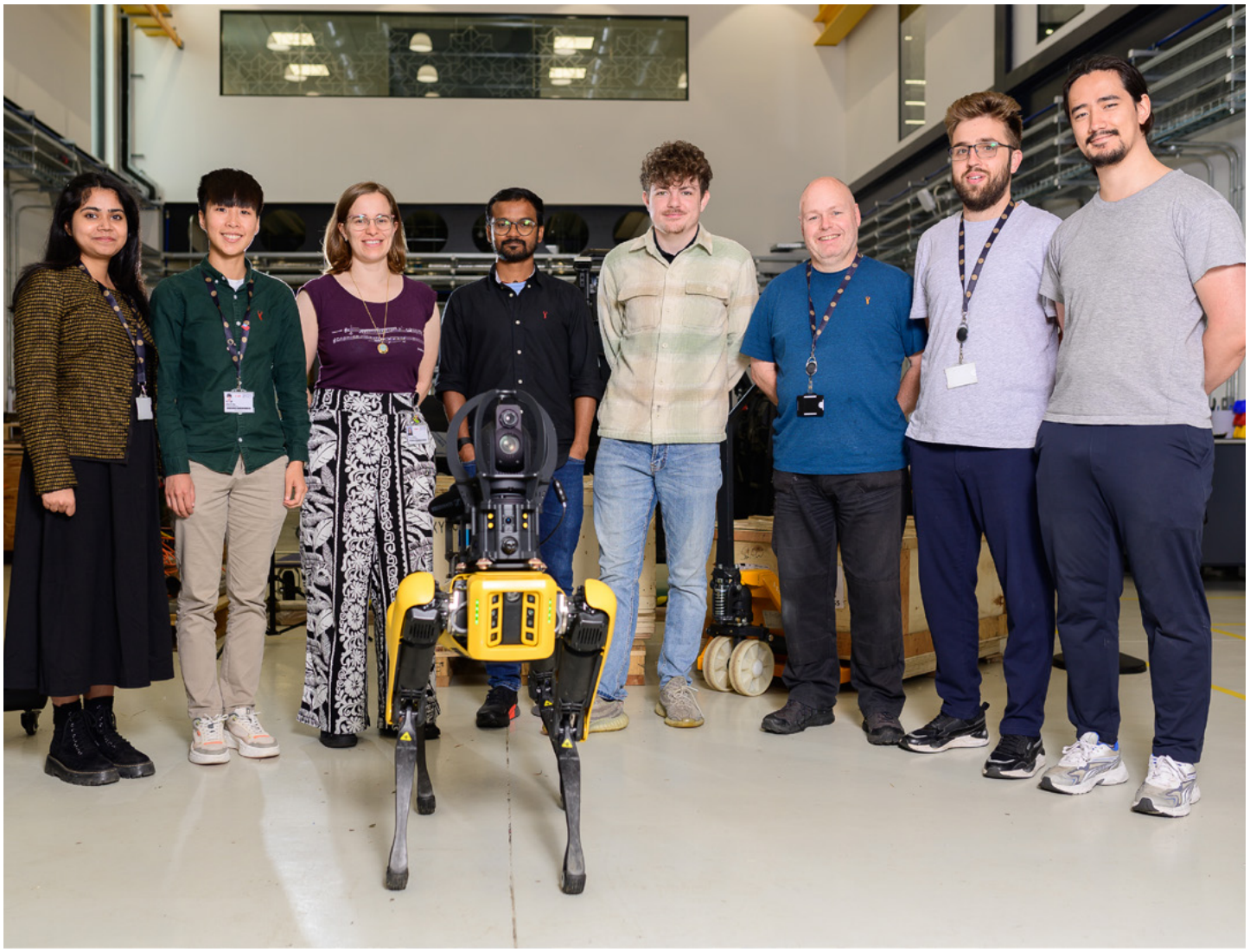


ARI

These high-performance social and collaborative humanoids are designed to interact with humans via speech and movement, utilising its machine learning to conduct multi-way conversations and respond to general enquiries. It can also support self-guided patient rehabilitation exercises through physical demonstrations, progress monitoring and verbal encouragement.

Pepper

The world's first social humanoid robot to recognise faces and basic human emotions, Pepper is optimised for human interaction, engaging people with its conversational AI and touchscreen.



Our dedicated Robotics Engineering team work side-by-side with industry to develop bespoke robotics solutions

DEVELOPING SOLUTIONS FOR INDUSTRY

Informed by sectoral needs, we work collaboratively with partners around the globe to define, develop and resolve industry challenges through the application of Robotics and AI.

Our **dedicated Business Development team** connect with a wide range of sectors, working closely with industry leaders to understand the challenges facing their business and exploring how robotics and AI can address them. Whether it's developing assistive robots to work alongside staff, easing workloads and augmenting the user experience, to creating bespoke autonomous and semi-autonomous systems that can reduce costs, increase productivity and improve safety, our team will help identify and de-risk the best robotic solution.

Once on-boarded, new industry projects are assigned member(s) of our **Robotics Engineering team**, dependent on the skillset and expertise required for developing the robotics prototype or proof-of-concept.

Throughout the process, clients will be looked after by one of our expert team of **Project Managers**, who will create a clear project timeline based on the client's needs, ensuring key milestones are delivered on-time and within budget.

Working with the National Robotarium can add value to industry by reducing cost, risk and time-to-market.

HELPING INDUSTRY PREPARE FOR THE ROBOTICS REVOLUTION

The National Robotarium is committed to advancing robotic solutions to address real-world problems.

A key challenge for many industries is the ability to adopt robotics, automation and AI into the workplace efficiently, and at scale.

We **collaborate with industry partners across multiple sectors** to explore safe, reliable and practical robotic applications. We create robotic solutions that work for – and with – people, helping them do things better whilst directly addressing business needs.

Many of our research grants support both fundamental research and translation activities and through this mechanism our relationships with industry are becoming deeper and stronger.

We have a broad portfolio of industry projects covering sectors including:

- Food and drink
- Pharmaceuticals
- Utilities
- Retail
- Testing and certification
- Security
- Health and patient care
- Construction
- Offshore and renewable energy
- Manufacturing

In 2025, The National Robotarium is also l**aunching its robotics-readiness programme**, a step-by-step assessment based on our unique robotics roadmap, for industry representatives to understand how to integrate robotics into their business.

Through self-driven assessment tasks, participants will be able to strategically evaluate how, and where, robotics can be used to enhance their operations. The programme goes beyond the principle that simply adopting more robotics will help future-proof businesses and delves into the many factors that need to be considered to ensure their success.

These include:

- Understanding **different types of robots** and what would work best based on size, cost, functionality, control system, battery life etc.
- Where in business robotics can create value. Whether it's by improving workplace safety, increasing productivity or supporting staff, it's important that any investment into robotics yields positive results for business owners and their employees.
- How to scale up, ensuring functionality can be evolved quickly and cost effectively within existing infrastructures.
- **Investment into staff training** – for handling, co-working, and troubleshooting if something goes wrong.
- Health and safety in relation to co-bots e.g. humans and robots working side-by-side.
- The key elements of supply and demand, making sure these are in sync and governed effectively before integrating new robotic technologies.

Our robotics-readiness professional development programme – launching in 2025 – will include a half-day workshop and bespoke business development support

FEATURED INDUSTRY PROJECTS AND PARTNERSHIPS

Northumbrian Water Group Innovation Festival 2024

For the second year running, The National Robotarium team were at the 2024 **NWG (Northumbrian Water Group)** Innovation Festival, leading innovators, creators and robot enthusiasts for special, robotics-themed design sprint.

Held over 5 days in July, the sprint explored the use of robotics to improve the safety and efficiency of water and wastewater inspections. One of the resultant ideas, a soft robotic application for water filtration units, received £25k of seed funding to advance the potential of the technology, successfully producing a proof-of-concept within 8 weeks. The team are aiming to secure additional funding to continue its development throughout 2025.

A soft robotics prototype control system developed by National Robotarium engineers in partnership with Northumbrian Water Group

ACS Clothing

This year, we entered into an accelerated Knowledge Transfer Partnership with circular fashion company **ACS**. Based in Glasgow, they're working with fashion brands and retailers, enabling them to join the circular economy by offering a clothes cleaning and repair service, often with items returned by customers, giving them a new lease of life.

The partnership aims to **develop a novel garment identification and sorting system** with The National Robotarium developing advanced robotic and AI tools to support ACS' mission to enable UK-based circular fashion to eschew the principles of the often exploitative and environmentally damaging fast fashion movement.

Longer term, we foresee working with ACS Clothing to identify additional processes within their business model that could benefit from robotic integrations.

Corps Monitoring

In June this year, the National Robotarium signed a new MOU (Memorandum of Understanding) with Corps Monitoring, a specialist in security solutions, to **improve security and monitoring services for the social care sector.**

The agreement will underpin the safe development of technologies, such as assistive robots and smart sensors, in assisted living environments.

Corps Monitoring, a division of Corps Security, will apply its extensive expertise to ensure these technologies are deployed safely with enhanced cybersecurity to protect patient data and information.

"The advancement of technology is moving at such a rapid pace. This partnership won't just allow us to 'keep up' but to be ahead of the curve. By focusing on innovations that not only enhances independent living within the varying care sectors but aids the security and other sectors in general.

Andrea Strong,
Managing Director,
Corps Monitoring

The National Robotarium at the MOU signing with Corps Monitoring

Engineers from The National Robotarium visiting soft robotic project partners Senai Cimatec in Brazil

Senai Cimatec

In partnership with **Senai Cimatec**, a scientific and technological education institution in Brazil, engineers at the National Robotarium, Dr Alix Partridge, Hsing-Yu Chen and Kyle Walker developed a **new soft robotics solution** that could revolutionise onshore and offshore inspection.

The 'tentacle', an agile, remotely-operated flexible robot manipulator, has the ability to traverse narrow and irregular environments in both water and air, common in offshore structures, **providing a lower-cost, safer alternative** to human operation in hazardous conditions.

The success of this project marked an important milestone for the facility as the soft robotic solution was the **first system to be fully-created from scratch by the National Robotarium team**.

As well as the technology featuring in several academic papers, the team are aiming to develop it further for potential deployment by commercial partners.

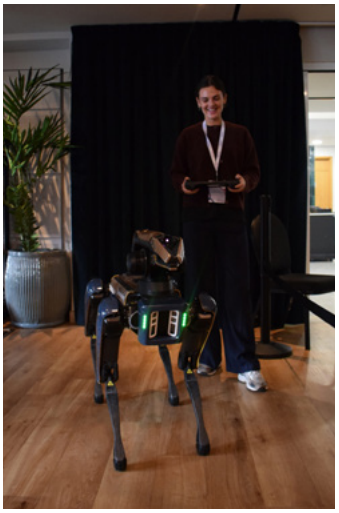
UKRAS-STEPS Network

In March, the National Robotarium was announced as a partner in the **UK Robotics and Autonomous Systems Strategic Technical Platform** (UKRAS-STEPS), a 3-year project to support and enhance training and development for technical research staff.

With the backing of funding from the UKRI Engineering and Physical Sciences Research Council (EPSRC), **UKRAS-STEP** is strengthening the UK's Robotics and Autonomous Systems capabilities, improving the long-term career prospects of Research Technical Professionals (RTPs) and create stronger links between academia, industry and government.

Overseen by Chief Operating Officer, Steve Maclaren, The National Robotarium leads on the Task Groups work package, **hosting professional development placements for RAS technicians** from across the UK, who will work within the facility on bespoke projects, with additional opportunities for training, networking and mentorships.

In September, Steve, along with Senior Technician Thomas McGravie, Robotics Engineer Hsing-Yu Chen and Events Lead Emily Fletcher (pictured), joined the first all-hands workshop in Leeds, working through the six key areas of the programme alongside representatives from the network consortium of 37 universities.



In December, we hosted our first secondment placements, inviting technicians from institutions in York and London to spend a week working with the National Robotarium technical and engineering teams, learning more about the facility, sharing skills and best practice, and exploring potential collaborations.

Research technicians from UKRAS-STEPs on secondment at the National Robotarium, alongside Project Manager Catherine Ciarka-White

"Research technicians are the backbone of world-leading research into Robotics and Autonomous Systems, providing a wealth of technical expertise and operational support...Without them, we would be unable to maintain and manage essential research components, so it is vital that our community of technical research professionals feel valued with opportunities to develop and grow."

Steve Maclaren,
Chief Operating Officer,
The National Robotarium

Whyte & Mackay

Whyte & Mackay, is a leading whisky maker, with a portfolio of multi-award-winning Single Malt Whisky brands, and seven sites across its Distilling Function in Scotland. The company partnered with The National Robotarium to explore advancing robotics and innovation within their operations.

As a manufacturer Whyte & Mackay produce high volumes of bottled consumer goods that include the UK's Number 1 Single Malt - Jura, meaning Health and Safety is a priority for the business. The projects focus on identifying tasks that are repetitive or represent risk in the work place. Together we explored how automation and robotics can strengthen the approach to managing the process and transform operations. By strengthening capabilities and driving innovation within Scotland, the collaboration aims to enhance efficiency, improve workplace safety, and lay the foundation for meaningful technological advancements within Whyte & Mackay's operations.'

Filament STAC – Smart Things Accelerator Centre

The National Robotarium has entered a partnership with **Filament STAC - Smart Things Accelerator Centre** to support the next generation of Scottish entrepreneurs. The partnership combines resources to offer robotics and autonomous systems start-ups mentorship, education and enhanced business acceleration support across Scotland, including co-working spaces at the National Robotarium in Edinburgh and STAC's Glasgow facility.

"The National Robotarium will bring expert robotic engineering support to further boost STAC's capabilities in smart and connected products. The partnership made perfect sense, and at the core is our shared mission to position Scotland as a centre of excellence in smart things, IoT technologies, and robotics."

Paul Wilson,
CEO, STAC

Co-working spaces at the National Robotarium

Freshwave 5G

Since its launch, The National Robotarium has been committed to advancing the centre's capabilities to ensure the facility remains at the cutting-edge of technology.

We have been working with Freshwave, experts in digital infrastructure and innovation, on the **deployment of a portable, private 5G network** to support the testing of robotic systems in remote or rural areas. The collaboration has made incredible progress this year with a successful trial utilising the network to support the Boston Dynamics Spot robot in an agricultural data mapping and live streaming exercise.

CEED - cybersecurity essentials

The National Robotarium - alongside Technology Scotland and CeeD (Centre for Engineering, Education and Development) – have joined forces to support ScotlandIS in the delivery of its Cyber Essentials Grant, which provides funding of up to £1000 to secure CE certification.

The fund - backed by The Scottish Government – has been distributed to eligible companies operating in emerging technologies, including robotics, photonics and manufacturing.

The pop-up 5G network is being tested for use with robots in rural or remote areas

Skedda

To support the management of the National Robotarium's flexible laboratory, office and events spaces, we have been working with Skedda since September 2022 to **create a bespoke booking system** that is suitable for use by both internal (core team, engineers, researchers etc.) and external (e.g. resident start-ups) stakeholders.

This year has seen the culmination of that partnership thrive with the 'NR Booking System' providing effective support to the myriad of activities that go on at the facility. As well as a simple on-boarding process, the system offers user-friendly floor plans, space descriptions, software integrations, and analytics on how the spaces are being occupied throughout the year.

A **case study on the partnership** featuring COO Steve Maclaren, who spearheaded the relationship, was published this year. Steve also took part in a global **webinar on Effective Workplace Management**, chaired by Skedda Senior Vice-President Jenny Moebius.

The National Robotarium's bespoke booking system by Skedda supports access to the facility's flexible meeting spaces, labs and equipment

Ameca, one of the world's most advanced humanoids

One of the 'world's most advanced' humanoid, Ameca, moved into the National Robotarium in April 2024. The robot, which can wink, laugh, shrug and crack jokes, is being used as part of the facility's outreach and engagement work with schools and the general public.

Created by **Engineered Arts Ltd**, Ameca's sophisticated features include embedded microphones, cameras, facial recognition software, and articulated motorised components, which enable human-robot interaction in a natural and engaging way. More than transactional, The National Robotarium has retained close ties to the British company, sharing best practice and bridging the gap between science, engagement and entertainment.

News of Ameca's arrival garnered widespread media coverage with nearly 200 outlets sharing the announcement. Chief Operating Officer, **Steve Maclaren**, featured on a number of radio interviews, including BBC Radio Scotland, Forth Radio, and The Times Radio, Business Development Manager **Lisa Farrell** spoke about the robot on **BBC** Radio 4's Today programme, and ITV visited the facility for an exclusive broadcast feature about Ameca's role in our schools and outreach programme.

"At The National Robotarium, we value our ongoing relationships with global robotics companies like Boston Dynamics, ensuring that together we can advance knowledge, share best practice and accelerate the Robotics Revolution worldwide."

Dr Ingo Keller,
Head of Robotics

The Ameca humanoid robot by Engineered Arts

Boston Dynamics

We have strengthened our relationship with another pioneering robotics manufacturer, Boston Dynamics, this year. With their blessing, we **customised one of our Spot quadruped robots for an international showcase campaign** for Scottish industry. Led by the Scottish Government marketing arm, Brand Scotland, Spot was filmed traversing the National Museum of Scotland after hours, to highlight how the nation is bridging old traditions with emerging technology and innovation.

We were also thrilled to host **Academia and Research Sales Manager Debbie Cole**, who visited the facility during a trip to the UK in October.

Debbie met with COO Steve Maclaren, Schools and Industry Engagement Lead Blair Wilson and Head of Robotics Dr Ingo Keller for a tour and discussion on how we're utilising our Spot robots, including in live industry projects and engagement with schools and educators across the UK.

Left right: Steve Maclaren, Debbie Cole (Boston Dynamics), Dr Ingo Keller, and Blair Wilson

Thermo Fisher

The National Robotarium has forged a strong partnership with global leaders in scientific services and products, Thermo Fisher Scientific, supporting them to identify operational and business challenges that could be addressed through robotic solutions.

So far, the collaboration, also supported by leading experts from Edinburgh Business School, has **delivered a bespoke, rapid proof-of-concept project** focused on automated supply of production lines. A number of MSc Robotics with Industrial Applications students were recruited, as part of a paid internship, to help deliver the solution, enhancing their theoretical learning and deepening their understanding of real-world applications of robotics with a major industrial partner.

Since then, the **consortium has worked together to co-produce and design a Robotics Roadmap**, a methodology that helps identify, score and prioritise projects that could benefit from robotic integration. Through its holistic approach – which considers everything from business need and budget to staff safety and wellbeing – the tool, which was funded by an accelerated Knowledge Transfer Partnership, **helps derisk the deployment of robotics** within existing infrastructures and allows for better multiyear planning.

GROWING THE ENTERPRISE ECOSYSTEM

The National Robotarium plays a crucial role in growing the UK's robotics ecosystem and capabilities. We seek to augment the existing framework and provide a bridge to connect members of our network to world-leading science and technology, industry expertise, funding and investment, government, regulators and manufacturers, cementing the UK's reputation as a main player in the global robotics community.

Business support

We offer **business acceleration and incubation support to start-up tech companies, spin-outs and SMEs**. As well as providing access to office space, labs, equipment, technical and engineering expertise, we act as a **gateway to the Scottish and UK robotics networks**, funding, and Government support.

Industry residents

The National Robotarium is now **home to over a dozen start-up robotics companies**, providing them with incubation space and access to the facility's state-of-the-art labs, technology and robotics expertise, aiding the development of their technologies and accelerating their business.

Industry residents

Touchlab

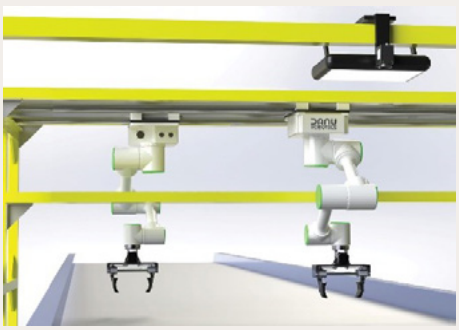
The first start-up robotics company to move into the National Robotarium, Touchlab are developing and manufacturing a **biomimetic e-skin system that allows robots to 'feel'**. Their unique nanotechnology enables operators to remotely manage pressure, location and direction in real-time. The team have successfully piloted their technology with assistive robots in a healthcare setting, supporting the delivery of basic tasks that can help reduce workload pressures on staff and minimising the spread of infections or diseases.

www.touchlab.io

Bioliberty

Technology firm Bioliberty – a spinout from The University of Edinburgh – have created Lifeglov, **a soft robotic glove** the provides resistance and monitors key metrics to help patients of traumatic and degenerative conditions develop and **rebuild their hand strength**. Through the combination of robotics, digital signal processing and machine learning, Bioliberty are at the forefront of the next generation of rehabilitative and assistive devices.

www.bioliberty.co.uk



Danu Robotics

Moving into the National Robotarium in 2024, Danu Robotics manufacture **recycling waste-sorting robots**. The team are utilising the facility's Robotics and Autonomous Systems lab to develop their patented series of robotics, AI and computer vision technologies to pick and sort dry mixed recyclable materials.

www.danurobotics.com

Metacarpal

Metacarpal Ltd are the creators of the **world's first prosthetic hand that is completely controlled and powered by body motion**. Through high-performance engineering, their technology offers adaptable grasp, fluid motion and variable grips, providing users with a highly-functional yet comfortable prosthesis.

www.metacarpal.co.uk

Konpanion

Integrating artificial intelligence with elegant design, Konpanion are pioneers in **domestic robots for the home**. Their first creation, the 'Maah' robot, synergises textile design, machine learning and movement for a soft, squishy (allergy-free!) robot pet, which aims to enhance people's wellbeing with tailored companionship and non-invasive monitoring of those with additional needs.

www.konpanion.com

Crover

Crover are a grain storage management company that develop a range of **'grain-swimming' robots for the agriculture sector**. With their unique portable robotic solution, their aim is to optimise grain storage conditions, reducing waste and improving staff safety.

www.crover.tech

Frontier Robotics

A spinout from the ORCA (Offshore Robotics for the Certification of Assets) Hub, led by Heriot-Watt University, Frontier Robotics are **advancing software for autonomous underwater robotic exploration and inspection**. Their revolutionary system is being developed for industry giants in the offshore energy sector ocean economy to undertake safe and sustainable asset inspections and marine exploration using ROVs (remote-operated vehicles) autonomous underwater robots

Launching our policy plan 'Reaping the Rewards of the Robotics Revolution' at the Houses of Parliament, March 2024

ENGAGING WITH GOVERNMENT

Investment into the creation of the National Robotarium by the UK and Scottish Governments has cemented its strategic role in growing the UK's robotics capabilities.

Throughout 2024, the facility has been a beacon for highlighting the UK's robotics capabilities and talent amongst decision makers. Through sustained engagement with key figures in government and policy, we are passionate about highlighting the many economic benefits that are possible through greater investment into robotics technologies, innovation and manufacturing and most importantly the **enabling infrastructure for innovation and adoption in robotics**.

The success of the National Robotarium in its first two years has demonstrated that the model works - driving increased productivity, accelerating product and technology development, growing talent and skills, and improving public understanding and perception of robotics.

"The global robotics market is poised for explosive growth; expected to surge from $72 billion in 2022 to an estimated $283 billion by 2032. This represents an unprecedented opportunity for economic growth and job creation. "

Stewart Miller,
CEO, The National Robotarium

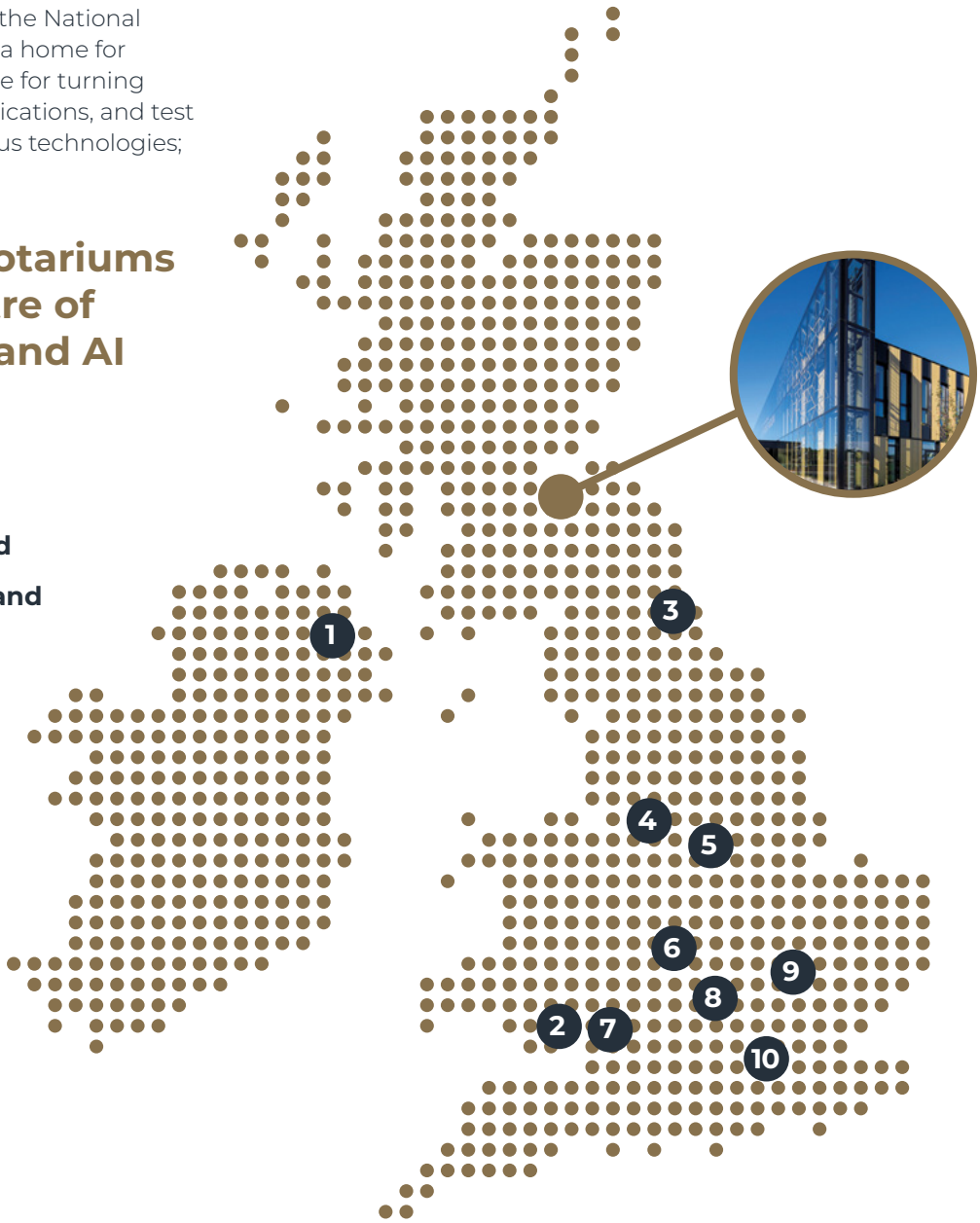
The National Robotarium has significantly advanced its policy engagement with **both Westminster and Holyrood** through strategic initiatives and sustained stakeholder outreach. A cornerstone of this work was the launch of an ambitious 5-point plan policy document, **Reaping the Rewards of the Robotics Revolution**, in March 2024. Delivered at the Houses of Parliament in Westminster, the event, attended by MPs, government advisors, civil servants, scientists and industry leaders, has helped shape discussions with key government departments including DSIT, NHS, Innovate UK, and UKRI.

A 5-Point Plan to the UK at the Heart of the Global Robotics Revolution

1. **Create a Robotics UK agency** to develop a robotics industry strategy that ensures the UK doesn't miss out on economic growth and high-quality job;
2. Invest in **ten new Robotarium centres across the UK**, based on the successful model of the National Robotarium in Edinburgh – providing a home for innovative young businesses, a crucible for turning scientific research into real-world applications, and test centre for new robotic and autonomous technologies;
3. **Build industrial clusters around new Robotariums**, based on the 'Triple Helix' model (industry / academia / government), with specialisms based on regional specialisms and needs;
4. **Create a manufacturing base** within these clusters, allowing a path for innovation, testing and design without companies having to leave the UK;
5. Work with academia and industry to **produce a report on the future of talent and skills in robotics**, identifying and addressing gaps and opportunities in education at schools, colleges and universities;

A network of new Robotariums to make the UK a centre of innovation in robotics and AI

1. **Belfast**
2. **Cardiff**
3. **Newcastle, North East England**
4. **Manchester, North West England**
5. **Sheffield, Yorkshire**
6. **Birmingham, The Midlands**
7. **Bristol, South West England**
8. **Oxford**
9. **Cambridge**
10. **London**



Tony Blair Institute Report

The National Robotarium was a key contributor to **'A New National Purpose: The UK's Opportunity to Lead in Next-Wave Robotics'**, a policy document produced by the Tony Blair Institute for Global Change.

In the report were a number of recommendations greatly aligned to our own campaign, including the creation of a UK Robotics Strategy and network of specialised robotics facilities across Great Britain and Northern Ireland, **emphasising the urgency for greater investment** and highlighting the critical role of collaboration between science and industry.

The report's publication garnered media coverage across the UK, including in The Times, which included quotes from our CEO Stewart Miller, who was interviewed by the Tony Blair Institute specifically for the report.

UK Parliament debate – Scotland's Economy

The National Robotarium was praised by Dr Scott Arthur, Labour MP for Edinburgh and South-West Scotland, in a **UK Parliament debate on 'Scotland's Economy'**.

The facility was highlighted as a globally-significant example of how Scotland's innovation centres are stimulating economic growth through business support and market-driven research and development.

Government Office for Science Rapid Technology Assessment of Service Robots

Head of Robotics, Dr Ingo Keller, was invited to give evidence at a **private roundtable event chaired by the Government Chief Scientific Adviser (GCSA)**, Professor Dame Angela McLean at the UK Government offices in Westminster. The discussions explored recent trends in AI and robotics, and how the UK can overcome challenges and barriers to realising greater adoption.

Alongside Ingo were contributors from the UK robotics industry, members of the Department of Science, Innovation and Technology, and the Minister for Science, Lord Patrick Vallance.

Deputy First Minister announces new £5m fund for enterprise

On 20 May, the National Robotarium was proud to host Deputy First Minister (DFM) and Cabinet Secretary for the Economy, Kate Forbes MSP.

The DFM chose the UK's centre for robotics and AI as the venue to **announce a new £5 million funding package**, created by the The Scottish Government to boost the economy and attract international investment.

Targeted at start-up businesses, spinouts and female entrepreneurs, the scheme helps to deliver end-to-end support as part of the government's ongoing commitment to developing a world-class technology sector in Scotland.

CEO of the National Robotarium, Stewart Miller, was involved in shaping the Tony Blair Institute report on Robotics

Conan Bradley (Bioliberty) alongside Lisa Farrell, Deputy First Minister Kate Forbes MSP and Scottish entrepreneurial expert Mark Logan

During the visit, the DFM, alongside then-Chief Entrepreneurial Advisor to the Scottish Government Mark Logan and tech entrepreneur and investment partner Ana Stewart, met with our industry residents Bioliberty, Touchlab, Crover, Danu Robotics and Frontier Robotics, to hear directly how being located at **the National Robotarium has been vital for enabling them to accelerate their technologies** and grow their businesses.

The Scottish Programme for Government

The National Robotarium was included in The Scottish Government's Programme for Government, when it was announced in September. First Minister John Swinney MSP, **highlighted the centre's credentials**, alongside other enterprising agencies including Scottish Enterprise and the National Manufacturing Institute Scotland, in **growing the nation's most promising deep tech businesses** through the formation of clusters of research, manufacturing and innovation.

Motion in Scottish Parliament – 2nd anniversary

Local MSP for Edinburgh Pentlands, **Gordon MacDonald lodged a motion in the Scottish Parliament** congratulating the National Robotarium on its second anniversary.

In **the motion,** he outlined how the National Robotarium is advancing Scotland's position at the forefront of global robotics innovation, highlighting its achievements across business acceleration, robotics for healthcare, and outreach and engagement.

The motion received strong cross-party support, meeting the criteria for a Members' Business debate.

CEOs from NHS Scotland met to discuss how robotics can address key issues facing the healthcare sector

NHS Scotland Chief Executives Annual General Meeting

In September, the National Robotarium hosted **NHS Scotland** Chief Executives and senior leaders from healthcare and government for two days of meetings and discussions on key issues facing the healthcare sector in Scotland.

CEO at The National Robotarium **Stewart Miller** and Business Development lead **Lisa Farrell** presented on the **potential of robotics technologies to help alleviate waiting lists and ease staff pressures**, and underlined the role the centres like the National Robotarium can play in supporting the exploration of new models to fast-track and de-risk innovation in the sector.

Scottish Development International

This year we have **hosted several tours with international ambassadors**, led by Scottish Development International (SDI), the international arm of Scottish Enterprise, to promote Scotland as a place for investment and trade. In the past year, our team has been in discussion with representatives from countries including **Spain, Austria, India and Belgium** about potential collaborations, expanding the Scottish science and technology ecosystem overseas and helping to grow the nation's reputation in robotics and AI.

The National Robotarium was also featured in **Why Scotland could be the right location for your business**, an SDI digital campaign to **promote the nation as an epicentre of innovation and entrepreneurship** and attract inward investment from overseas developers.

Members of the Scottish Parliament Economy and Fair Work Committee
Left to Right: Daniel Johnson, Convenor Colin Symth, Ameca, Stewart Miller, Lorna Slater and Gordon MacDonald

Visits from government officials and parliamentarians

As part of our ongoing dialogue with government ministers, parliamentarians, MSPs and advisors, the National Robotarium has been honoured to welcome the following visitors over the past year.

- **29 January** – Scottish Affairs Committee
- **21 March** – Andrew Griffiths then-MP and UK Government Cabinet Secretary for Science, Innovation and Technology
- **25 March** – Peter Kyle MP, Shadow Secretary for Science, Innovation and Technology (now Cabinet Secretary for Science, Innovation and Technology)
- **25 April** – Richard Lochhead MSP (in place of Mairi McAllan MSP)
- **11 June** – Councillor Scott Arthur (now MP for Edinburgh and South-East Scotland)
- **1 July** – Advisors from the UK Government Department of Science, Innovation and Technology
- **11 September** – Scottish Leadership Group for Manufacturing, chaired by Deputy First Minister Kate Forbes MSP
- **27 September** – Members of the Edinburgh and South-East Scotland Regional Board.

  Scottish Government Permanent Secretary John-Paul Marks
- **25 November** – Members of the Scottish Parliament Economy and Fair Work Committee including Gordon MacDonald, Lorna Slater and Colin Smyth

Secretary of State for Science and Innovation, Peter Kyle MP (centre), alongside Business Development Manager Lisa Farrell and Principal of Heriot-Watt University, Professor Richard Williams

ENGAGEMENT

The National Robotarium is committed to advancing knowledge and understanding of robotics for all. A vital part of our activity is engaging with the public to showcase how robots can help humans do things better, instilling confidence, building trust and breaking down barriers to adoption.

Schools outreach and engagement

A main delivery strand of the National Robotarium is to 'inspire the next generation of roboticists' and we have developed a tried-and-tested programme of activities that use robotics to drive engagement across a number of key engagement themes in young people.

These include:

- increasing **equality, inclusion and diversity** in computer science, engineering, maths and other STEM subjects;
- tackling digital exclusion and **reducing the attainment and achievement gap** for those living in areas of poverty and deprivation;
- **addressing future skills gaps** in the workforce by building skills in design, engineering and computer programming;
- raising awareness of the positive impact robotics, AI and automation have on society;
- **increasing understanding and adoption of robotics** in the classroom, workplace and at home.

In our second year of operation, we have **engaged with over 9300 school-aged children** through in-person site visits and at events all over the UK.

Competitions and Clubs

In the past year, our team have been focused on building the engagement profile of the National Robotarium on a national scale, forming partnerships with renowned robotics contests and robotics clubs in the local community.

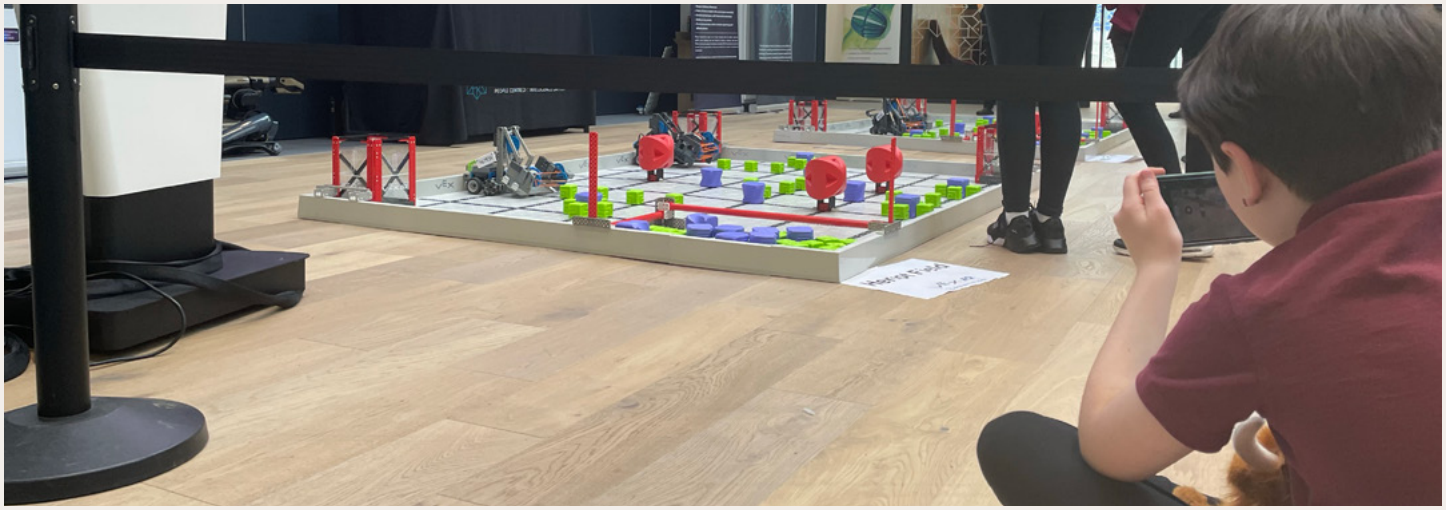
VEX Robotics

The National Robotarium joined forces with the **VEX IQ Robotics competition**, an international contest sponsored by global tech heavyweights, including Tesla and Microsoft.

The facility hosted the Scottish regional heats – the first held in Scotland since 2019 – welcoming 13 teams from ten secondary schools to take part in an intensive robot battle, during which teams had to engineer innovative robotic solutions with a basic kit of components, which the National Robotarium gifted in-kind.

The UK finals of the competition were held in Telford in March, with National Robotarium engagement lead Blair Wilson, who spearheaded the partnership, invited to judge one of the categories.

A local community group, First Step Robotics, were relative newcomers to the VEX Robotics competition but dazzled the judges to win the prestigious Amaze Award. Since then, the National Robotarium has maintained close ties with the club, supporting members to **learn STEM skills like computer coding and engineering**, and inspiring them to consider robotics as a future career.



The VEX Robotics competition held at the National Robotarium in February 2024

Causeway Education

This summer, the National Robotarium teamed-up with Causeway Education, a charity that aims to reduce the attainment gap and equip young people from less privileged backgrounds with the knowledge, skills and confidence to progress to further and higher education.

Together, we launched a new schools outreach programme, delivering webinars – including a guest appearance from humanoid robot Ameca! - to **over 300 young people aged 11-14**, encouraging them to consider developing skills for a future career in robotics, computer science or engineering. Classes were then tasked with submitting a poster, Powerpoint or video presentation on how AI could solve a global problem with winners Springwood High School (King's Lynn) receiving a robotics starter kit

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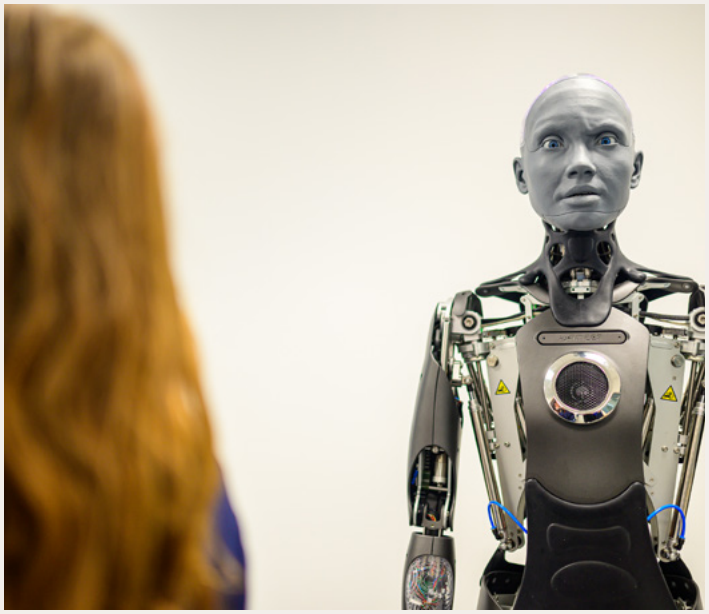


Engagement lead Blair Wilson (second from right) at the Learning Places 2024 conference, October 2024

FIRST Tech Challenge

For the second year running, the National Robotarium have been involved in the UK arm of the FIRST Tech Challenge, the world's largest robotics competition.

Last year, the first Scotland event was held at local football club Heart of Midlothian FC's Hearts Innovation Centre, which included an inspiring talk from CEO Stewart Miller, and robot activities led by Blair Wilson alongside Robotics Engineers Alix Partridge, Kyle Walker, Hsing-Yu Chen and Rahul Ramachandran.

In November 2024, the National Robotarium **hosted the FIRST Tech Game Changer Conference**, an annual event to train and upskill mentors and volunteers ahead of 2025's event season. The event included inspirational talks and hands-on workshops, all designed to enable them to deliver their programme of events to young people.

Since the event continued its partnership with FIRST Tech, appearing together in a panel on '**EDI, young people, and robots – building the future of STEM education**' at the 2024 Learning Places Scotland Conference.

PUBLIC ENGAGEMENT

Throughout the year, the National Robotarium has hosted a number of public events, workshops, festivals and virtual sessions, attracting audiences of all ages. We have also been involved in delivering public engagement and outreach activities for all ages, educating and informing the public about the positive benefits robotics and AI can have on their lives.

Ameca at Edinburgh Futures Institute

In October, The National Robotarium partnered with fellow Data-Driven Innovation hub Edinburgh Futures Institute at The University of Edinburgh for a special event Ameca in Conversation with Jeanette Winterson.

The sell-out event, which kicked-off the EFI Learning Curves Autumn event season, included a panel discussion with our Head of Robotics, Dr Ingo Keller, in a wide-ranging conversation exploring the intersections of technology, literature, and human connection.

Watch the conversation in full at: **efi.ed.ac.uk/event/jeanette-winterson-in-conversation-with-ameca/**

Doors Open Day 2024

The National Robotarium hosted its inaugural Doors Open Day event on 27 September, **welcoming over 350 visitors** to explore the facility. Attendees had the opportunity to engage with advanced robotics, including the Ameca humanoid, and learn about laser technology in our high-spec labs. Hands-on activities included interactions with clawbots and spheroes, providing a comprehensive learning experience.

Edinburgh Science Festival 2024

In collaboration with the Heriot-Watt Engage team, The National Robotarium was pleased to host two events for this year's Edinburgh Science festival.

Over 100 people attended 'Two Truths and a Robot Lie', a Traitors-like event held at Adam Smith's Panmure House, exploring truth and deception between humans and robots.

Later in the festival, we opened our doors for **Robotics Unveiled**, a family-focused event, which included tours, and fun interactive games including remote controlled-robot paintings, soft robotics and a crash-course in laser precision.

The event was a sell-out with over 220 people attending over three sessions.

Events and Exhibitions

IROS 2024

Members of the Robotics Engineering and Business Development teams along with industry residents Touchlab Limited flew to Abu Dhabi for the **International Conference on Intelligent Robots and Systems (IROS)**, one of the biggest and most impactful international robotics research conferences.

The team were showcasing an innovative new robotic touch system - developed in collaboration - that, through its advanced **remote-controlled arms and tactile sensors, can support healthcare workers in delivering remote care** safely with dexterity and precision.

The National Robotarium and Touchlab Ltd. at the IROS conference in Abu Dhabi. Left to Right: Shayne Shaw, Laura Garcia-Caberol, Naomi Battison, Zaki Hussain and Rahul Ramanchandran

To help raise the international profile of the National Robotarium and build connections with leading research, development and industrial robotics agencies across the globe, the Robotics Engineering team also represented the centre at:

- **Humanoids** IEEE-RAS International Conference on Humanoid Robots, Nancy, France, November
- **ROSCon** an industrial Robot Operating System conference, Odense, October
- **ICRA** IEEE International Conference on Robotics and Automation, Yokohama, Japan, May
- **iSpaRO** International Conference on Space Robotics, Luxembourg, April
- **RoboSoft** IEEE-RAS International Conference on Soft Robotics, San Diego, April
- **Robotics & Automation** Birmingham, March
- **European Robotics Forum** Rimini, Italy, March
- **SoRo** Soft Robotics in Healthcare, London, February
- **RAS 2024** Annual IEEE UK and Ireland Robotics and Automation Society Chapter Conference, Sheffield, February

TechFlix - "AI and Robotics: A near future you're not prepared for'

The National Robotarium was the focus of a **new documentary on the future of AI and Robotics**, created by Tech Flix producers from global technology company Nash Squared.

The thought-provoking film, "AI and Robotics: A near future you're not prepared for', hosted by 'tech evangelist' David Savage, was partly **filmed at the National Robotarium** and features interviews with our CEO Stewart Miller and academic co-lead Professor Yvan Petillot, offering an insightful exploration of how robotics and AI are shaping our lives, work, and health in an increasingly automated world.

The film is now streaming at:
www.nashsquared.com/techflix

The film premiered at an exclusive event held at the National Robotarium before **culminating its global tour of screenings at a special panel event in New York City**, attended by COO Steve Maclaren.

Chief Operating Officer Steve Maclaren at a special New York screening of the Nash Squared TechFlix documentary, AI and Robotics: A Near Future You're Not Prepared For

The Scotsman Data Conference

The National Robotarium supported a guest appearance of the Ameca humanoid robot at The Scotsman Data Conference on 26 September. The annual conference, led by the Data-Driven Innovation Initiative team, explored **Disinformation, Deepfakes and Democracy**.

TechUK Tech and Innovation Summit

Chief Operating Office Steve Maclaren was invited to London to speak at the techUK Tech and Innovation Summit.

The second annual event, which began with a welcome from Lord Patrick Vallance, Minister of State for Science, Research and Innovation, brought together leading experts from industry, government and academia to celebrate the **UK's technological breakthroughs**, and discuss its future innovation potential.

Steve was invited as a panellist focused on '**Tackling the UK's productivity puzzle: Are Robotics and Automation part of the solution?**', exploring the latest advancements in robotics applications and how different industry sectors are already benefitting from their deployment, and what the UK Government and industry leaders can do to increase robotics adoption for the good of society and the economy.

OUR RESEARCH

The National Robotarium is a global leader in advancing research and innovation in Robotics and Artificial Intelligence.

Partner institutions Heriot-Watt University (HWU) and The University of Edinburgh (UoE) bring with them a **rich history of scientific excellence and innovation** that underpins everything we do. By harnessing their combined areas of expertise, the National Robotarium represents a powerful research ecosystem, fostering advancements across various fields.

Research Themes

Led by Professors Yvan Petillot and Oliver Lemon (Heriot-Watt University), alongside Professors Adam Stokes and Michael Mistry (The University of Edinburgh), The National Robotarium is home to a diverse range of expertise in robotics and Artificial Intelligence.

Our researchers work across the following themes:

Bio-inspired Robotics

Leads: Dr Alistair McConnell (HWU) and Barbara Webb (UoE)

Bio-inspired robotics involves studying biological systems found in nature and applying their principles to create robots that can mimic their movements and behaviours. By learning from nature, bio-inspired robots can be designed to be more versatile and efficient.

2D and 3D Vision and Perception

Leads: Dr Hakan Bilen (UoE) and Dr Audrey Repetti (HWU)

For robots to be able to safely operate and interact in different environments, they must be able to see and understand the world around them. Our experts are advancing 2D and 3D vision and perception technologies to equip robots with the data visualisation and processing power to complete complex tasks and navigate through unstructured environments.

Healthcare robotics

Leads: Dr Suphi Erden and Dr Marta Vallejo (both HWU)

Robotics has the potential to revolutionise the delivery of healthcare. From patient monitoring and diagnostics to rehabilitation and robotic surgery, robots can ease staff workloads, prevent infection control and improve patient care. Our research in healthcare robotics isn't purely theoretical; we work directly with patients, clinicians and other healthcare professionals to ensure robotic and AI technologies address real-world challenges in the sector.

Researchers testing robot rehabilitation as part of the Horizon Europe VITALISE project trials

Generative AI for Robotics

Leads: Professor Oliver Lemon and Dr Alessandro Suglia (both HWU), Professor Mohan Sridharan and Professor Subramanian Ramamoorthy (both UoE)

Generative AI is revolutionising the field of robotics by combining vision, language, and robot actions in new systems which can learn from data, interact with humans and the world, and adapt to new situations.

Generative models such as LLMs (large language models) and VLMs (vision and language models) are now being extended for use in robotics, allowing robots to become more adaptable, intelligent, and capable of performing a wider range of real-world tasks.

Reasoning, Control, Learning

Leads: Professor Ron Petrick (HWU) and Dr Mohan Sridharan (UoE)

Developing robots with logical reasoning, problem-solving and planning abilities enables them to approach and complete tasks of greater complexity, with greater autonomy. Robotic reasoning, control and learning skills enhance the interactions between humans and robots, making them more intuitive and better able to respond effectively to commands.

Field Robotics
Lead: Professor Ignazio Viola (UoE), Professor Yvan Petillot (HWU)

Field robotics involves deploying robots in unstructured and dynamic environments such as agriculture, construction, the marine environment, mining, environmental monitoring, and search and rescue. These robots use advanced sensors and AI to navigate and perform tasks autonomously, improving efficiency and safety.

Field robotics is transforming industries by enhancing productivity and sustainability.

Control for the real world
Leads: Dr Carlos Mastalli (HWU) and Dr Steve Tonneau (UoE)

Robotics control for the real world involves developing systems that enable robots to perceive, plan, and execute actions effectively in dynamic and unstructured environments.

Intelligent control systems manage interactions between robots and their environments, ensuring precise performance, while augmented reality enhances control through interactive, real-time interfaces. These advancements make robots more adaptable and efficient in real-world applications.

Safe and Secure AI for Robotics (SAIR)
Leads: Professor Ekaterina Komendantskaya, Dr Ioannis Konstas, and Dr Marta Romeo (all HWU), and Professor David Aspinall (UoE)

Significant advances in Machine Learning have led to its ubiquitous deployment in autonomous systems. However, Machine Learning is a black-box technology meaning that any system that adopts it could potentially compromise safety, security, and interoperability.

The SAIR research theme is focused on building safer and more secure machine-learning components, ensuring that robotics and AI are developed to work within society in a responsible, verifiable, ethical, legal and safe manner.

Research in this area will align with international regulatory functions such as the EU AI Act and The Bletchley Park AI Declaration.

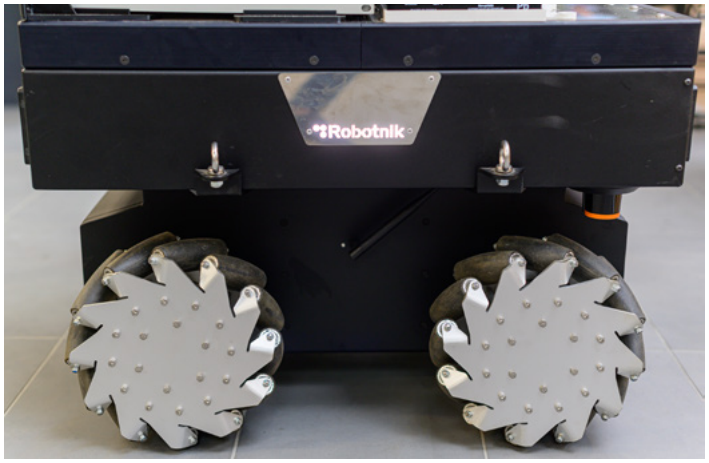
Multi-agent Robotic Systems
Leads: Dr Stefano Albrecht (UoE) and Ignacio Carlucho (HWU)

Multi-agent robotic systems involve multiple robots working together to achieve common or individual goals. Our researchers are developing new ways for robots to coordinate and communicate with each other and their environments, allowing for greater flexibility, adaptability and information sharing.

Human-Robot Interaction
Leads: Professor Lynne Baillie (HWU) and Professor Ram Ramamoorthy (UoE)

The goal of HRI is to create robotic systems that can effectively and safely interact with humans, whether through physical interaction, communication, or collaboration. This involves designing robots that can understand and respond to human commands, emotions, and behaviours, making interactions more intuitive and beneficial to users.

The National Robotarium is applying its HRI research into healthcare, social care, patient diagnostics and assisted living.



Edinburgh Centre for Robotics

The Edinburgh Centre for Robotics (ECR), a joint partnership between Heriot-Watt and The University of Edinburgh, is producing a new generation of highly skilled robotics experts.

The ECR is leading the UK effort to realise its industrial potential in the robotics revolution, **building the technical skill of future roboticists**, coupled with industry and market awareness. Graduates are innovation-ready, equipped through cohort-wide training to conduct world-leading responsible research with effective scientific, creative, ethical and enterprise skills.

Researchers work on a range of topics in the field of Robotics and Autonomous Systems (RAS), with a **particular focus on safety and safe interactions** between robots, people and their environments.

ECR graduates are innovation-ready, equipped to conduct world-leading responsible research with effective scientific, creative, ethical and enterprise skills.

UKRI AI Centre for Doctoral Training in Dependable and Deployable AI for Robotics (CDT-D2AIR)

The new UKRI Centre for Doctoral Training in Dependable and Deployable Artificial Intelligence for Robotics – shortened to CDT-D2AIR – pronounced 'dare' – is training new PhD students in verification and certification systems for robotics and AI.

The aim of the centre is to ensure that widespread adoption of robotics applications in the home and in industry can interact safely with the environment and users. Postgraduate students in the CDT will be trained in in the **latest methods in AI, verification, design, and robotics**, along with practical skills to ensure that robotic systems can be safely developed and deployed.

Students will be given access to high-spec lab space, robotics equipment and expertise at the National Robotarium as part of their studentship.

ESPRC and MoD Centre for Doctoral Training in Sensing, Processing, and AI for Defence and Security (SPADS)

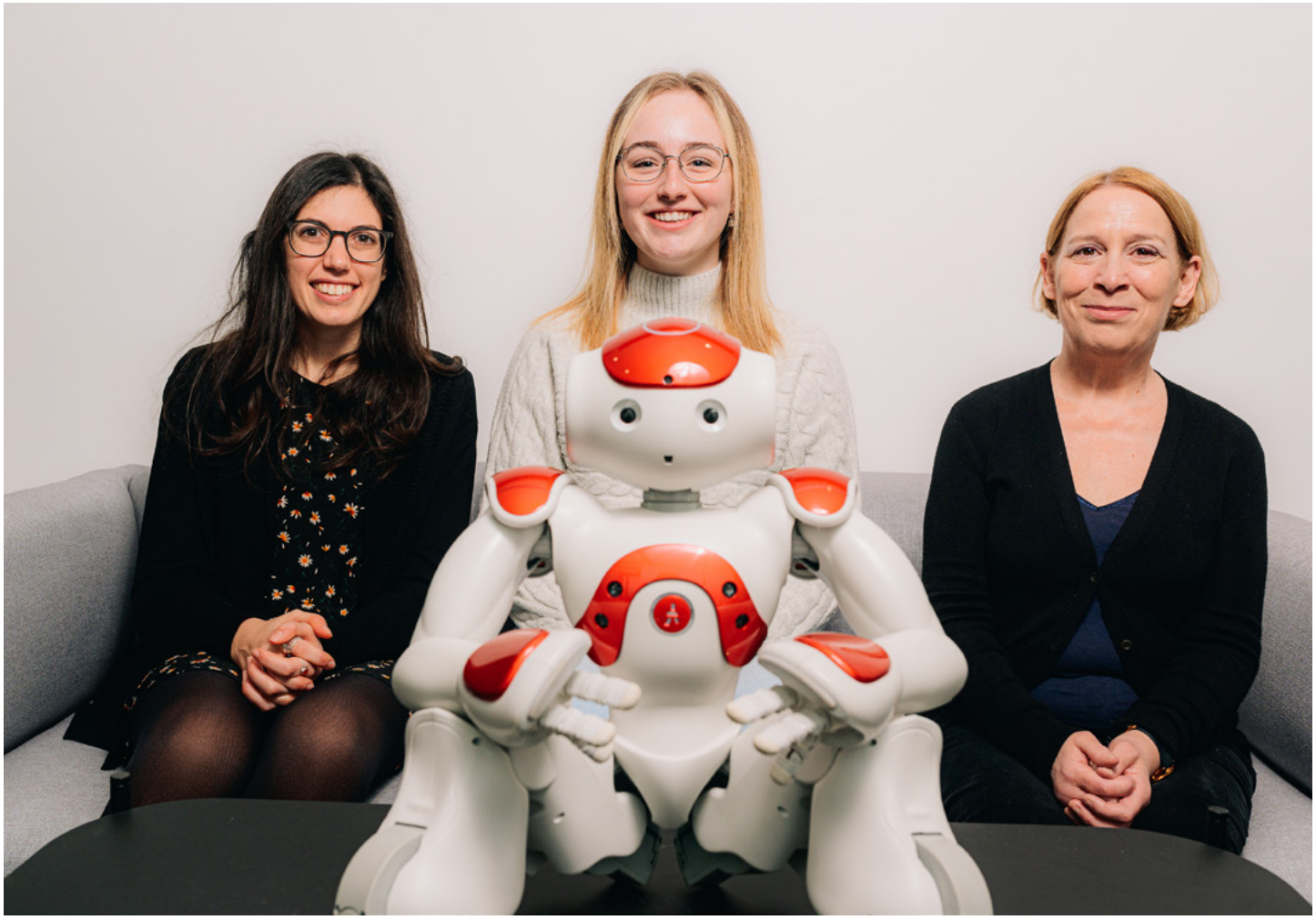
A partnership between Heriot-Watt University and The University of Edinburgh, the SPADS doctoral programme is training the next generation of highly professional defence scientists, including engineers, computer scientists and mathematicians capable of leading developments in cutting-edge information and communication technologies.

Graduates of SPADS leave with a solid **understanding of hardware, sensing and processing**, and software that can be applied to a spectrum of specialisations within engineering and Artificial Intelligence. Alongside the technical aspects of the programme, graduates learn about the ethics of research and development, ensuring the highest standard of safe and responsible AI.

Industry-ready graduates

As we work to create the next generation of roboticists, AI-specialists and researchers, we aim to attract the brightest minds and entrepreneurial brains to **produce highly-skilled graduates**.

The National Robotarium provides space for Masters students to conduct cutting-edge responsible research, often directly with industry partners, helping them build effective, scientific, creative and enterprise skills.



Researchers from the Human-Robot Interaction team.
Left to Right: Dr Marta Romeo, PhD researcher Emilyann Nault and Head of HRI at the National Robotarium Professor Lynne Baillie.

FEATURED RESEARCH

SPRING

The SPRING (Socially Assistive Robots in Gerontological healthcare) trial achieved an important milestone, with the deployment of robots in a hospital in Paris. The ARI robots, equipped with advanced artificial intelligence to enable natural conversations with groups of people in busy environments, were stationed at Assistance Publique Hôpitaux de Paris, where they provided general assistance and information to patients.

It is hoped that wider use of assistive robotics in healthcare could ease workload pressures and staff shortages, freeing-up staff for more quality interactions with patients.

UNITE

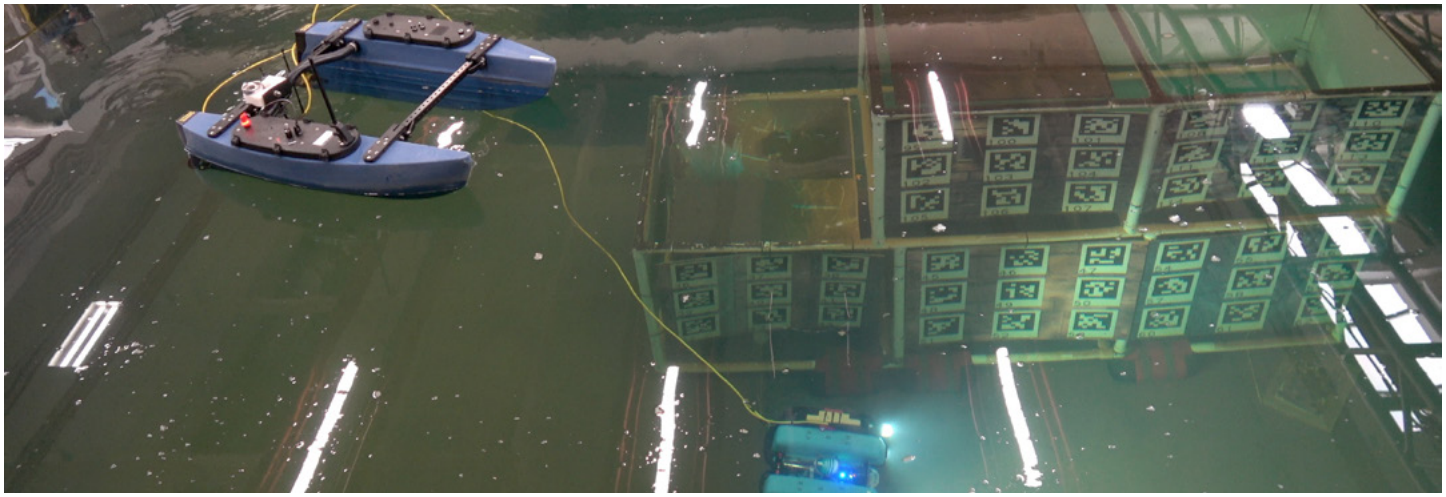
The offshore environment is one of the most hazardous for humans to work in. There are over 11,000 offshore wind assets in the UK alone, with thousands more planned by 2050. Currently, offshore energy companies are legally required to check and maintain these offshore assets on a regular basis (minimum 3 times per year), using human workers on large support vessels to visually assess, manage and maintain large-scale assets at sea, such as wind turbines and oil rigs. This task is not only perilous for humans but also time-consuming and carbon negative.

To address this challenge, the National Robotarium is **collaborating with leading geo-data specialists Fugr**o on UNITE (Underwater Intervention for Offshore Renewable Energies), a £1.4m project supported by EPSRC to develop autonomous, electric remotely-operated vehicles (eROVs) to conduct maintenance and repair on offshore wind turbines. The successful application of **eROVs for offshore maintenance can offer a safe, efficient and sustainable solution** for global energy providers.

The National Robotarium and Heriot-Watt's specialist facilities offer a **unique testbed** for trialling the Fugro ROVs in realistic underwater environments, simulating the unique conditions of the seas, including pressure, visibility and water movement.

Since its official announcement in June 2023, the project team have made significant progress creating a research roadmap and developing hardware and software for remote offshore operation. The first physical trials took place in September 2024 within an industrial wave tank, located within the Oceans Systems Lab.

The trials showed promising results in enabling underwater robots to maintain stable contact with offshore structures in challenging conditions. The 'chicken-head problem' – named as such to mimic a chicken's ability to keep its head steady while its body perpetually moves - is an integral challenge to overcome as regular maintenance and inspection of offshore structures is required by operators all year round, whether waters are calm or choppy.



Surface vessel and autonomous underwater robot during the UNITE trials

VITALISE

The VITALISE (Virtual Health and Wellbeing Living Lab Infrastructure) project, funded by the Horizon Europe programme and led by Professor Lynne Baillie, head of the National Robotarium's Human Robot Interaction (HRI) team, has developed a system where socially assistive robots communicate with patients using a headset that detects brain neural activity.

The **robotic 'coaches' for aiding upper limb rehabilitation** for stroke and brain injury survivors were successfully trialled at AIT Austrian Institute of Technology, a rehabilitation clinic in Vienna, Austria.

This research aims to make it easier and more engaging for people to adhere to prescribed self-managed rehabilitation routines by providing personalised support based on individual needs, cognitive capability, and exercise pace.

Blantyre Life

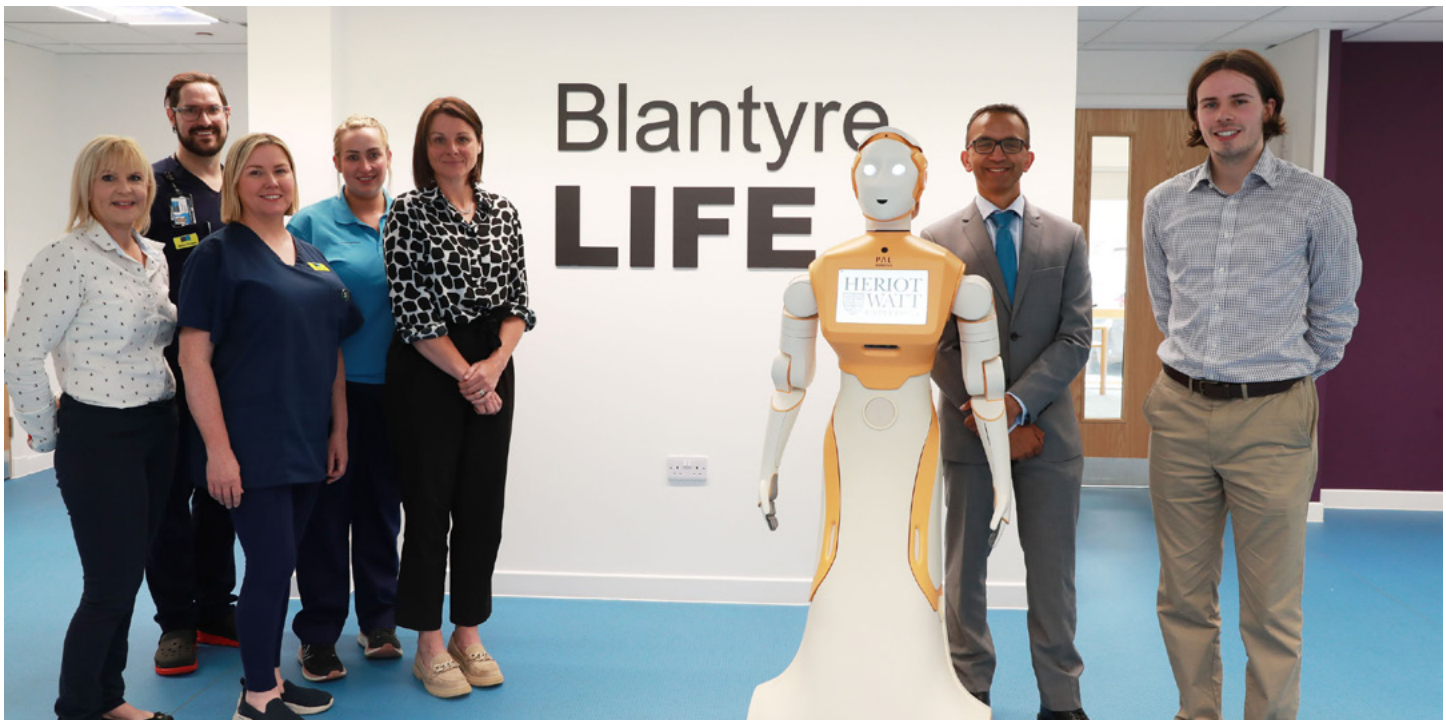
Researchers at the National Robotarium have been working with Blantyre LIFE, an innovative new health and care facility in Lanarkshire to advance development of the next generation of assistive robotics for patient rehabilitation.

An ARI assistive robot and PhD student Carl Bettosi were based at the facility for two weeks in August to gather feedback from health and social care staff on how the robot can assist people recovering after a critical injury.

A key focus of the research is to equip robots with autonomous decision-making abilities to help reduce the burden on healthcare staff.

"Collaborating with facilities like Blantyre LIFE allows us to work closely with experts in health and social care throughout the testing and development stage. Their lived experience helps us understand their priorities when working with patients, allowing us to build robotic systems that are safe, effective, and user-friendly."

Lisa Farrell,
Business Development lead for healthcare robotics



The ARI assistive robot during trials with healthcare workers at Blantyre LIFE in South Lanarkshire

RESEARCH HIGHLIGHTS

- Heriot-Watt University was named as a new member of the **Turing University Network**. Member institutes that excel in data science and AI are given the opportunity to engage with its broader network and advance world-class research to address global challenges.
- Researchers from The National Robotarium and The University of Edinburgh presented at the 2024 **IEEE RAS HUMANOIDS Conference**, which took place in Nancy, France from 22-24 November. Drs Hefan Wang and Steve Tonneau presented a paper outlining the latest developments from a joint project that aims to optimise how humanoids move in changing environments.
- Professor of Conversational AI and academic co-lead of the National Robotarium, Oliver Lemon, has been accepted the Ellis Society as an **Ellis Fellow**. The Society was founded to promote scientific excellence in modern AI research across Europe.
- Lead for generative AI for robotics Dr Alessandro Suglia was named as a winner of the **'Italy Made Me' 2024 Award** by the Embassy of Italy's Scientific Office. The award was in recognition of Alessandro's research into "Visually Grounded Representation Learning using Language Games for Embodied Generative Artificial Intelligence".
- Academic co-lead Professor Oliver Lemon has given five keynote talks on generative AI for healthcare robotics. These include the highly prestigious Cambridge University Language Sciences annual symposium the Royal Society of Edinburgh, **The European Chatbot and Conversational AI | Generative AI Summit** and the European Commission.
- Researchers and students at the National Robotarium and Edinburgh Centre for Robotics presented a record 8 papers at the prestigious 2024 **Conference on Empirical Methods in Natural Language Processing**, held in Miami from 12-16 November.
- PhD student in the Ocean Systems Lab Heriot-Watt University Niamh Marie Frances Ellis was accepted into the **Inclusion RSS (Robotics Science and Systems) Conference 2024** Fellowship Programme, which provides students from groups traditionally underrepresented in robotics to an all-expenses-paid trip to the prestigious international robotics conference, which took place at Delft University of Technology in the Netherlands from 13-20 July.
- Researcher in Conversational AI Angus Addlesee won the Best Demo award at **EACL 2024**, a European Conference for Computational Linguistics;
- Research into robotics for rehabilitation was showcased by PhD student Carl Bettosi at the Fourier Intelligence Rehab showroom in Kuala Lumpar. Carl and the HRI team have been utilising Fourier's medical technology, donated in-kind, to test and develop patient engagement and progress.
- Researchers from the National Robotarium, including our Laboratory for Robotic Assistive Living (LARA) lead Dr Mauro Dragone, were featured in the Heriot-Watt University Healthy Ageing Showcase on 2 October.
- PhD student in Human-Robot Interaction Emilyann Nault presented a paper on the **FEATHER project** at the **IEEE RO-MAN conference** in Pasadena in August.

PRESS, PR AND MEDIA

In 2024, the National Robotarium achieved exceptional visibility and influence across media and policy spheres. The facility secured over 1,100 pieces of coverage, including significant international reach through Reuters, Associated Press, and Agencia EFE newswire packages.

Nine major news announcements garnered premium coverage across broadcast, national press, and specialist media, spanning healthcare innovations, advanced robotics, agricultural technology, and renewable energy.

The facility's public affairs programme successfully expanded political engagement through a strategic 5-point policy plan, securing support across Westminster and Holyrood, while strengthening relationships with key government departments and stakeholders.

This integrated communications approach led by Communications Manager Louise Jack has firmly positioned the National Robotarium as a leading voice in robotics and autonomous systems innovation.

Particular highlights this year included a discussion on robots for alleviating loneliness with **Kay Burley for Sky News**, a two-page spread on healthcare robotics in The Times, our M.A.R.T.I.N.A Spot robot from Boston Dynamics featuring in a **global campaign for Brand Scotland** and a story on the SPRING assistive robots project appearing in TIME Magazine.

Key Stats

Total Identified coverage hits:
1,101

Press release distributions:
9

Articles/Comments/ interviews:
29

Radio/TV Hits:
68

International newswire packages*:
5

* Reuters x3, Associated Press x1, Agencia EFE x1

November 2024

- The Engineer – Robotics in 2025: The key developments set to transform industry and society
- Edinburgh Evening News – Edinburgh students inspired by Scottish charity to engage in nation's rich heritage of design and manufacturing
- FutureScot – How to help the med-tech fledglings fly
- Robotics and Automation – Seeing is Believing. How is technology changing the way robots 'see' and perceive the world?
- Digital Health – How robots can turn the NHS from a cost centre to an economic driver
- PODCAST: Institution of Mechanical Engineers Impulse to Innovation – How Service Robotics is providing a helping hand

October 2024

- TechFlix: "AI and Robotics: A near future you're not prepared for"
- The Engineer [Comment]: Robots are transforming offshore wind farm maintenance
- The Times – Robots are coming for our jobs. Will we welcome them?
- The Tony Blair Institute for Global Change – A New National Purpose: The UK's Opportunity to Lead in Next-Wave Robotics
- ScotlandIS: New investment fund launched to support IoT and Robotics startups in Scotland

September 2024

- Robotics and Automation: The NHS needs a robotic revolution – let's not miss our chance
- The Engineer [Comment]: Robotic innovation is helping NHS Scotland deliver better healthcare
- The Scottish Sun: 'There just aren't enough physios,' robots to help Scots patients recover as NHS is in crisis

August 2024

- Robotics and Automation: The OIDS of March
- STV Online: Robot 'coaches' used to aid recovery of stroke survivors
- BBC Radio, Good Morning Scotland: Robotic coaches programmed to guide stroke patients through rehabilitation exercises could soon be tested in Scotland
- BBC Reporting Scotland (20 August): Robotic coaches to help stroke patients rehabilitate

July 2024

- The Herald – DeepTech Launchpad accelerated at Heriot-Watt
- ITV News – Meet Ameca: The world's most advanced humanoid robot
- TES Magazine – How robots and pupils could interact in the classroom
- The Engineer – Robot recruits: human-shaped solutions to the global labour shortage

June 2024

- BBC Radio 4 World Business Report – 17 June 2024
- Institute of Mechanical Engineering – 'Walking looks natural, but it's a very complicated thing for robots': Dr Carlos Mastalli, National Robotarium
- The Times – Could a cuddly robot be the answer to loneliness?
- The Mirror – AI tool can count flowers on fruit trees to help farmers boost crop yields
- Energy Voice – How robots are making offshore wind maintenance safer and more efficient

May 2024

- The Mirror – Incredible robots that could help cut NHS waiting lists and tackle care home crisis
- The Mirror – World's most advanced robot gives eerie answer about human souls as it defends AI
- Brand Scotland – MEET BOSTON DYNAMICS' ROBOT DOG M.A.R.T.I.N.A.

April 2024

- CBBC BBC – Ameca: World's most advanced humanoid robot
- BBC Radio 4 Today 17 April
- BBC World News – Bye, robot: Atlas HE retires after 11 years of jumps, flips and falls
- The Raconteur – Time to get real with robotics, stresses National Robotarium CEO
- The Herald Business HQ – Robot production can put us head and shoulders above our rivals
- Health Business UK – The future of healthcare
- The Herald Agenda – Listen to Bill Gates: robotics is the future and we need to act
- Skedda case study: The National Robotarium uses Skedda to book everything from hot desks to robots
- STV Scotland Tonight: Healthcare's Robot Revolution

March 2024

- PBC Today – How Britain's construction sector could benefit from using robotics
- PODCAST: ReAutomated (Universal Robots) Episode 10 – Stewart Miller
- The Engineer – How to make real breakthroughs in robotics motion
- Sky News (19 March) – Interview with Stewart Miller

February 2024

- The Times – Inside the robotarium building companions for our old age
- BBC Live Lesson – Safer Internet Day

January 2024

- TIME Magazine – Robots created to help patients in hospitals pass testing phase
- BIMPlus.co.uk – How robots are taking BIM to the next level
- STV News – Inventors go head to head at disability design awards
- The Times – Robots designed in Edinburgh help out in Paris hospital
- Premier Construction – Nails and bolts meet bits and bytes: how robots are leading the construction revolution

December 2023

- IEEE Spectrum – Brace for Impact, Here Comes Personalized AI
- TechRound – Expert Predictions for Artificial Intelligence in 2024
- TechRound – We Asked the Experts: What RoboTech Trends will shape 2024?

November 2023

- The Engineer – Robotics and AI are the future, but we have to make sure they're sustainable
- MailOnline – How experts think humanoid robots will change the world by 2035
- Medical Device Network – A year of robotics: Q&A with Lisa Farrell of the UK's National Robotarium
- Tony Robinson's Marvellous Machines
- i40today.com – Autonomous training tool delivers in-demand surgical skills with real-time feedback

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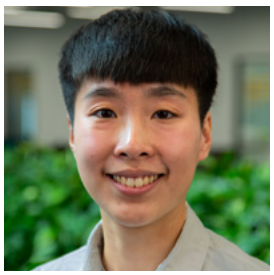

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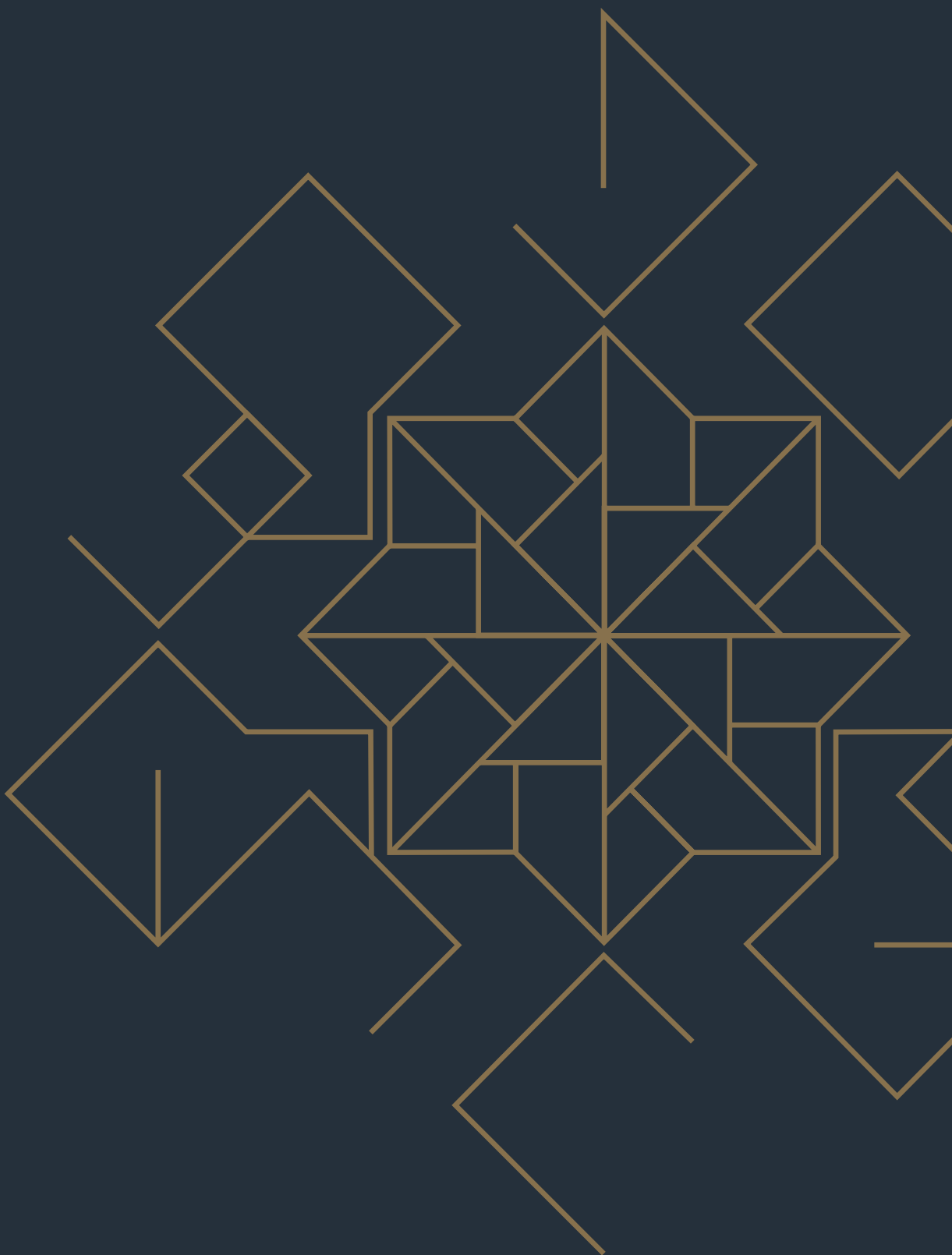

THE NATIONAL
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PEOPLE CENTRED :: INTELLIGENCE DRIVEN

The National Robotarium is supported by £21 million from the UK Government and £1.4 million from the Scottish Government as part of the £1.3 billion Edinburgh and South East Scotland City Region Deal - a 15 year investment programme jointly funded by both governments and regional partners.

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