

AI AT LIVERPOOL

**INNOVATION THROUGH
COLLABORATION**

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Discover a Powerhouse in Artificial Intelligence Research

Liverpool City Region is a hub of AI research and innovation, boasting world-class talent and dynamic businesses alongside the next generation of challengers and collaborators.

AI technology is transforming our lives, driving innovations that shape economies, careers, health and wellbeing, and productivity. At the University of Liverpool, we are leading the development of the next generation of AI innovations. By collaborating with governments, academic institutions, and industry partners, we will extend and harness the continued rapid advances in AI to deliver innovations born in Liverpool that make a global impact.

Our world-class researchers are making significant strides in addressing some of the world's most pressing challenges and AI is enabling even greater impact. Our interconnected expertise in AI spans multiple disciplines, from health to future economies, security, place and innovation, and environment and sustainability. This expertise underpins our 'AI for Life' Research Frontier, as well as activities driven by our Interdisciplinary Centre for Sustainability Research.

Collaboration is essential to our research strategy, and we partner with a range of industry and public services in AI advancement and application. Industry partners include Unilever, IBM, NVIDIA, Kyndryl, Roche Diagnostics, Cisco and infrastructure hubs and platforms for companies at Sci-Tech Daresbury and the Hartree Centre. Advances in AI are inspired by as well as used by our public services across Cheshire and Merseyside from the NHS, local government, charity and voluntary sector organisations, along with their industry partners. This civic AI cluster is underpinned by the Liverpool City Region Community Charter on Data and AI, where our residents seek progressive uses of data to develop AI that improves lives.

Innovation thrives through collaboration: partnering with the University of Liverpool opens doors to valuable national and global opportunities for businesses of all sizes to drive transformative change.

FOREWORD

Professor Tim Jones,
Vice-chancellor of the
University of Liverpool

Research England's
Knowledge Exchange Framework
results place the University
in the **top quintile** for
Research Partnerships, Working
with Business, Working with
the Public and Third Sector,
and IP and Commercialisation
– **exceeding the**
average score
for the cluster.

The University of Liverpool is a place where academic excellence meets creativity and innovation, and where pioneering AI research is transforming lives and industries around the world. Since our founding in 1881, our mission – for the advancement of learning and ennoblement of life – has remained at the forefront of everything we do.

We are ambitious about our future and aim to be recognised as a global Top 100 university by our 150th anniversary in 2031.

We have strong foundations on which to build. 91% of our research is recognised as world leading or internationally excellent. Our Computer Science and Informatics research ranks 5th in the UK for world-leading research outputs (4*), with 100% of our research environment rated as either world-leading or internationally excellent (3*) in the Research Excellence Framework 2021.

Our AI research combines fundamental breakthroughs with real-world applications to address global challenges. World-class facilities such as the **Materials Innovation Factory**, **Digital Innovation Facility**, **Virtual Engineering Centre**, and **Civic Health Innovation Labs** are shaping next-generation technologies, from sustainable materials and Net Zero solutions, to AI-driven advances in health and social care, law, and industry.

Scientists from our Materials Innovation Factory and Chemistry Department are using AI and robotics to develop sustainable materials for consumer products to transform the global chemical supply chain and support the UK's Net Zero goal by 2050.

Our work aligns with the Liverpool City Region's Growth Plan and its emphasis on AI for Good, targeting the Health and

Life Sciences, Advanced Manufacturing, Professional and Business Services, Maritime and Net Zero – all with care to address the profound inequalities that affect society.

A key player in England's second Life Sciences Investment Zone, we're working with the Liverpool City Region to pave the way for up to £800m of public and private investment and 8,000 new jobs. Projects include the **Civic HealthTech Innovation Zone** and the **Microbiome Innovation Centre**.

We are at the forefront of AI in healthcare, from machine learning for fundamental biology to medicines discovery (e.g. **multi-omics**), development (e.g. **long-acting medicines**) and optimisation (e.g. **prescribing AI**), and clinical diagnostics such as advances in digital pathology, improving cancer diagnosis and diabetic eye screening (e.g. spin out AI Sight). And in public health we are embedding our AI research into the **NHS Data into Action programme** and working with the UK Health Security Agency in **preparing for the next pandemic**.

Moving beyond health, our researchers have developed new AI models that revolutionise the way law firms operate by automating routine tasks, allowing lawyers to dedicate more time to client interactions and case strategy.

We are equally dedicated to developing talented students at

every level, equipping them with the skills and knowledge they need in AI to make a real impact. Our Maths School, in partnership with Inversity, is empowering local youth to become AI trailblazers. Additionally, through collaborations with over 35 organisations, we're preparing PhD graduates in areas like Distributed Algorithms, Automated Materials Chemistry, and Risk and Uncertainty to meet the global demand for skilled experts in data science and AI.

Through partnerships and networks, we influence future government policy on applied digital technology and open doors to significant grants for interdisciplinary research. Research England's **Knowledge Exchange Framework** places us in the top quintile for Research Partnerships, Working with the Public and Third Sector, and IP and Commercialisation.

I am proud of our world-class research and confident that collaboration with us will yield progressive solutions for growth, sustainability, and technological advancement.

The projects in this brochure showcase how AI at the University of Liverpool is delivering growth, sustainability advancements, and societal benefit. We invite you to join us in shaping a future where innovation thrives, collaboration flourishes, and technology works for the good of all.

HEALTH

As underlined in England's 10-Year Health Plan, AI is fundamental to progress in protecting and improving health and wellbeing across society, and the economic security that depends on a healthy workforce. Liverpool's AI for Life Frontier speaks to the three 'big shifts' in this plan: analogue to digital; treatment to prevention; and hospital to community.

Liverpool's medical school and world-leading public health innovations pre-date the founding of the University and have long embraced engineering and technology advancement. Today, we continue to break new ground in data science and AI for public health systems, infection resilience and discovering, developing and optimising uses of medicines.

The Covid-19 pandemic demonstrated the importance of data science to society, with the University and its civic partners driving world-leading responses, ranging from molecular computation in vaccine and antiviral research to the world's first pilot of voluntary mass testing with lateral flow devices, which reduced hospitalisation by around a quarter and informed policies world-wide.

Our pandemic responses were enabled by progressive data sharing and infrastructure across public services, supported by the University-led Liverpool City Region Civic Data Cooperative, leading to a Community Charter for Data and AI and the NHS Cheshire and Merseyside Data into Action programme. These data and AI assets feed a portfolio of around £75m of research projects that embed data science into public service development, with industry partners. This critical mass allows Liverpool to address national gaps such as the lack of community-based mental health research amid a global rise in mental

illness. For example, we founded the Mental Health Research for Innovation Centre (**MRIC**) with its core Mental Health Avatar AI theme.

We are developing AI to tackle emerging infections, and the global threat of antimicrobial resistance. For example, creating a blueprint for system-wide antimicrobial stewardship and simulating scenarios to improve infection prevention and control in the NHS. Our Pandemic Institute works closely with the UK Health Security Agency on pandemic preparedness, including plans for conversational AI to support citizens, for example with testing, and to protect them from misinformation, for example over vaccines. This work extends to animals, such as the Small Animal Veterinary Surveillance Network, which is harnessing AIs to turn veterinary records into actionable intelligence for both animal and human health.

Building on decades of internationally important pharmacology research, we are now shaping AIs to discover new biological targets and better, safer medicines that can be fitted to patients' genetics, medical history and test results. This included reducing the harms and maximising the benefits of medicines that are taken together but rarely tested together in trials. For example, Liverpool was first to report harmful drug-drug interactions involving HIV-Tuberculosis coinfection as well as the beneficial boosting of

HIV protease inhibitors. Our Dynamic Prescribing AI (DynAIRx) is now producing AIs that help patients and clinicians to make better decisions over which medicines might be doing more harm than good.

Building on over 175 years of public health innovation, in 2023 we launched the Civic Health Innovation Labs (CHIL) that cross-fertilises around £75m of research using data from across our public services to produce actionable insights and AI interventions. This includes support for local entrepreneurs and businesses from the Civic HealthTech Innovation Zone (CHI-Zone), where we are developing technologies that bridge health and social care – this is key to the 10-Year Health Plan's shifts to better prevention and community-based care. CHIL works across all faculties, easing the interaction of fundamental AI engineering, health data science and real-world applications.

The University of Liverpool led the world's first large-scale Covid-19 rapid antigen mass testing pilot, in partnership with Liverpool City Council and the NHS. Using the CIPHA health data platform, the scheme provided critical evidence for public health policies, allowing Liverpool to lift restrictions while surrounding areas remained closed.

Small Animal Veterinary Surveillance Network (SAVSNET)

Even though half of adults own pets, health surveillance and research in companion animals has long been neglected globally, with no comprehensive active surveillance system in place to detect and demonstrate disease outbreaks, population trends and to inform matters that affect humans as well, such as use of antibiotics in animals.

SAVSNET was created in 2008 and harnesses electronic health records from veterinary practices and diagnostic laboratories and environmental data for rapid and actionable research and surveillance, prioritising areas such as antimicrobial use and resistance, climate and environment, and infection and zoonosis.

Its key aims include monitoring disease trends over time, identifying populations at risk and highlighting appropriate interventions as well as monitoring treatments and outcomes, with this data made available for academics and others.

The impact of SAVSNET has been recognised by government and pharmaceutical companies, and it plays a leading role in national companion animal surveillance and UK disease preparedness. A case study of how its data can be utilised came into effect in 2019 and 2020 during an unprecedented outbreak of gastroenteric disease in dogs.

Using methodologies developed in SAVSNET, the team harnessed syndromic data from electronic health records to track the outbreak in near-real time both temporally and spatially and launched regularly updated websites aimed at both owners and vets.

These included evidence-based case descriptions, treatment recommendations and biosecurity advice. This information reached thousands of people through the website and social media. Through case and control questionnaires and sample collection tools, we determined that the likely cause of the outbreak was a canine enteric coronavirus variant within just 8 weeks.

SAVSNET also rapidly responded to government requests for data about the potential for pets to act as hosts for the SARS-CoV-2 virus, which helped to inform policy and advice during the early days of the pandemic.



Making Combinations of Medicines Safer and Better

Drug-drug interactions (DDIs) are where a combination of drugs interacts, which can be harmful or helpful. The harms from DDI are an international problem, and between a third and half of all drugs are not taken as prescribed. In the UK, the Overprescribing Review called for systematic optimisation of medicines, and Liverpool has responded with the Dynamic Prescribing AI project, DynAIRx, building on decades of globally impactful DDI research.

For example, in HIV, Liverpool researchers recognised DDI dangers for those undergoing HIV and hepatitis treatments as well as potential beneficial use of an HIV protease inhibitor (ritonavir) to ‘boost’ concentrations of other drugs. Since 1998, they have produced prescribing tools to optimise medicines for people living with HIV. Between 2012–2018, the University helped to characterise the frequency and severity of DDIs involving HIV medications. Of approximately 39,000 patients from the UK, Switzerland, Spain and Uganda, significantly harmful DDIs were reported in 18–35% of patients taking antiretrovirals.

Our DDI reference tools now cover HIV infection, hepatitis and liver disease, and COVID-19. Using clinical and scientific expertise and review of scientific literature, we have developed these tools to provide detailed and comprehensive coverage involving over 100,000 DDI-pairs, providing clinical recommendations for each interaction. The team works with patient advocacy groups, such as i-Base, to find the best ways to provide patients and clinicians with high quality, up-to-date drug information. The Liverpool tools are recommended for use in every HIV clinic in the UK, have established users across Western Europe and North America, and are increasingly used in Latin America, Asia and Africa.

Extending beyond DDI reference sets for specific conditions, our DynAIRx project is now addressing the major challenge of optimising medicines for people with multiple long-term conditions (MLTCs). This is a growing problem. By 2035, it is estimated that two thirds of the over 65s will be living with MLTCs. Overall, there are around 14 million UK residents currently living with MLTCs. In deprived areas like Liverpool, these numbers are higher and affect people earlier in life, including their ability to work. Most people with MLTCs take multiple medicines and many suffer DDI harms.

We are developing DynAIRx AI to work with existing NHS systems to help GPs and pharmacists identify which patients are most likely to benefit from a review of their medicines. We use state-of-the-art causal machine learning and modelling to identify the patients most at risk from their current combinations of conditions and medicines. This DynAIRx AI will use routinely collected NHS data to highlight prescribing patterns, support shared decision making, and enable more joined up care. The work is co-produced with public advisors, clinicians, and researchers to ensure we are creating AI that is as useful and fair as it can be.



FUTURE ECONOMIES

Building the **world's first** AI-powered mobile robotic scientist – researchers at the MIF have developed a way to automate chemical synthesis laboratories with teams of **mobile robots** that use **AI to make decisions**.



AI is increasingly important as an underpinning strategy for future economies, with projects spanning a much wider range of sectors to support more holistic development of growth potential.

The rise of LawTech, MedTech, FinTech, for example, demonstrates the ubiquity of AI technologies across sectors. Innovation in these technologies is already transforming decision-making, autonomy and efficiency in systems, processes and operations, and the University of Liverpool is undertaking ground-breaking research into diverse applications for strengthening future economies.

One example is the creation of financial systems that use explainable AI (XAI) and blockchain technology to improve access to capital for underserved communities. These innovative systems foster transparency in decision-making and support decentralized collaboration, making it easier for individuals—especially those facing discrimination based on gender, ethnicity, or social status—to secure loans.

The result of work by a team of chemists, computer scientists, engineers and roboticists from the University of Liverpool, the robot can work almost 24–7, either alongside human colleagues or alone managed 688 experiments over 8 consecutive days in the first published example of its work.

The use of digitalisation and AI in operations and logistics is an area of research focus. Projects include digital strategy design, including the development of an augmented reality (AR) prototype simulator, computer-based modelling of

operations, and gamification of decision support systems.

Supply chain efficiencies are being enhanced by research on blockchain applications, the development of collaborative logistics platforms, and the use of AI in port/shipping operations and in wider supply-chain management.

The University has also been at the forefront of research into how AI can be utilised in the legal sector, particularly when it comes to task automation designed to cut down on workload and speed up legal tasks for solicitors when triaging new legal cases.

Research is also being undertaken to examine the correlation between productivity and digitalisation, and how digitalisation is supporting manufacturers with the service elements of their business. Big data research, taken from satellite imagery, is being used to assist decision-making in humanitarian crises as well as revolutionising the availability of credit to farmers.

Digital skills, such as big data analytics, data-modelling, python programming and generative AI, are being taught across the University, ensuring tomorrow's leaders, innovators and disruptors have the transferable expertise for roles that don't yet exist. Programmes across all three faculties of the University include digital upskilling as well as new pedagogy using technology to enhance student learning outcomes.

FUTURE ECONOMIES CASE STUDY

Autonomous Robot

Many important areas of scientific research require us to tackle problems of a scale and complexity that are beyond the grasp of human researchers, including the development of new technologies such as chemical catalysts, batteries, and medicines.

Experimental complexity also scales up exponentially with the number of variables, which means that most searches are restricted to narrow areas of interest. Laboratory robotics can help with this, but the diversity of sample types, operations, instruments and measurements required has prevented their widespread adoption.

Robots that are used in chemistry research are typically hardwired to a specific experiment, limiting their ability to work more flexibly. However, they offer the potential of automating experimental research to a scale that would be impossible for human scientists if new modular technological solutions could be created.

A team of chemists, computer scientists, engineers and roboticists from the University of Liverpool has sought to solve this issue with the creation of a mobile robot scientist that can work almost 24–7, carrying out experiments by itself. The aim was to take robotics in laboratories to the next level by automating the researcher rather than the instruments.

The 1.75m tall robot has humanoid dimensions and can work in a standard laboratory, using instruments in the same way that human researcher would, but without the limitations of tiredness or human error.

It can roam around the laboratory and perform a wide range of tasks, having the physical reach of a human being, and it uses a combination of laser scanning coupled with touch feedback for positioning.

In the first published example of its work, the robot conducted 688 experiments over 8 consecutive days, working for 172 out of 192 hours, making 319 moves, completing 6,500 manipulations and travelling a total distance of 2.17 km.



FUTURE ECONOMIES CASE STUDY

AI and the law

A potential industry need had been identified for the use of AI in the area of clinical negligence where the complexity of assessing cases might not align with the likely financial value of those cases, leaving a gap in the market that meant justice would be denied to people who were unsure of the viability of pursuing their cases.

The University of Liverpool partnered with medical negligence and serious injury law firm Fletchers Solicitors on a project to develop a digital legal assistant for supporting legal work in the sector.

The goal was not to replace human lawyers but to enhance efficiency and accuracy in handling medical negligence cases. AI tools in this area need to not only provide accurate results but also explainable reasons for their decisions, something that sets aside this research from other similar projects.

The University team extracted legal knowledge from the experts and turned it into AI-based software solutions which could then be tested against real cases to see whether it would achieve similar outcomes as human lawyers had done.

These tools could then be used to assist lawyers by speeding up the triage process and providing advisory support, enhancing efficiency and accuracy in handling cases.

Each case that was put through the system is assessed by lawyers from Fletchers to determine if they agreed with the AI decision and this was demonstrated effective in an overwhelming number of cases, saving tens of thousands of hours in staff time.

The project produced a tool that is in daily deployment within the company and has subsequently led to further expansion of its AI strategy and expertise, to assist both the company in its operational efficiencies and clients in the service and outcomes that they receive.



SAFER WORLD



Our **Geographic Data Service** provides **secure research infrastructure** that harnesses geographic methodologies to integrate vast streams of Smart Data with national statistics, transforming them into **research-ready insights** that identify economic and social inequalities and inform policies **for a more equitable and prosperous society**.

AI has a hugely significant role to play in making our world a safer place, and not just within the digital realm of the internet. The University of Liverpool is undertaking research and delivering applied projects looking at crucial areas such as fighting international internet child abuse and using AI for monitoring the world's shipping to tackle piracy. Applications span local, national and international contexts.

The University's commitment to and investment in secure data infrastructure, are key to providing a world-leading environment necessary to facilitate our pioneering work. Such infrastructure provides the governance, access and other controls necessary that enable authorised researchers to access those data that are required to allow our research to take place. This makes it possible for our research to harness the potential of our data science, AI, big data, data engineering and data linkage experience and so provide insights which can inform, for example, police and criminal justice policy responses to contemporary challenges related to ensuring public safety. For example, a study of linked

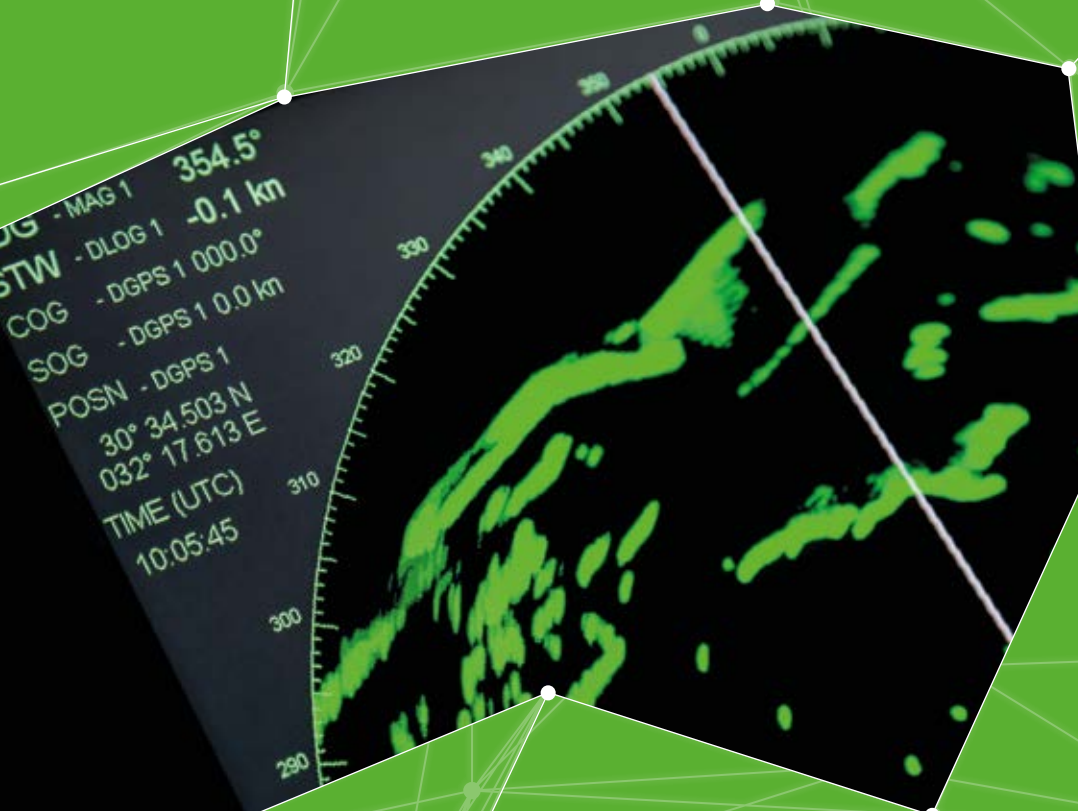
court and probation data examined whether court enforced alcohol abstinence reduces reoffending and demonstrated improved estimation of alcohol-related crime by capitalising on advanced geographic and data science methods.

As well as ensuring our world is safe from domestic and international crime, the University is at the forefront of protecting the UK against actors that represent a threat to national security and our citizens' safety. For example, there are unfortunately situations where our adversaries purposefully interfere with GPS and cause it to fail. It is also possible for the operation of satellites to be deliberately compromised, limiting

the ability of those satellites to support critical functions and operations.

The University is not only developing technological processes to minimise and counter these risks but also has the national and international partnerships that can help drive the associated financial return to the Northwest of the UK and the wider country. At the same time, the University is also training the people who can help the organisations involved around the world make best use of these technologies when responding to these challenges.

Our mission is not only to make our city safe but to ensure our world is a safer one, too.



Using AI to Expose Illegal Fishing at Sea

Illegal fishing threatens marine ecosystems, undermines coastal economies, and often goes hand in hand with other illicit activities such as smuggling and human trafficking. Yet detecting it remains a huge challenge. Fishing vessels operate far from shore, and while they are required to transmit their location through the Automatic Identification System (AIS), this data is often incomplete, misleading, or deliberately falsified.

At the University of Liverpool, researchers are tackling this challenge by developing new ways to spot suspicious behaviour in AIS data using artificial intelligence. Instead of relying on self-reported information about vessel type, which is often inaccurate, researchers have trained algorithms to classify ships based on the sequence of ports they visit. This novel approach makes classification of ship types more resilient to misreporting and manipulation.

The researchers also applied an automated method to identify “coopering” events, when two ships come unusually close together at sea. Such encounters can be dangerous, and repeated patterns may indicate illegal activity such as unregistered transfers of fish or goods. By analysing just one month of satellite AIS data from Southeast Asia, the team flagged 17 cases of unusual behaviour warranting further investigation.

This research, which has been published in the Journal of Marine Science and Engineering, is a step towards smarter surveillance systems that can help authorities prioritise where to focus their attention. Any future system would likely combine AIS analysis with other data sources, such as high-resolution satellite imagery, to confirm suspicions and guide enforcement. These AI-driven methods could play an important role in reducing illegal fishing and protecting the world’s oceans.



Generative AI and the Challenge of Misinformation

Generative AI (GAI) tools such as ChatGPT can create fluent, human-like text in seconds. This ability makes them powerful, but also very risky. Unlike humans, these systems do not truly understand knowledge. Instead, they predict the most likely sequence of words based on patterns in their training data. As AI pioneer Geoffrey Hinton has observed, their intelligence is “very different from the intelligence we have.” While GAI can process and reproduce vast amounts of text, it lacks the ability to reason about accuracy or consider consequences.

Interdisciplinary research at the University of Liverpool is tackling these risks by studying how GAI generates misinformation and exploring ways to redesign these tools for social good. Studies have shown that GAI systems can fake academic citations, fabricate book references, or distort key points from original texts. This makes them unreliable for tasks such as finding credible sources or summarising complex material.

GAI-generated misinformation is particularly dangerous because it is highly persuasive. In testing, systems like ChatGPT have quickly produced harmful instructions such as unsafe dieting advice or misrepresented academic content in ways that appeared authoritative. One study of AI-generated podcasts found that summaries omitted crucial methodological details, introduced misleading interpretations, and even invented definitions. Because these outputs are packaged in fluent, polished language, audiences are less likely to question them.

The risks extend beyond information quality to decision-making. For example, in recruitment scenarios, ChatGPT reinforced gender stereotypes by valuing male-associated traits such as “technical skills” and “quantifiable results” for leadership while downplaying collaboration and interpersonal skills. This shows that AI is not inherently more objective than humans; in fact, it can amplify existing biases.

To address these challenges, Liverpool researchers are reverse-engineering GAI to detect misinformation and developing conversational designs that encourage “reasonable parrots”. Further research focuses on digital inclusion, investigating what skills are needed for the responsible and effective use of AI. This has led to the development of a framework for AI literacy, designed to equip users with the competencies necessary to critically engage with these technologies.

PLACE & INNOVATION

A new **deep learning tool** from University of Liverpool researchers is mapping exposure to **unhealthy adverts**, giving policymakers data to support healthier communities.

AI tools may have the ability to connect us with people on the other side of the world, but a vast amount of what we use them for is to connect with local people, local information and local services.

The innovative world of AI is shaping the places we live in, according to the needs of the present and the future.

The University of Liverpool is tackling digital inequalities in communities through cutting-edge research. Their teams use urban analytics, participatory digital twin technologies, and social science methods to develop practical solutions that make towns and cities more inclusive and liveable for all residents.

Our innovations come in all shapes and sizes, from data analysis tools used to demonstrate levels of digital inequality and exclusion to Combining AI integration and a vector database to bring historical figures to life.

Digital tools developed by the University of Liverpool, have been used to analyse theatre patronage for the spatial targeting of outdoor advertising, while the Geographic Data Service has developed spatial indicators using tools and AI to

support the Liverpool City Region Combined Authority in a successful £1.6B City Region Sustainable Transport Settlement

Digital inequality in access and skills disproportionately affects marginalised communities. The University partnered with local organisations across Liverpool City Region, Greater Manchester, Scotland, and Wales to collect evidence on digital access and skills, informing local policy. Our place-based approach, working with local authorities and social housing providers rather than relying on top-down national initiatives has supported projects and advocacy efforts that helped millions gain access to digital benefits.

The opportunities and challenges that we face in the modern, digital world will continue to evolve, so it is clear how important it is to continue to build new methods and find new data sources to solve these evolving problems in a practical way.

PLACE & INNOVATION CASE STUDY

Building trust and readiness for the AI revolution

As part of the UK's Defence AI Strategy, University of Liverpool led the *Attitudes to Data* project which explored how organisations and individuals perceive and work with data and understand the technical, cultural, and ethical factors that shape AI readiness across sectors.

Through 76 creative, interactive workshops involving participants from government, higher education, non-profits, SMEs, the public sector, and consultancy, the research examined how people experience data both as employees and as citizens.

Using LEGO® Serious Play®-style workshops, participants physically modelled how data and AI flow through their organisations, addressing emotional, cultural, and practical barriers that traditional surveys often miss. This method revealed how deeply human attitudes and workplace cultures influence the success or failure of data initiatives.

Across different sectors, the research found that enthusiasm for AI and data innovation is widespread, but progress is hindered not by technology, but by culture and governance. Participants identified confusing policies, siloed systems, inconsistent access to data, and security concerns as persistent barriers.

A complementary national survey reinforced these findings, showing that AI readiness is limited by uneven skills, patchy data quality, and uncertainty about responsibility and accountability.

By mapping real-world experiences of data users against national policy ambitions, the *Attitudes to Data* project is helping shape guidance for organisations to improve their data environments, build trustworthy data practices, and support the responsible adoption of AI.

Its findings are informing best-practice recommendations for the UK's Defence AI Strategy and beyond — ensuring that AI readiness is built not only on powerful technology, but also on the human, ethical, and organisational foundations that make innovation sustainable.



PLACE & INNOVATION CASE STUDY

Liverpool City Region Community Data & AI Charter

A first-of-its-kind Community Charter on Data and AI was developed by members of the public from across the Liverpool City Region.

Formed through a Residents' Assembly of 59 people and backed by Mayor Steve Rotheram's "AI for Good" initiative, the charter outlines 11 guiding principles for how public data should be used and shared responsibly.

The Assembly was set up by the LCR Civic Data Cooperative (CDC), a project funded by the Liverpool City Region Combined Authority (LCRCA) and hosted by the Civic Health Innovation Labs (CHIL) at the University of Liverpool.

The charter aims to improve services such as healthcare by enabling better data sharing between organisations. It also supports the development of AI tools for public benefit, from tracking disease outbreaks to planning transport and tackling misinformation on social media.

The 11-point Charter is helping organisations such as the NHS, the University and the LCRCA's Office for Public Service Innovation tailor their data and projects to public expectations.

These three organisations were signatories of the charter, committing to use it in the approval and set-up of large-scale data and AI projects.

The top 5 points on the Charter selected by residents are:

- **Principle #1 Beneficial:** Use data and AI for the good and benefit of the community and the Liverpool City Region (LCR). Where possible, benefits should reach wider society as well.
- **Principle #2 Security:** Ensure that the Five Safes (Safe Data, Projects, People, Settings, and Outputs) and the UK General Data Protection Regulation are being adhered to.
- **Principle #3 Accountability:** Ensure accountability at all levels including a declaration of responsibility for each data and AI project.
- **Principle #4 Transparency:** Inspire trust between organisations and residents by being honest in how data is collected, used, and implemented in projects.
- **Principle #5 Inclusivity:** Promote fairness, universal access, and equity in the development of data and AI innovation. Ensure diverse and affected communities are involved and heard throughout the life of the project.

The launch of the Charter on Data and AI Innovation from our Residents' Assembly marks the embedding of this way of working as core business for the Liverpool City Region.

It demonstrates how we are fast becoming one of the most progressive places in the world for producing AIs that improve lives.



ENVIRONMENT & SUSTAINABILITY



Liverpool's **Virtual Engineering Centre** is developing AI agents that analyse open data to deliver **powerful regional and institutional insights**. Built for public-sector use, these explainable tools enhance policy benchmarking, research **mapping**, and **outcome forecasting**.

The local and global impacts of climate change are amongst the greatest threats we face to public health, the economy and biodiversity. AI has a dual role to play in helping us to understand the science and processes behind our changing climate and the actions we can take to mitigate its effects.

In both areas, the University of Liverpool is leading the way when it comes to AI innovation.

Research institutions have the ability and responsibility to utilise the very latest digital technology to help inform the decisions being made by policymakers on a local and global scale.

This can be seen in two University projects, the first of which is taking place in Greenland, on the forefront of climate change's impact on glaciers and the resultant sea level rises that pose such a threat to our way of life.

Data from the University's project is shaping how local and global policies are being created, based on a greater understanding of how the glaciers are being changed by human activity.

Closer to the home, the day-to-day impacts of air pollution are being closely tracked for the first time in Liverpool, giving authorities the ability to see how air quality varies across the city.

These projects represent how AI tools have taken us from the days of science simply capturing data to

where that data can be translated into a platform for exploration by people outside of the scientific community and used to inform policy.

This democratisation of the data has a significant potential role to play in environment and sustainability, not least in a historic port city like Liverpool, which has the chance to lead the world in regeneration of maritime spaces.

The importance of applications of AI for this area such as optimising port operations and supply chains, making them safer and more fuel efficient and tracking impacts on local populations are all the more evident and urgent when the data is there to evidence those impacts.

Another project using AI to improve our understanding and protection of the environment includes the new EPSRC Centre for Doctoral Training (CDT) in Net Zero Maritime Energy solutions (NOMES). A CDT is a specialised research and training program that focuses on developing doctoral-level expertise in specific areas of study. NOMES will pursue new, engineering-centred,

interdisciplinary research to address vital net zero challenges.

Meanwhile, the CLIMate SENSitive DISEase Forecasting Tool (CLIMSEDIS) uses climate data to help better predict and prepare for infectious diseases outbreaks, ranging from short range numerical weather prediction (NWP) models to seasonal forecasting systems and future climate change prediction models to forecast the risk posed by key vector-borne diseases at different time scales.

Investing in AI research and innovation to understand the science of climate change and the synergy between nature and the environment together with research and technology pathways to mitigate climate change have never been more critical.

These digital projects from the University have a crucial role in protecting the planet from inevitable impacts of climate change, as well as in achieving the UN's sustainable development goals and the UK's ambitious target of net zero greenhouse gas emissions by 2050.

ENVIRONMENT & SUSTAINABILITY CASE STUDY

AI-Powered Urban and Environmental Planning

Urban planning has traditionally been an exclusive domain of technical experts, with limited meaningful participation from communities most affected by development decisions. The integration of artificial intelligence is revolutionising this field, transforming urban planning from a closed, expert-driven process to an inclusive, data-rich discipline where environmental sustainability and community engagement converge through advanced technology.

The University of Liverpool has developed an innovative AI-powered platform that fundamentally reimagines how urban and environmental planning policies are shaped by public input. The tool employs natural language processing to analyse thousands of consultation feedback submissions, identifying key environmental concerns and priorities that might otherwise be lost in traditional consultation processes.

The platform's machine learning algorithms can process unstructured feedback from multiple channels, converting this diverse input into actionable insights. Where traditional consultations might receive hundreds of responses requiring weeks of manual analysis, the AI system processes tens of thousands of contributions in hours, detecting patterns in urban and environmental priorities across different neighbourhoods and demographic groups.

Central to the platform's development has been a series of public workshops bringing together residents, community organisations and planning professionals to shape the tool's design and governance framework. Our participatory approach to AI development has created unprecedented trust in the technology.



ENVIRONMENT & SUSTAINABILITY CASE STUDY

Glaciology in the age of AI

Glaciers and ice sheets are retreating rapidly due to climate change, and the consequences are being felt worldwide. Changing sea level, icebergs in newly opening Arctic trade routes, glacier driven flooding, landslides and avalanches are posing new risks to both environment and communities at large. Monitoring these rapid changes is essential. Advanced satellite systems now provide complete global coverage every six days, generating vast datasets of these complex systems that would be impossible to analyse without artificial intelligence.

At the University of Liverpool, we are getting glaciology ready for the AI revolution. Our researchers are generating the datasets needed train local and global scale models. In doing so, we are leading on the fundamental, but often unsung work that will be required for identifying these risks before they happen.

Powered by novel cloud-computing approaches that accelerate task efficiency from hours to seconds, our work has included meticulous manual analysis of satellite imagery from the entire Greenland Ice Sheet over the last 40 years. By applying machine learning to these data, we have disentangled the complex drivers of change at iceberg-producing glaciers in Greenland which account for half of its contribution to global sea level change.

Glaciers are also retreating in mountainous regions across the world, with our work also including the first global scale analysis quantifying how many glaciers have already been lost. Through automating analysis of more than 10 million satellite images, we have been able to show the impacts that climate change has already had on the global cryosphere and provide invaluable training data for AI models that will enable continuous monitoring of glaciers globally.

Our work is laying the foundation for transformative discoveries in our understanding of glaciers globally and how they will continue to impact people who live near and far from them. By uniting AI with decades of satellite surveillance, we are enabling new discoveries in how glaciers respond to climate change and how these shifts will affect societies. From Arctic shipping to water supplies in mountain regions, and the future of coastal cities worldwide.



IMPACT THROUGH ENTERPRISE



Introducing the Sir Peter Rigby Centre for Enterprise – a new home for entrepreneurial talent and innovation at the University of Liverpool.

At the Sir Peter Rigby Centre for Enterprise, we exist to empower people by developing entrepreneurial mindsets and skills. Our mission is to support individuals across the University and the Liverpool City Region, whether they're launching a business, bringing research to market, or building a meaningful career.

We offer dynamic opportunities for collaboration, inspiration, and growth, and you can play a part. By sharing your time, experience, and expertise, you'll help shape the next generation of entrepreneurs.

Together, we can support 50,000 people in turning ambition into reality.

Find out more about the various ways you can get involved, helping 50,000 people achieve their dreams.

Examples of academic spin-out companies in AI include:

AI-Sight – A novel artificial intelligence solution helping reduce vision loss for people with diabetes. It combines human expertise with AI to interpret and rank retinal images, reducing reliance on costly, limited specialist care.

Robotiz3d – Autonomous robotic platforms designed to detect and repair road damage, enhancing safety, cutting repair costs, and keeping maintenance teams out of harm's way.

SenseAI – Advanced process imaging powered by AI and developed by world-leading electron microscopy experts. Sense AI is transforming how images are captured and analysed across scientific fields.

Discover more at **Sir Peter Rigby Centre for Enterprise – Careers and Employability – University of Liverpool**

OUR FACILITIES



*In partnership with the STFC Hartree Centre (Science and Technology Facilities Council), the DIF is leading the creation of “**Meta-Liverpool**” – an exciting **new city scale digital asset** and policy modelling tool akin to that being developed by some of the **world's smartest cities**.*

Digital Innovation Facility (DIF)

The £12.7 million Centre of Excellence, The Digital Innovation Facility (DIF), launched in May 2022 through co-funding from the University of Liverpool and the Liverpool City Region Combined Authority. The DIF is the UK's leading centre for advancing and applying next-generation AI and digital technologies across a magnitude of industries.

The DIF is a purpose-built environment for collaboration including, state-of-the-art lab spaces, providing new opportunities to assist industry partners in developing meaningful research partnerships, across multiple academic disciplines.

The 1500 M² facility features cutting-edge equipment and highly skilled support to facilitate enhanced access for businesses that wish to collaborate with university experts across multiple technical areas, including robotics, data analytics, visualisation, simulation, and advanced modelling.

Specialist labs in the DIF include a Mixed Reality Lab containing the latest in immersive and virtual reality technology and equipment, an Extreme Environments Lab that simulates real-world hazardous conditions for testing robotics and autonomous systems, and an Immersive Laboratory that focuses on developing sensory technologies in areas of smell and touch for future “Tactile Internet” applications.

For more information visit:
www.digitalinnovationfacility.com/about-us/

OUR FACILITIES



The Virtual Engineering Centre (VEC)

The VEC is Liverpool's leading digital innovation and transformation hub, bridging the gap between academia and industry. Equipped with state-of-the-art facilities and an interdisciplinary team of engineers, developers, scientists, and commercial experts – many with first-hand start-up experience – the VEC specialises in AI, digital twinning, drones, application development, and data science.

The Team provides hands-on support for AI-focused start-ups, entrepreneurs and investors, helping to navigate the complexities of machine learning, computer vision, and predictive analytics challenges.

Beyond technical resources, VEC collaborators gain access to deep domain expertise, valuable industry connections, and capabilities in agile experimentation, rapid prototyping, and real-world testing – essential for accelerating, de-risking, and scaling solutions from ideation to deployment.

To date, the VEC has helped over 120 start-ups and 300 scale-ups develop Minimum Viable Products (MVPs) and launch more than 160 new products and services, in addition to its R&D and digital transformation projects with multinational enterprises (MNEs).

For more information visit: www.virtualengineeringcentre.com/about-us/

Materials Innovation Factory (MIF)

The MIF aims to develop next-generation functional materials for science and industry, accelerating the R&D process by up to 200-fold. The unique nature of the MIF, created through a unique suite of state-of-the-art, open-access facilities, provides a new template to allow researchers to work together and meet society's grand challenges whilst driving the UK's competitive advantage. With computer-aided materials science (CAMS) and high-throughput (HT) automation, new approaches to materials science and novel applications will be sought bringing materials chemistry into the 21st century; it is our belief that the benefits of large-scale aggregation of automation, control and cognitive computing are limitless.

The MIF activity spans Organic Materials, Inorganic Materials, Nanomedicines, Sustainability, Genomic Sequencing and High Throughput Formulation/Automation. It houses the Leverhulme Research Centre for Functional Materials Design to drive a design revolution for functional materials at the atomic scale by fusing chemical knowledge with state-of-the-art computer science.

For more information visit: liverpool.ac.uk/materials-innovation-factory/



*VEC's LCR4.0 initiative, funded by the European Regional Development Fund (ERDF), generated over **£121m** in GVA, driving the growth of the **manufacturing industry** across the Liverpool City Region supporting the adoption of **Industry 4.0 technologies**.*

Civic Health Innovation Labs (CHIL)

The Civic Health Innovation Labs (CHIL) is an interdisciplinary research centre tackling global health challenges with civic data and technology while driving positive change for the people of the Liverpool City Region.

Hosted at the University of Liverpool, the centre brings together leading experts from academia, the NHS, local government, charities and industry to develop a new model for progressive data uses and responsible artificial intelligence in civil society, fuelling innovations for health, social and economic advancement.

Building upon the University's strengths in **digital** and **health and life sciences** research, and impactful **civic data** partnerships, CHIL addresses a critical gap in population health and systems approaches to data, AI, and related technologies.

CHIL fosters an environment where data, expertise, technology, and community engagement intersect to help tackle some of the most pressing health, social and economic challenges of our time. CHIL's secure, collaborative data analytics facility and AI design studio support around £75m of research projects ranging from data science for discovering new medicines and tackling infection threats to AI interventions in mental health, social care and fairer use of resources across health systems to protect vulnerable individuals, households and other groups.

CHIL is the academic delivery partner for NHS Cheshire and Merseyside Data into Action programme and the technology partner for Liverpool City Region Office for Public Service Innovation. It's Civic Data Cooperative has delivered a Community Charter for Data and AI and the Centre provides a space where members of the public can work with researchers and public service professionals to design and evaluate the AI that affect their lives.

For more information visit: liverpool.ac.uk/civic-health-innovation-labs/

Liverpool Shared Research Facilities (LIV-SRF)

Liverpool Shared Research Facilities offers external organisations flexible access to world-class equipment, facilities and expertise.

Working across more than 20 facilities, with over 100 dedicated staff and £60m-worth of equipment – their highly experienced professionals are leaders in their fields who can guide your research project and harness the available technologies to the full.

The LIV-SRF offer is fully flexible, designed around your needs and ways of working. They welcome all kinds of engagements, lengthy and complex or small, quick-turnaround assignments.

For more information visit: liverpool.ac.uk/research/facilities/shared-research-facilities/

*Driven by automation, autonomy and machine learning, the MIF is **working in partnership** with the FMCG industry to **unlock new materials** for sustainable household products, **transforming** the chemical **supply chain**.*



DEVELOPING NEXT-GENERATION AI EXPERTS

Centres for Doctoral Training (CDTs)

The University leads or partners in several CDTs focused on developing the next generation of researchers in digital fields. These cover a wide range of specialisms, including Innovation in Data Intensive Science, Distributed Algorithms, Risk & Uncertainty, Digital & Automated Materials Chemistry, Data Analytics & Society, and more!

CASE STUDY

Using high-power computing to enable bedside 3D chest imaging LIV.INNO students apply their skills to Adaptix innovation project.

Researchers in the Liverpool Centre for Doctoral Training for Innovation in Data Intensive Science (LIV.INNO) are collaborating with Adaptix in developing a low-cost, low-dose 3D chest X-ray device. LIV.INNO, supported by STFC, trains students in the use of artificial intelligence (AI), machine learning and data analysis, offering them the opportunity to tackle real-world challenges alongside their research.

Adaptix innovative technology uses digital tomosynthesis, firing X-rays from multiple angles to create detailed 3D visualisations. The technology has the potential to overcome limitations of traditional 2D X-rays, which can miss critical diagnoses. Dr Steve Wells, CTO at Adaptix, explains that "CT and MRI provide much better images, but they are expensive and in the case of CT also deliver a much higher dose of radiation."

The collaboration was recently awarded £400k by STFC for the OptiX project, aiming to revolutionise chest imaging through the application of AI and machine learning techniques developed by students and staff from LIV.INNO.

Dr Steve Wells, Chief Technical Officer at Adaptix, highlights the benefits of working with LIV.INNO: "We faced challenges in optimising emitter

array systems, and the data science experts at Liverpool applied advanced modelling techniques, such as genetic algorithms, to find optimal solutions efficiently."

Potential applications of OptiX include improved detection of cystic fibrosis and better placement of nasogastric tubes. Importantly, it could enable earlier lung cancer diagnosis, often missed in conventional 2D imaging.

Dr Wells emphasises the impact: "Early detection with our mobile 3D X-ray scanner could make quality diagnosis more accessible and significantly improve survival rates."

Adaptix is currently working on regulatory approvals, with promising feedback from radiologists.

"There is a shortage of skills in AI; our demanding industry projects enable the co-development of solutions to intractable problems, creating competitive advantage for the companies and invaluable commercial skills and experience for our staff and students," Professor Carsten P Welsch, Director of LIV.INNO and leader of the OptiX project.

For more information visit:
liverpool.ac.uk/doctoral-training

University of Liverpool Fellowships

Revolutionising research innovation

Do you have an original and compelling vision for harnessing the power of AI for research? Bring it to life at Liverpool.

Our prestigious five-year fellowships cultivate future research leaders, providing the time, resources, and collaborative environment needed to push boundaries, challenge convention, and deliver real world impact.

For more information visit:
liverpool.ac.uk/research/fellowships

Study with Liverpool

The University of Liverpool, renowned for its outstanding teaching, resources, and student success, is a top destination for digital studies.

New to the field? Our Data Science & AI MSc welcomes students from non-computing backgrounds, providing essential skills in mathematics, data mining, AI, and programming.

Looking to advance your career? Our **MSc in Computer Science conversion programme** is a proven pathway into PhD programmes and high-impact industry roles.

Already working? Expand your expertise with tailored workforce training options, such as Continuing Professional Development (CPD) in Health Data Science.

Discover more opportunities here:
www.liverpool.ac.uk/study/

Sir Robin Saxby studied

Electronics at the University of Liverpool and went on to be **CEO** of the **global company ARM**, who make the processors that **power 95% of smartphones**.

INNOVATION THROUGH COLLABORATION

Your gateway to university expertise

The University of Liverpool's world-leading research, underpinned by our Research Frontiers and Interdisciplinary Centre for Sustainability Research (ICSR), together with our collaborative ethos and state-of-the-art facilities, empowers our academic community to partner with you to address societal challenges and deliver innovative solutions for your organisation.

Our expert teams can connect you with the right people and tailor solutions for any business need – whether for a single project or a long-term partnership.

Our teams have worked with **market-leading companies**, including Unilever, NVIDIA, Roche Diagnostics UK and Ireland, IBM, Ricoh, NSG, Jaguar Land Rover, and SMEs alongside NHS partners to **develop** a wide range of digital solutions with **real-world impact**.



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Ways to engage

Research Collaborations and Partnerships

Establish a partnership or framework and work with us to bring together new ideas and key capabilities to your complex challenges and research and development programs.

Consultancy

We offer a dedicated consultancy service, enabling staff to share their skills and apply their research expertise to help a wide range of organisations.

At the University of Liverpool, we are constantly generating ideas, making discoveries and finding innovative solutions to overcome challenges and make a direct impact on society.

Whether you require support for a one-off project or a longer term collaboration, our consultancy services can combine world-class expertise with **access to state-of-the-art facilities and equipment** to create a tailor-made solution that meets your needs.

Access to Facilities and Equipment

Access our specialist laboratories and facilities equipped with the latest cutting-edge research instrumentation, managed by highly trained staff.

Enterprise: Licensing & Ventures

Turning research into innovations that solve global challenges – our portfolio of commercial licensing and spin-out opportunities are available for partnership across many various sectors.

Knowledge Transfer Partnerships (KTPs)

KTPs enable organisations to work in a mutually beneficial, grant-funded partnership with our academics to transfer knowledge into your workplace to address a strategic need and improve your competitiveness and productivity.

Access to Talent

Benefit from the training and ideas from our undergraduates, graduates and postgraduates through student projects and placements.

For more information visit: liverpool.ac.uk/collaborate

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Or simply scan the QR code below to connect with us:



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