

By Josh Fearn,
Lydia Harriss,
Clare Lally
28 June 2023

Data science skills in the UK workforce



Overview

- Across the UK workforce, there is increasing demand for specialist data skills (including skills for artificial intelligence), which have the potential to bring economic and social benefits.
- Evidence suggests that availability of people with specialist data skills in the UK is insufficient to meet demand. A 2021 study found that in the UK, the supply of data scientists from universities was unlikely to exceed 10,000 per year, yet there were potentially at least 178,000 unfilled data specialist roles.
- Research finds that certain groups (such as women, those from minority ethnic backgrounds and people with disabilities) are underrepresented in the data workforce. A lack of workforce diversity has the potential to amplify existing inequalities and prejudices.
- Efforts to reduce the skills gap can be hindered by the inconsistent definition of data skills, organisational culture, the availability of specialist primary and secondary school teachers, and barriers to people moving between sectors.
- Initiatives to increase the number of people with data skills include degree conversion courses, doctoral training centres for PhD students, online upskilling platforms, apprenticeships, and visas to attract international talent.
- A 2022 inquiry by the Lords Science and Technology Committee found that there was a mismatch between the scale of the UK's STEM skills gap and the solutions posed by the Government.

Background

Data science is an umbrella term for fields that use large quantities of data to discover actionable insights.¹⁻⁵

Data science projects typically begin with data collection, processing and storage (where data are assembled, cleaned and loaded into a repository), followed by the final stages of analysis and modelling.² The final stages may involve artificial intelligence (AI), a branch of computer science concerned with developing systems that carry out tasks normally requiring human intelligence.⁴

Data science projects may involve a team with a range of roles such as data scientists, data engineers, data analysts, and data stewards.⁶ These roles require both technical and non-technical skills at a range of levels.

This POSTnote primarily focuses on the skills needed for data analysis and modelling, which require technical skills, such as data visualisation and programming; and non-technical skills, such as communication, creative thinking, and data ethics.⁷⁻¹¹

Collecting and analysing data offers potential economic and social benefits.¹²⁻¹⁴ In 2019, an analysis by the McKinsey Global Institute estimated that, by 2030, UK GDP could increase by up to 22% as a result of AI.¹⁵ Most of this growth was expected to stem from productivity improvements and consumer product development, by providing consumers with greater choice and more personalised products.¹⁵⁻¹⁸ Potential social benefits could range from climate change mitigation, where analysing large data sets can help to monitor deforestation, to improving early detection and diagnosis of cancers by using AI to identify patterns from imaging (MRI) scans that are not readily detected by humans ([POSTnote 637](#)).¹⁹⁻²¹ However, greater automation through AI or robotics may also bring challenges, for example through the potential displacement and creation of jobs ([POSTnote 534](#) and [CDP-0090 \(2023\)](#)).²²⁻²⁴

The McKinsey Global Institute's AI Readiness Index* found that the UK ranked in the top 25% for AI readiness in 2019, when compared with the US, China and EU countries.¹⁵

In its National AI Strategy, the UK Government emphasised the importance of developing and attracting people with specialist data skills to maintain this position.^{25,26} Additionally, the National Data Strategy recognised 'data skills' as one of four pillars to ensure the UK benefits from data.²⁷ Other key factors include ensuring that data is available, fit for purpose, and used responsibly;²⁶ and that the UK has secure and resilient infrastructure for storing and processing data.^{27,28} However, these other factors are beyond the scope of this briefing.

Organisations have reported a shortage of data skills across the UK workforce.^{13,29-32} A 2020 Ipsos Mori survey of 118 UK public and private sector organisations using AI or developing AI-led products or services, found that 62% of respondents could not meet their goals because job applicants and existing staff lacked the skills needed to work with AI.³¹ In 2021, the former Department for Digital, Culture, Media and Sport

* The McKinsey Global Institute's AI Readiness Index considers factors such as research, start-up investment and human capital.

estimated that the supply of data scientists from UK universities was unlikely to exceed 10,000 per year, yet there were potentially at least 178,000 data specialist roles to be filled.²⁹ Therefore other supply pathways, such as upskilling the current workforce ([POSTnote 659](#)), are important for bridging the UK data skills gap.^{29,33,34}

The UK Government has a number of initiatives aimed at addressing the UK's Science, Technology, Engineering and Mathematics (STEM) skills gap. A 2022 inquiry by the Lords Science and Technology Committee concluded that a mismatch exists between the scale of the UK's STEM skills gap and the solutions proposed by the Government, especially given the UK's ambition to be a "science and technology superpower".^{35,36} It described the Government's policies as "inadequate and piecemeal".

The UK data science skills landscape

Demand for skills

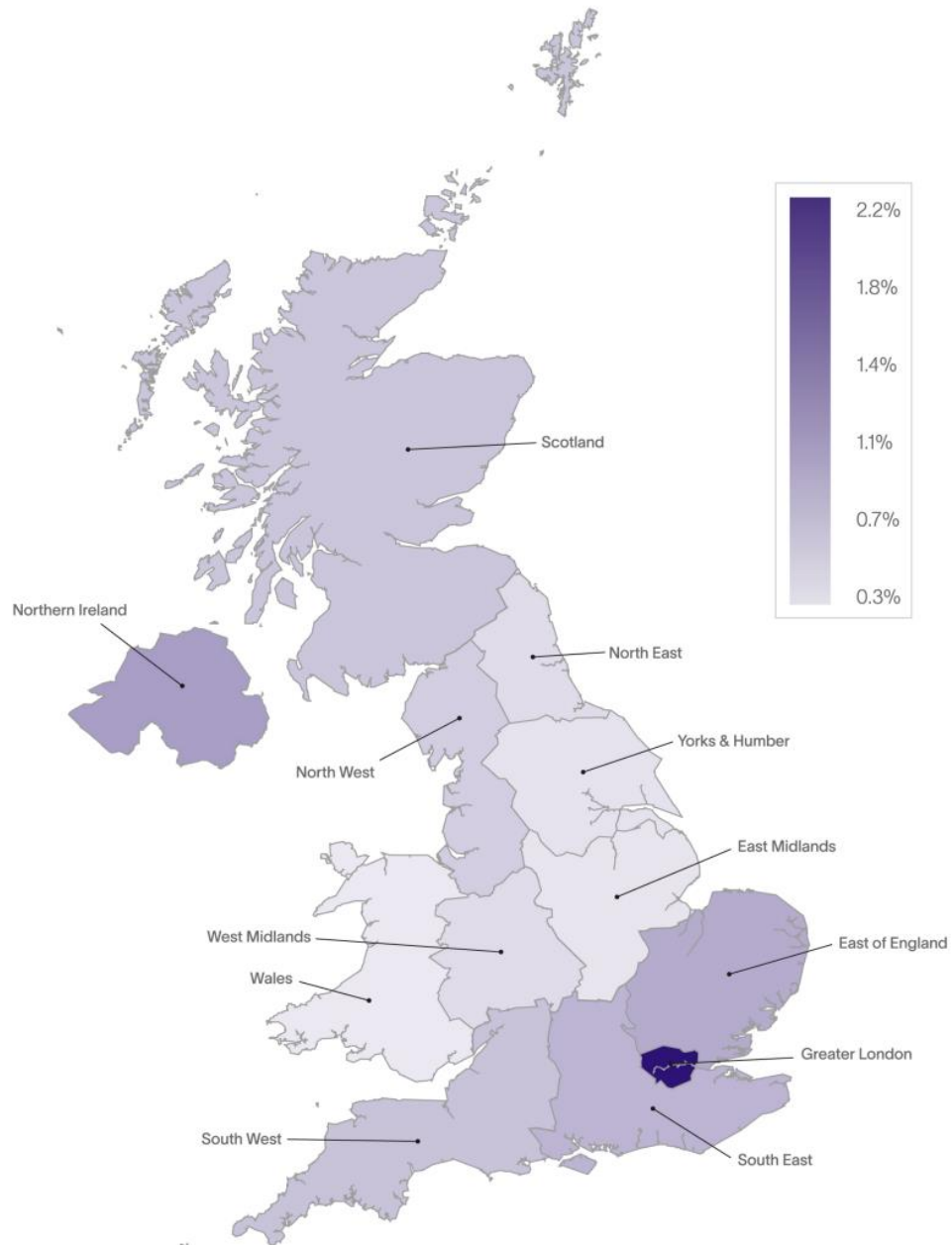
Employer demand for specialist data skills is growing across a wide range of industries.^{29,37} Analysis suggests that between 2013 and 2018, job adverts for Data Scientists and Advanced Analysts increased by 231%, compared with a 36% increase in UK-based job postings overall.³⁸ In 2021, a survey by Opinium Research found that, out of 1,045 UK businesses, 48% were recruiting for roles requiring data skills (ranging from basic IT skills to programming).²⁹

Regional variations

Demand for specialist data skills varies across the UK, which may be linked to areas that have a high density of digital technology companies and universities (Figure 1).^{37,39-41} In 2021, an analysis by Lightcast[†] showed that Greater London, with its large number of IT and finance companies, had the highest demand for specialist data skills: 2.2% of job postings in this area mentioned AI.³⁷ This was followed by Northern Ireland (1%), the East of England (0.9%), and the South East (0.8%).³⁷ Across the Midlands and North of England, the percentage of job postings mentioning AI ranged between 0.4 and 0.6%.³⁷

[†] Lightcast is a labour market analytics company.

Figure 1: Proportion of job postings in 2021 requiring AI skills, across the UK (%)



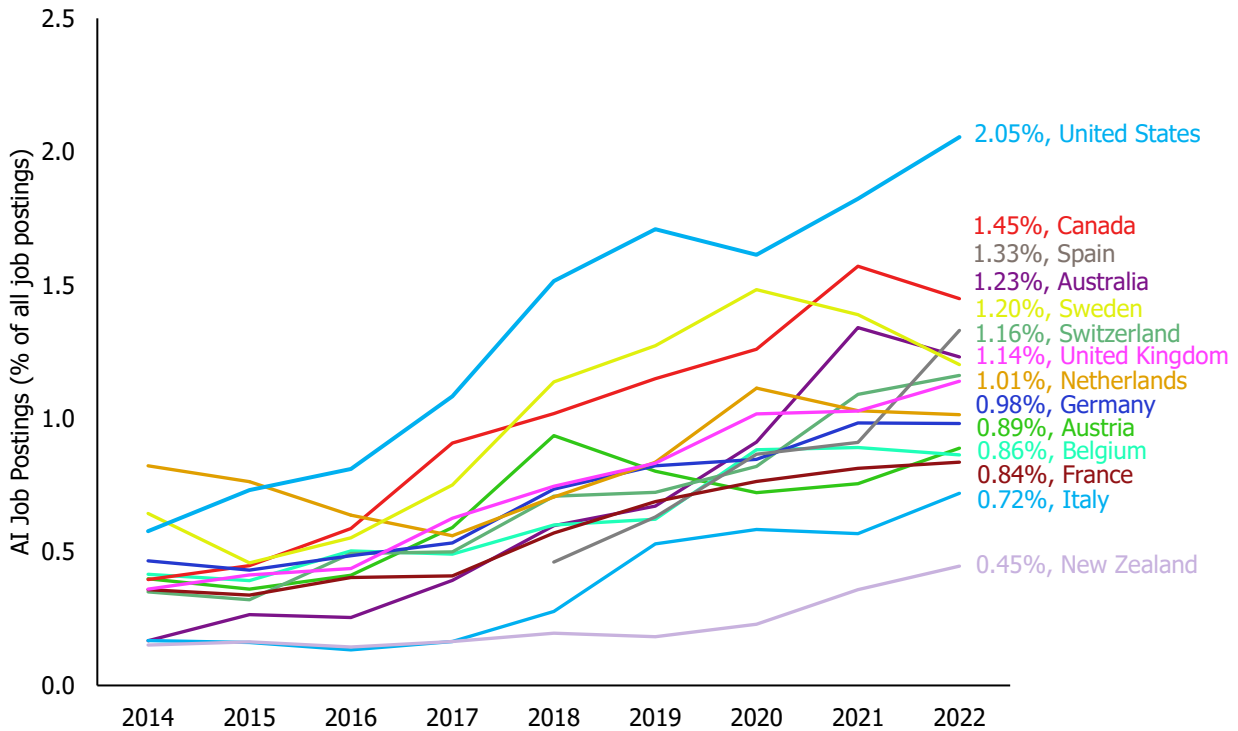
Source: provided to POST by Lightcast, based on the Lightcast study 'Artificial Intelligence in the UK' that analysed over 8.7 million job postings across the UK.³⁷

International comparisons

According to Lightcast, the demand for AI skills has increased since 2014 in six G7 countries, as well as in Spain, Australia, Sweden, Switzerland, The Netherlands, Austria, Belgium and New Zealand (Figure 2).⁴² Compared to other European countries, the UK has one of the highest demands for AI professionals. Moreover, a 2021 study by the Centre for Security and Emerging Technology think tank found that 5.4% of job postings in China were technical roles that involved working with AI.⁴³

Internationally, demand is predicted to continue increasing. In 2023, the World Economic Forum surveyed 803 global companies and found that 'AI and Machine Learning Specialists' and 'Data Analysts and Scientists' roles were in the top 10 jobs expected to grow fastest between 2023 and 2027.⁴⁴

Figure 2: AI share of total job postings between 2014 and 2022 (%)



Source: based on Lightcast data from the report 'Artificial Intelligence Index Report 2023' that analysed job postings from over 51,000 online job sites worldwide.⁴² (Please note: data for Spain was only available from 2018.)

Supply of skills

Between 2017 and 2022, the Organisation for Economic Co-operation and Development found that the percentage of UK LinkedIn members with self-declared AI skills, or who were employed in an AI role, had quadrupled from 0.33% to over 1.4%.⁴⁵ However, stakeholders have noted that the current supply of specialist data talent through the main pathways (Box 1) is insufficient to meet demand.^{29,31,39,46,47}

Respondents to the 2020 Ipsos Mori survey reported that skills gaps were limiting innovation and organisations' abilities to conduct larger, complex projects.³¹ It also found a lack of technical and non-technical AI skills across employees and job candidates.³¹

- **Technical skills** gaps were reported by 49% of surveyed employers, across a range of technical areas.³¹ This included knowledge of AI concepts and algorithms; programming and software engineering skills; and specialist data skills (including statistics) to manage and analyse data sets.³¹

- **Non-technical skills** gaps were an issue for 32% of firms.³¹ Reported shortages included a lack of awareness of privacy or ethical issues, potential bias in the use of AI, and a lack of commercial awareness.³¹

Box 1: Pathways to acquire skills

There are four main routes for developing technical and non-technical data science skills:

- **Academic pathway:** where people study a STEM degree at university.^{48–50} This may be followed by further study through a Masters or Doctorate (such as a PhD or EngD).^{51,52} This pathway includes students who complete a degree in a non-STEM subject and enrol in a conversion course, allowing them to learn a new discipline without background knowledge.^{53,54} The 2020 Ipsos Mori study showed that 42% of organisations surveyed said employees joined at the start of their careers.³¹
- **Upskilling pathway:** the upskilling of existing employees, usually from roles outside of data science ([POSTnote 659](#)).³³ In 2020, the KRC Research consultancy surveyed 12,000 people working within enterprise companies (with more than 250 employees), including 600 in the UK. It found that 17% of UK employees were part of an upskilling process – compared to the 38% average reported globally.⁵⁵ Respondents to the World Economic Forum’s 2023 survey of global companies highlighted ‘AI and big data’ as one of the top three upskilling priorities.⁴⁴
- **Vocational pathway:** where students learn data science skills through apprenticeships or internships.^{56,57} This can include degree apprenticeships, where people obtain a degree alongside working.^{58,59} Vocational pathways are less common within the AI workforce. The 2020 Ipsos Mori survey found that 11% and 3% of respondents said that employees entered as interns or apprentices, respectively.³¹
- **International pathway:** where skilled individuals are granted visas enabling them to work in the UK.^{25,60}

Demographic composition of the data science workforce

A diverse workforce, with people that have a range of different experiences, knowledge and characteristics, can bring benefits to organisations.^{61–63} This includes improving decision making by bringing together employees with different perspectives, increasing innovation by building teams with unique experiences, and improving business performance.^{62,64} For example, a 2020 McKinsey Global Institute study of 1,000 large firms found that those in the top 25% for gender diversity were 25% more likely to have above-average profitability than firms in the bottom 25%.^{62,64}

The Alan Turing Institute[‡] highlighted that having a diverse workforce is not just about equal economic opportunity and social justice, but also fairness and ethics.⁶⁵

For organisations working with AI and using algorithms, a lack of workforce diversity has the potential to amplify existing inequalities and prejudices, for example through algorithmic bias, where automated systems produce systematically prejudiced results (POSTnote 633).^{66–68} This can perpetuate social inequalities when AI systems are used to make decisions, such as whether a person is invited to an interview or selected as a tenant for a rental property.^{67,69–72}

In a review of bias in algorithmic decision-making, the Centre for Data Ethics and Innovation[§] concluded that having more diverse teams made the identification of biases more likely and their replication less likely.⁷³ It advised organisations deploying decision-making algorithms to make diversity across their workforce a priority.⁷³

Data about the demographics of the data science workforce is very limited.^{65,74} However, studies indicate that there are demographic disparities in the UK's data science workforce, including on the basis of gender, ethnicity, disability and socio-economic background.^{65,69,75}

- **Gender:** The 2020 Ipsos Mori study found that across surveyed organisations, 24% of employees in AI roles were women.³¹ Meanwhile, 53% of organisations had no female employees in AI roles.³¹ Research in 2021 by the Alan Turing Institute found that women in AI and data roles were more likely to occupy a job associated with lower status and pay, even though, on average, across all industries, women had higher formal education levels than men.⁶⁵

Women are also underrepresented in education.⁷⁶ The Joint Council for Qualifications^{**} found that girls represented 21% of students taking a GCSE in computing in 2022.⁷⁷ While according to the Higher Education Statistics Agency, women comprised 23% and 20% of higher education students on computing and engineering courses (respectively), in the 2021/22 academic year.⁷⁸

- **Ethnicity:** Employees from minority ethnic groups made up 27% of the AI workforce, across firms in the 2020 Ipsos Mori survey.³¹ This was higher than the proportion of people aged 16 and over from minority ethnic backgrounds in the UK population (approximately 13% in 2021).⁷⁹ The report also showed that diversity varied between firms; 40% of firms reported no employees from minority ethnic groups in their AI teams.³¹
- **Disability:** There is a lack of data about the participation of people with disabilities in the data science workforce.^{65,80} However, evidence exists for IT specialists. Analysis of the Office of National Statistics (ONS) Labour Survey, found that in 2020 there were 158,000 IT specialists in the UK with disabilities – accounting for 10% of all IT specialists.⁸¹ Compared to the general population,

[‡] The Alan Turing Institute is the UK's national institute for data science and AI.

[§] The Centre for Data Ethics and Innovation is a UK Government body that aims to enable the trustworthy use of data and AI.

^{**} The Joint Council for Qualifications is a membership organisation comprising the eight largest qualification providers in the UK.

this was lower than the proportion of the UK workforce with disabilities, which was approximately 14%.⁸¹

- **Socio-economic background:** The 2020 Ipsos Mori study found that views on socio-economic diversity were mixed.³¹ Some participants were concerned that there were few AI professionals from working-class backgrounds, while others did not think this was an issue.³¹ Some said that they found it harder to judge the socio-economic diversity of their workforce because it is a less visible criterion.³¹

Challenges with bridging the skills gap

Definition and awareness

There is no agreed definition of a data scientist role, and practitioners in different organisations may have different skills profiles.^{27,29,38,82–84} Role requirements also change over time.³⁸ Research by analytics company Burning Glass Technologies^{††} found that in 2013, the most common skills required for data science roles included statistics, data analysis and Microsoft Excel.³⁸ In 2021, Lightcast found that the most frequently requested skills included software engineering and programming languages Python and SQL.³⁷

Inconsistent role requirements, and a diverse understanding of what a data scientist is, can make it difficult for employers to recruit the right people.²⁷ The Alliance for Data Science Professionals has defined the professional competence and behaviour expected of data professionals, and developed standards to inform the certification of professionals and accreditation of data science degrees.^{86–89} Further, the National Careers Service has established an AI Data Scientist profile to explain what being a data scientist involves, the skills required, and available training routes.^{7,90}

Organisational culture

Numerous stakeholders have identified the need to upskill workers across organisations.^{29,91–93} However, a 2020 Microsoft report highlighted that upskilling is often under-utilised as a way to increase AI talent within firms.⁵⁵ The same report found that UK business leadership focused on implementing AI tools before considering their employees' ability to work with AI.⁵⁵ It called for business leaders to provide employees with flexible learning opportunities (such as a choice between formal and experience-based training) and career development paths to encourage upskilling.^{55,93}

In 2022, Coleman Parkes Research surveyed key-decision makers across 39 organisations in the UK and Ireland and found that, although upskilling may be more cost effective than recruiting, senior management can be reluctant to invest due to

^{††} Burning Glass Technologies merged with labour analytics firm, Emsi, in 2021. The combined company was re-named to Lightcast in June 2022.⁸⁵

concerns employees will leave after being trained.¹³ It also highlighted staff motivation and limitations in available time as reasons behind upskilling shortages.¹³

In 2021, the Data Skills Taskforce launched a self-assessment tool to help businesses understand their organisational and technical readiness with respect to data, and to provide signposting to resources and training.⁹⁴ Further, in 2023, the UK Government published a Data Maturity Assessment for public sector organisations to identify their capability, effectiveness and readiness to use data.^{95,96}

Teaching

There is a shortage of computing teachers across primary and secondary schools.^{97,98} In England, the UK Government met 30% of its 2022/23 target for new entrants onto secondary initial teacher training courses for computing.⁹⁹

In 2017, Pye Tait Consulting surveyed 945 primary and secondary teachers, and 48% rated their confidence in delivering computing education as less than 7 out of 10.^{97,100} A common explanation for this was that they lacked technical knowledge.^{97,100} The same survey found that 30% of secondary schools had reduced teaching time available for computing, allowing less time for teachers to build experience and confidence.¹⁰⁰

Various stakeholders have highlighted the need to support teachers by offering improved continuing professional development, and for higher education institutes to promote careers in computing education.^{38,39,101,102} For more on data science in the school curriculum, see 'Pre-18 education' below.

Cross-sector workforce movement

Barriers may prevent skilled workers from collaborating and moving between industry, academia, and the public sector.³⁸ Fewer permanent positions exist in some sectors, such as academia, which may reduce willingness to transfer to academic roles.¹⁰³ Further, career opportunities may differ between sectors. For example, some academics may be discouraged from moving into industry or collaborating with industry partners if it means fewer opportunities to publish their research.³⁸ However, in some cases, academics and public sector workers may be attracted to industry by higher salaries and more advanced technological tools.^{104,105}

There have been calls to improve the flow of talent to ensure all sectors benefit from data science.³⁸ In 2017, the Royal Society highlighted the need for more teachers to work simultaneously in both industry and computing education, so that they can benefit from industry knowledge and experience.⁹⁷ Additionally, in 2021 the UK AI Council^{††} highlighted that greater collaboration between universities, colleges and businesses was needed to increase the supply of data skills.¹⁰⁶

Initiatives to share knowledge across sectors exist.^{107,108} For instance, the Institute for Government think tank brings together stakeholders to demonstrate how data can make government more effective.^{109,110} The 10 Downing Street data science unit and

^{††} The AI Council is a non-statutory expert committee of independent members set up to provide advice to the Government and leadership for the AI ecosystem.

the ONS Data Science Campus also run fellowships that bring academics with data science expertise into the public sector.¹¹¹ Further, the Turing Internship Network enables doctoral students to engage with industry from across a range of sectors.¹⁰⁷

Initiatives to reduce the skills gap

Developing data skills within the education system

Pre-18 education

The school curriculum varies across the UK ([POSTnote 643](#)).^{112–116} In England, foundational data science skills are developed in primary school through statistics and computing.¹¹⁷ At secondary school, students learn programming languages, data handling techniques, and more complex analysis and data visualisation methods.¹¹⁷

Whilst aspects of data science and computing are taught across the curriculum, there is no focus on AI.^{117,118} In 2018, the Royal Society recommended that awarding organisations should review GCSE Computing to reflect developments in data science.¹¹⁷ This was echoed by the UK AI Council in 2021, which highlighted that children leaving school should have a basic sense about how AI works.¹⁰⁶ However, witnesses to the House of Lord's Select Committee on AI suggested that such changes may result in less time for teaching arts and humanities that develop creative thinking and communication skills.¹¹⁹

T-Level courses were rolled out in England in 2020.¹²⁰ Equivalent to 3 A-Levels, they involve an industry placement alongside classroom-based learning.^{120–122} The Digital Business Services T-Level covers the use of data in software development, ethical and moral aspects of technology, and use of systems to analyse and solve problems.¹²²

The National Centre for Computer Education provides professional development for teachers in England, from primary to A-Level.^{123–125} It also offers students free online courses on topics including software engineering, data storage and algorithms.^{126,127}

A range of industry and third-sector organisations run initiatives aimed at school students. For example:

- **The Raspberry Pi Foundation^{§§}** runs the Code Club World platform for 9 to 13 year-olds, enabling them to develop games, characters and animations.¹²⁸
- **BAE Systems^{***}** runs school roadshows to demonstrate the practical applications of science to UK students aged between 10 and 13 years.¹²⁹

^{§§} The Raspberry Pi Foundation is a UK-based charity.

^{***} BAE Systems is a defence, security and aerospace company.

Post-18 education

Universities are increasingly offering courses in data science and related fields. According to the Universities and Colleges Admissions Service, there are over 800 such undergraduate and postgraduate courses available for 2023/24, compared to 311 in 2018/19.^{31,130}

Between 2020 and 2023, the UK Government provided £13.5 million of funding to support English universities to develop data science and AI conversion courses.^{131,132} Part of this was used to offer 1,000 scholarship places on these courses to students from underrepresented groups.¹³¹ For UK-domiciled students awarded scholarships between 2020 and 2022, 73% were women, 59% had a minority ethnic background, and 26% reported a disability.¹³³ In 2022, the Government announced up to £17 million for 30 English universities to deliver another 2,000 of these scholarships between 2023 and 2025.^{131,134}

Additional support has been made available at a doctoral level, with £117 million of public funding announced to train PhD students at AI Centres for Doctoral Training (CDTs) from 2024/25.^{135,136} This investment builds upon 16 existing centres funded in 2019.^{136,137} The 2021 Alan Turing Institute survey of people developing or working with AI in the UK, asked what was effective in providing the workforce with AI skills.¹⁰⁵ Respondents frequently cited higher education courses, especially CDTs.¹⁰⁵

Universities and businesses have forged partnerships to share expertise.¹³⁸⁻¹⁴² For example, the University of Cambridge partnered with Microsoft to develop AI tools.¹⁴² Similarly, the University of Manchester and BAE Systems established the Data Science Accelerator to share expertise in data captured from fast jet flight.¹⁴⁰

The Alan Turing Institute supports higher education teachers through its Data Science and AI Educators Programme, by providing training in educational practice to build confidence and capacity in data science and AI teaching.¹⁴³ Further, it runs the Data Science Education Interest group, that brings together educators, researchers and industry to collaborate and share best practice.¹⁰⁸

Developing data skills within workplaces and beyond

Public sector initiatives

The UK Government provides various [sources of funding](#) to support adult learning, including the National Skills Fund, Advanced Learner Loans, and the Education and Skills Funding Agency (ESFA).^{121,144-146} The Government plans to introduce a Lifelong Loan Entitlement in 2025 to support lifelong learning (see [POSTnote 659](#)), by providing people with a loan to enable them to learn, upskill or retrain during their working lives.^{33,146,147} ESFA Skills Bootcamps provide a range of free courses of up to 16 weeks, including those that develop data science skills.^{148,149} Additionally, employers can use Skills Bootcamps to upskill their staff, by contributing 10-30% of the training costs, based on business size.¹⁴⁹

The ONS Data Science Campus upskills workers across Government and the wider public sector to develop data science capabilities.¹⁵⁰ It runs courses ranging from raising awareness to developing advanced skills.¹⁵⁰

The Lords Science and Technology Committee's 2022 inquiry into people and skills in UK STEM concluded that it did not hear sufficient evidence from the Government that the impact of initiatives was enough to address the STEM skills shortage.^{35,36}

Bringing international talent to the UK

The UK Government has several visa routes that aim to attract international talent across different sectors, including technology.^{60,151}

- **High Potential Individual Visa:** aimed at graduates from top global universities, enabling them to come to the UK without a job offer.¹⁵²
- **The Global Talent Visa:** aimed at bringing talent to the UK.^{153–155} In 2022, the Home Office surveyed 307 Global Talent Visa holders. Of these, 33% thought the £623 visa application fee was unfair,^{156,157} and 59% thought the Immigration Health Surcharge (a fee applicants pay to use UK healthcare) was unfair.^{156,158}
- **Scale-up Worker Visa:** intended to support fast-growing UK businesses by allowing entrance to the UK for individuals with a high-skilled job offer from a qualifying UK 'scale-up' (subject to the company's revenue or employment growth rate).¹⁵⁹
- **Innovator Visa:** aims to enable international entrepreneurs to start innovative businesses in the UK. It was recently modified to remove barriers that had previously existed, such as ensuring applicants had at least £50,000 in investment funds and restrictions on working outside of their primary business.¹⁶⁰
- **Global Business Mobility Visa:** intended to support multinational companies to expand by transferring workers to the UK.¹⁶¹

Respondents to the 2021 Alan Turing Institute survey of people developing or working with AI in the UK, were asked what one incentive the Government should implement to reduce barriers to recruiting and retaining top AI talent.¹⁰⁵ The most common response was to relax immigration rules relative to other countries, to avoid visa restrictions impacting the UK's ability to compete for global talent.¹⁰⁵

Industry initiatives

Across industry, there are initiatives that aim to equip the current workforce with data skills (Box 2).¹⁶² To further incentivise upskilling initiatives, the UK AI Council recommended in 2021 that the Government extend business tax relief to investment in upskilling initiatives.¹⁰⁶

Industry initiatives also introduce data skills into the workforce through vocational pathways. For instance, insurance company Aviva offer a Data Apprenticeship for school leavers or those looking for a career change,¹⁶³ and Lloyds Banking Group run Data Analyst Apprenticeships across business areas such as cash management, payments and client servicing.¹⁶⁴

Box 2: Examples of industry upskilling initiatives

- **Sainsbury's Bootcamp:** a 16-week programme to upskill employees, with the possibility of moving into data engineering or analyst roles afterwards.¹⁶⁵
- **Grow with Google:** a publicly available online platform with courses from data analytics to coding.¹⁶⁶ Includes a Skills to Go initiative that offers bite-size courses, enabling learning when commuting or during lunch breaks.¹⁶⁶
- **SAS STEP Programme:** a free programme open to the public, offering courses from foundational data literacy to advanced data science.¹⁶⁷
- **Udemy:** an online platform for businesses to upskill their workforce.¹⁶⁸ Udemy also provides courses to individuals looking to acquire data skills.¹⁶⁹

Third-sector initiatives

Some charities offer free online courses to help learners build specialist data skills. Code First Girls supports UK women and non-binary people move into tech careers by running courses on topics such as coding and data analysis.¹⁷⁰ DataKindUK assists UK social change organisations in applying data science through 'DataDive' events, where charities work with volunteer data scientists to tackle challenges faced by their organisation.^{171,172}

Informal training routes such as hackathons and massive open online courses (MOOCs) can be flexible ways to build awareness and teach data skills.³⁴ Some stakeholders have called for more to be developed to help bridge the skills gap.^{38,39} Recruiters appear receptive to the value of informal courses. The 2022 Coleman Parkes Research survey found that 56% of organisations assessed candidates based on their participation in informal courses.¹³

References

1. The Alan Turing Institute [Data science and AI glossary](#).
2. IBM [What is Data Science?](#)
3. Coursera (2023). [Data Science vs Machine Learning: What's the Difference?](#)
4. Defence Science and Technology Laboratory (2020). [AI, Data Science and Machine Learning: a Dstl biscuit book](#). *GOV.UK*.
5. Provost, F. *et al.* (2013). [Data Science and its Relationship to Big Data and Data-Driven Decision Making](#). *Big Data, Vol 1, 51-59*.
6. Royal Statistical Society [The Alliance for Data Science Professionals](#). *RSS*.
7. Central Digital and Data Office (2022). [Data scientist](#). *GOV.UK*.
8. IBM (2020). [The Data Science Skills Competency Model](#).
9. Central Digital and Data Office (2022). [Data analyst](#). *GOV.UK*.
10. Coursera (2023). [What Is a Data Modeler?](#)
11. Central Digital and Data Office (2020). [Data Ethics Framework](#). *GOV.UK*.
12. Thomas H. Davenport *et al.* (2022). [Is Data Scientist Still the Sexiest Job of the 21st Century?](#) *Harvard Business Review*.
13. SAS Institute (2022). [How to Solve the Data Science Skills Shortage](#).
14. UK Research and Innovation (2021). [Transforming our world with AI](#).
15. Jacques Bughin *et al.* (2019). [Artificial intelligence in the United Kingdom: Prospects and challenges](#). *McKinsey & Company*.
16. PricewaterhouseCoopers (2017). [The economic impact of artificial intelligence on the UK economy](#). *PwC*.
17. Barb Renner *et al.* (2019). [The adoption of disruptive technologies in the consumer products industry](#). *Deloitte Insights*.
18. International Trade Administration (2021). [United Kingdom Artificial Intelligence Market](#).
19. Liza Ramrayka (2018). [How big data can help us fight climate change faster](#). *World Economic Forum*.
20. National Institute of Dental and Craniofacial Research (2020). [Exploring AI for Cancer Diagnosis](#).
21. John Smeaton *et al.* (2021). [AI and healthcare](#). *Parliamentary Office of Science and Technology*.
22. Department for Science, Innovation & Technology *et al.* (2021). [The potential impact of AI on UK employment and the demand for skills](#). *GOV.UK*.
23. Office for National Statistics (2019). [Which occupations are at highest risk of being automated?](#)
24. Jan Hatzius *et al.* (2023). [The Potentially Large Effects of Artificial Intelligence on Economic Growth](#). *Goldman Sachs*.
25. Department for Science, Innovation and Technology *et al.* (2022). [National AI Strategy](#). *GOV.UK*.
26. Department for Science, Innovation & Technology *et al.* (2022). [National AI Strategy - AI Action Plan](#). *GOV.UK*.
27. Department for Science, Innovation and Technology *et al.* (2022). [National Data Strategy](#).
28. Department for Digital, Culture, Media & Sport *et al.* (2022). [Data storage and processing infrastructure security and resilience](#). *GOV.UK*.
29. Department for Science, Innovation & Technology *et al.* (2021). [Quantifying the UK Data Skills Gap](#). *GOV.UK*.
30. David Smith (2022). [UK PLC 'sleepwalking' into major AI skills crisis unless immediate action is taken, research shows](#).

31. Dabhi, K. *et al.* (2021). [Understanding the UK AI labour market: 2020.](#) *GOV.UK.*
32. Oxford Learning College [Skills Gap Statistics UK 2023.](#)
33. Mutebi, N. *et al.* (2021). [Upskilling and retraining the adult workforce.](#) *Parliamentary Office of Science and Technology.*
34. Jagannathan, S. (2021). [Reimagining Digital Learning for Sustainable Development: How Upskilling, Data Analytics, and Educational Technologies Close the Skills Gap.](#) Taylor & Francis Group.
35. (2022). [Action needed across Government to secure a high-skilled STEM workforce for the UK.](#) *UK Parliament.*
36. Baroness Brown of Cambridge (2022). [Lords Science and Technology Committee - inquiry into people and skills in UK STEM.](#)
37. Bledi Taska *et al.* (2022). [Artificial Intelligence in the UK.](#) *Lightcast.*
38. The Royal Society (2019). [Dynamics of data science skills. How can all sectors benefit from data science talent?](#)
39. Professor Dame Wendy Hall *et al.* (2017). [Growing the artificial intelligence industry in the UK.](#) *GOV.UK.*
40. Glyn Townsend (2022). [Smart cities: Which parts of the UK are the most AI-ready?](#) *SAS Institute.*
41. Lightcast [Heatmap of AI Jobs.](#)
42. Nestor Maslej *et al.* (2023). [The AI Index 2023 Annual Report.](#) Institute for Human-Centered AI.
43. Diana Gehlhaus *et al.* (2022). [China's AI Workforce.](#) Centre for Security and Emerging Technology.
44. World Economic Forum (2023). [The Future of Jobs Report 2023.](#)
45. OECD.AI (2023). [Visualisations powered by JSI using data from LinkedIn.](#)
46. Chinn, D. *et al.* (2020). [The future is now: Closing the skills gap in Europe's public sector.](#) *McKinsey & Company.*
47. David Jarvis (2020). [The AI Talent Shortage Isn't Over Yet.](#) *WSJ.*
48. University College London (2023). [Data Science BSc.](#) *Prospective Students Undergraduate.*
49. University of Exeter [Data Science BSc.](#)
50. University of Warwick [Data Science BSc.](#)
51. University of Surrey [Data Science MSc masters course.](#)
52. Imperial College London [Data Science Institute PhD.](#)
53. Anglia Ruskin University [Applied Data Science \(Conversion\) MSc.](#)
54. University of Wolverhampton [MSc Data Science.](#)
55. Microsoft (2020). [AI Skills in the UK.](#)
56. Exeter College [Data Science \(BSc Hons\) - Higher Apprenticeship.](#)
57. BBC [Data Science Degree Apprenticeship.](#)
58. University of Exeter [Research Scientist \(Data Science Professional\).](#)
59. UCAS [Degree apprenticeships.](#)
60. Department for Science, Innovation & Technology *et al.* (2021). [UK Innovation Strategy.](#) *GOV.UK.*
61. Dame Vivian Hunt *et al.* (2015). [Why diversity matters.](#) *McKinsey & Company.*
62. Sundiatu Dixon-Fyle *et al.* (2020). [How diversity, equity, and inclusion \(DE&I\) matter.](#) *McKinsey & Company.*
63. Professor Dame Ottoline Leyser *et al.* (2020). [Diversity and inclusion in STEM.](#) *Submission to the Commons Science and Technology Committee.*
64. McKinsey & Company (2022). [What is diversity, equity, and inclusion \(DE&I\)?](#)
65. Erin Young *et al.* (2021). [Where are the Women? Mapping the Gender Job Gap in AI. Policy Briefing: Summary.](#) The Alan Turing Institute.
66. PricewaterhouseCoopers (2022). [Understanding algorithmic bias and how to build trust in AI.](#) *PwC.*

67. PricewaterhouseCoopers (2021). [AI bias is personal for me. It should be for you, too.](#) *PwC*.
68. Christie, L. (2020). [Interpretable machine learning.](#) *Parliamentary Office of Science and Technology*.
69. Paul, K. (2019). ['Disastrous' lack of diversity in AI industry perpetuates bias, study finds.](#) *The Guardian*.
70. Jake Silberg *et al.* (2019). [Notes from the AI frontier: Tackling bias in AI \(and in humans\).](#) *McKinsey Global Institute*.
71. Lowry, S. *et al.* (1988). [A blot on the profession.](#) *Br Med J (Clin Res Ed), Vol 296, 657-658*. British Medical Journal Publishing Group.
72. Bartlett, R. *et al.* (2022). [Consumer-Lending Discrimination in the FinTech Era.](#) *Journal of Financial Economics, Vol 143, 30-56*.
73. Centre for Data Ethics and Innovation (2020). [Review into bias in algorithmic decision-making.](#)
74. The Alan Turing Institute (2022). [Diversity and inclusion in STEM. Submission to the Commons Science and Technology Committee.](#)
75. Minevich, M. (2020). [Women Are The Key To Scaling Up AI And Data Science.](#) *Forbes*.
76. Sentance, S. (2023). [Gender Balance in Computing — the big picture.](#) *Raspberry Pi Foundation*.
77. Joint Council for Qualifications (2022). [GCSE \(Full Course\) Results Summer 2022. Outcomes for key grades for UK, England, Northern Ireland & Wales, including UK age breakdowns.](#)
78. HESA (2023). [What do HE students study?](#)
79. Uberoi, E. *et al.* (2023). [Ethnic diversity in politics and public life.](#) *House of Commons Library*.
80. techUK (2023). [AI Adoption in the UK: Putting AI into Action.](#)
81. BCS - The Chartered Institute for IT (2021). [BCS Insights 2021.](#)
82. Miller, S. (2014). [Collaborative Approaches Needed to Close the Big Data Skills Gap.](#) *J. organ. des., Vol 3,*
83. Will Markow *et al.* (2017). [The Quant Crunch. How the demand for data science skills is disrupting the job market.](#) *Burning Glass Technologies*.
84. Zhang, D. (2021). [What is Data Science? An Operational Definition based on Text Mining of Data Science Curricula.](#) *Journal of Behavioral Data Science, Vol 1, 1-16*.
85. Ethan Oldham (2021). [Emsi and Burning Glass Merger.](#) *Lightcast*.
86. The Operational Research Society [Professional standards to be set for data science.](#)
87. National Physical Laboratory [Alliance for Data Science Professionals.](#)
88. BCS The Chartered Institute for IT [Alliance for Data Science Professionals.](#)
89. Alliance for Data Science Professionals [Standards.](#)
90. National Careers Service [Data scientist.](#) *GOV.UK*.
91. Tera Allas *et al.* (2020). [The economic case for reskilling in the UK: How employers can thrive by boosting workers' skills.](#) *McKinsey & Company*.
92. Rachel Taylor (2020). [How the UK Government can prepare for automation by upskilling its own workforce.](#) *PwC*.
93. PricewaterhouseCoopers (2021). [Transforming your workforce through upskilling: Citizen-led innovation.](#) *PwC*.
94. Data Skills Taskforce (2021). [Data Skills Portal Launch Press Release.](#)
95. Central Digital and Data Office (2023). [Data Maturity Assessment for Government: Framework.](#) *GOV.UK*.
96. Data Orchard (2023). [Our Data Maturity Framework has been embraced by UK Government.](#)
97. The Royal Society (2017). [After the reboot: computing education in UK schools.](#)

98. British Computing Society [England: Computer Science GCSE, AS, and A Levels.](#) *BCS The Chartered Institute for IT.*
99. UK Government (2022). [Initial Teacher Training Census.](#) *GOV.UK.*
100. Pye Tait Consulting (2017). [After the reboot: The State of Computing Education in UK Schools and Colleges.](#)
101. Davies, N. *et al.* (2021). [Teaching statistics and data science in England's schools.](#) *Teaching Statistics*, Vol 43,
102. Professor Dame Athene Donald (2022). [Diversity and inclusion in STEM.](#) *Submission to the Commons Science and Technology Committee.*
103. Woolston, C. (2021). [Researchers' career insecurity needs attention and reform now, says international coalition.](#) *Nature*,
104. Thomas, D. (2022). [UK civil servants warn over lack of digital resources and skills.](#) *Financial Times.*
105. The Alan Turing Institute *et al.* (2021). [AI ecosystem survey - Informing the National AI Strategy.](#)
106. UK AI Council (2021). [AI Roadmap.](#) *GOV.UK.*
107. The Alan Turing Institute [Turing Internship Network.](#)
108. The Alan Turing Institute [Data science education.](#)
109. Institute for Government (2022). [Data Bites.](#)
110. Freeguard, G. (2020). [Data Bites.](#) Institute for Government.
111. Office for National Statistics (2021). [New Fellows to work with the Office for National Statistics and 10 Downing Street to help deliver data science for the public good.](#)
112. Rice, E. *et al.* (2021). [Developing essential digital skills.](#) *Parliamentary Office of Science and Technology.*
113. Scottish Government [Curriculum for excellence: technologies.](#)
114. Department for Education (2013). [National curriculum in England: computing programmes of study.](#) *GOV.UK.*
115. Council for the Curriculum, Examinations and Assessment [Using ICT.](#) *CEA.*
116. Welsh Government (2023). [Curriculum for Wales: overview.](#) *GOV.WALES.*
117. Pittard, V. (2018). [The Integration of Data Science in the Primary and Secondary Curriculum.](#) The Royal Society.
118. Sentance, S. *et al.* (2022). [Perspectives on AI and data science education.](#) *Raspberry Pi Foundation.*
119. House of Lords Select Committee on Artificial Intelligence (2019). [AI in the UK: ready, willing and able?](#)
120. Department for Education (2023). [Introduction of T Levels.](#) *GOV.UK.*
121. HM Treasury (2021). [Build Back Better: our plan for growth.](#) *GOV.UK.*
122. HM Government [Digital Business Services.](#) *T-Levels.*
123. Department for Education (2018). [Schools Minister announces boost to computer science teaching.](#) *GOV.UK.*
124. Sentance, S. (2018). [The National Centre for Computing Education: your questions answered.](#) *Raspberry Pi Foundation.*
125. Colligan, P. (2018). [A world-class computing education.](#) *Raspberry Pi Foundation.*
126. Isaac Computer Science [Computer Science Learning.](#)
127. National Centre for Computing Education (2022). [Impact Report 2018-2022.](#)
128. Raspberry Pi Foundation [Code Club.](#)
129. BAE Systems (2023). [STEM roadshow demonstrates wonders of space to school pupils.](#)
130. UCAS [Search for Courses.](#)
131. Office for Students (2023). [Postgraduate conversion courses in data science and artificial intelligence.](#)

132. Office for Students (2023). [Find courses in artificial intelligence \(AI\) and data science.](#)
133. Robin Mellors-Bourne (2023). [Evaluation of new Data Science and Artificial Intelligence conversion Masters courses.](#) The Career Development Organisation.
134. Office for Students (2023). [£8 million boost for digital student scholarships.](#)
135. UK Research and Innovation (2023). [UKRI artificial intelligence Centres for Doctoral Training.](#) UKRI.
136. UK Research and Innovation (2022). [UKRI Centres for Doctoral Training in artificial intelligence.](#) UKRI.
137. The Alan Turing Institute [Centres for Doctoral Training \(CDTs\).](#)
138. Rich Adams (2018). [Five reasons why businesses can benefit from working with a university.](#) University of Plymouth.
139. Ransom, J. (2021). [Universities and the UK's economic recovery: an analysis of future impact.](#) Universities UK.
140. BAE Systems (2023). [Accelerating Combat Air System Design and Development.](#)
141. CCAIM [Cambridge Centre for AI in Medicine.](#)
142. Microsoft Research [Microsoft Research-Cambridge University Machine Learning Initiative.](#)
143. The Alan Turing Institute [Data science and AI educators' programme.](#)
144. Lewis, J. *et al.* (2022). [Further education funding in England.](#) House of Commons Library.
145. [Education and Skills Funding Agency.](#) GOV.UK.
146. Department for Education (2021). [Skills for Jobs: Lifelong Learning for Opportunity and Growth.](#) GOV.UK.
147. Department for Education (2023). [How we are transforming student finance.](#) GOV.UK.
148. Education and Skills Funding Agency (2023). [ESFA Skills Bootcamps.](#) GOV.UK.
149. UK Government [Skills Bootcamps.](#) GOV.UK.
150. Data Science Campus [Data science for the public good.](#)
151. Department for Science, Innovation & Technology (2023). [The UK's International Technology Strategy.](#) GOV.UK.
152. UK Government [High Potential Individual \(HPI\) visa.](#) GOV.UK.
153. Tech Nation [Tech Nation Visa.](#)
154. Department for Business, Energy & Industrial Strategy *et al.* (2021). [UK Research and Development Roadmap.](#) GOV.UK.
155. The Royal Society (2023). [Global Talent visa: overview.](#)
156. Rachel Worsley *et al.* (2022). [Global Talent Visa Evaluation: Exploring experiences of the Global Talent visa process.](#) GOV.UK.
157. UK Government [Apply for the Global Talent visa.](#) GOV.UK.
158. UK Government [Pay for UK healthcare as part of your immigration application.](#) GOV.UK.
159. UK Government [Scale-up Worker visa.](#) GOV.UK.
160. UK Government [Innovator Founder visa.](#) GOV.UK.
161. UK Government [Senior or Specialist Worker visa \(Global Business Mobility\).](#) GOV.UK.
162. Industrial Strategy Council (2019). [UK Skills Mismatch 2030.](#)
163. Aviva [Data apprenticeships.](#)
164. Lloyds Banking Group [Data.](#)
165. Sainsbury's [Sainsbury's Bootcamp.](#)
166. Google [Skills to Go for the UK.](#)
167. SAS Institute [The SAS STEP Programme.](#)
168. Udemy [Workforce Upskilling for the Enterprise.](#)
169. Udemy [Online Courses.](#)
170. Code First Girls [About Us.](#)
171. DataKindUK [DataDive Projects.](#)
172. DataKindUK [About DataKind UK.](#)

Contributors

POST is grateful to Joshua Fearn for researching this briefing, to the Institution of Chemical Engineers and the Materials Processing Institute for funding his Ashok Kumar Fellowship, and to all contributors and reviewers. For further information on this subject, please contact the co-author, Dr Lydia Harriss.

Members of the POST Board*	Dr Becky Allen, University of Sunderland
Office for Artificial Intelligence*	Dr Federico Botta, University of Exeter*
Department for Education*	Professor Rob Procter, University of Warwick and The Alan Turing Institute for Data Science and AI*
Office for National Statistics	
Department for Science, Innovation and Technology	Victoria Wade, University of London Careers Service
Dr Caroline Chibelushi, Innovate UK KTN*	Professor Neville Davies, University of Plymouth
David Bowkett, ESRC UKRI	Institute for People-Centred AI, University of Surrey
Trias Gkikopoulos, Innovate UK	
Sam McGregor, AHRC UKRI	Dr Charlotte George, X-NET
James Dracott, EPSRC UKRI	Professor Chris Ponting, X-NET
Nigel Armstead, SAS Institute*	Professor David Sims, X-NET
Glyn Townsend, SAS Institute	Dr Cristina Martín, X-NET
Mark Donnelly, BAE Systems	Professor Andrew Blake, Independent Consultant*
Richard Hamer, BAE Systems	
Nimmi Patel, techUK*	Dr Matthew Forshaw, The Alan Turing Institute for Data Science and AI*
Jonathan Hobson, Perspective Economics*	Andrew Strait, Ada Lovelace Institute
Dr Christopher Hallsworth, Imperial College London	National Centre for AI in Tertiary Education, Jisc
Dr Michelle Sahai, University of Roehampton	Neil Sheldon, Teaching Statistics Trust
Rob Slane, Lightcast*	
Layla O’Kane, Lightcast*	

* denotes people and organisations who acted as external reviewers of the briefing.

The Parliamentary Office of Science and Technology (POST) is an office of both Houses of Parliament. It produces impartial briefings designed to make research evidence accessible to the UK Parliament. Stakeholders contribute to and review POSTnotes. POST is grateful to these contributors.

Our work is published to support Parliament. Individuals should not rely upon it as legal or professional advice, or as a substitute for it. We do not accept any liability whatsoever for any errors, omissions or misstatements contained herein. You should consult a suitably qualified professional if you require specific advice or information. Every effort is made to ensure that the information contained in our briefings is correct at the time of publication. Readers should be aware that briefings are not necessarily updated to reflect subsequent changes. This information is provided subject to the conditions of the Open Parliament Licence.

If you have any comments on our briefings please email post@parliament.uk. Please note that we are not always able to engage in discussions with members of the public who express opinions about the content of our research, although we will carefully consider and correct any factual errors.

If you have general questions about the work of the House of Commons email hcenquiries@parliament.uk or the House of Lords email hlinfo@parliament.uk.

DOI: <https://doi.org/10.58248/PN697>

Image Credit: rawpixel.com

POST's published material is available to everyone at post.parliament.uk. Get our latest research delivered straight to your inbox. Subscribe at post.parliament.uk/subscribe.



 post@parliament.uk

 parliament.uk/post

 [@POST_UK](https://twitter.com/POST_UK)