The Alan Turing Institute

UK AI COUNCIL

AI ecosystem survey
Informing the National AI Strategy
Summary report

Forewords

The transformational power of AI to address long-held challenges is now clear, from understanding the folding of proteins to reducing the environmental impacts of goods, services and human activities. At the same time, it has become increasingly important to understand the changing needs of industry and society as technologies that were once considered niche now become mainstream.

The AI Council was founded on the understanding that we would provide advice to the UK Government and amplify the voice of the wider AI ecosystem. The Council was therefore pleased to lead a programme of evidence gathering and engagement to inform the development of the UK's forthcoming National AI Strategy – building on the Council's earlier recommendations through its own 'AI Roadmap'.

Supported by The Alan Turing Institute, the AI Council received over 400 responses to its recent online survey. While the UK starts from a position of strength in the fundamental enablers of AI development, the survey also reveals those areas where the UK will need to 'double down' on its recent investments to realise the full benefits of AI: recruiting and retaining top AI talent; translating world-leading research into commercial products and services; encouraging AI adoption and increasing buyer confidence; growing technical and ethical awareness at the leadership level; and improving access to data and AI governance.

The key challenge now will be for the Government to prioritise its investments as it sets out to cement the UK's place as a "science superpower". Our hope is that the results of this survey will help to inform those hard but necessary choices.

On behalf of the AI Council and its partners, I would like to thank everyone who contributed to the survey. I hope the findings will support decision makers across all sectors and industries as they consider how best to respond to the challenges and opportunities of the coming age of AI.

Tabitha Goldstaub
Chair, AI Council

The last decade has seen a dramatic rise in computer power, in data and scientific breakthroughs, as in deep learning and neural networks. Together, these advances have led to the emergence of data science and the resurgence of artificial intelligence – 'machines that think', as imagined in Alan Turing's landmark research paper published in 1950.

As a collaborative hub, with roots in universities and centres of research excellence across the UK, and strong links to a growing network of industry, public sector, and third sector partners, the Institute plays an important role in leading the national conversation on AI.

We were, therefore, pleased to work with the AI Council to support their efforts, following the 'AI Roadmap', to gather views from across the UK AI ecosystem to inform the development of the Government's upcoming National AI Strategy.

As the national institute, we embrace every opportunity to contribute to the UK's commitment to scale up AI research, development and innovation. Over 400 responses to this survey reinforce the commitment and enthusiasm from the AI community to do the same.

The National AI Strategy provides an opportunity to set out to the nation's AI ecosystem a strategic pathway to future success despite the uncertainty of our times. My hope is that this survey supports the Government in this endeavour.

I would like to extend my gratitude to all those who took the time and energy to submit their responses and I am confident their insights will prove useful to everyone interested in the future of AI.

Adrian Smith
Institute Director and Chief Executive, The Alan Turing Institute

Executive Summary of ‘Ecosystem’ Survey – Quantitative Results

This report summarises the responses to the online survey of the UK’s AI ecosystem conducted by The Alan Turing Institute in June 2021, working alongside the AI Council.

The survey sought to gather the views of the AI ecosystem (those researching, developing, working with, or using AI technologies) to inform the Office for AI’s development of its upcoming National AI Strategy.

The survey’s questions were separated into the same themes as the AI Council’s recent AI Roadmap: ‘Research and innovation’; ‘Skills’; ‘Data, infrastructure and public trust’; and ‘National, cross-sector adoption’.

There were 413 respondents, and the key findings are as follows:

Research and innovation

- Only around a third of respondents (29%) agreed there was sufficient **investment in ensuring AI technologies were applied to research** across all domains in the UK; with almost three quarters (74%) agreeing that there are **bottlenecks in AI research** that could be addressed with public investment.

Skills

- Only around one in five respondents (19%) thought that business currently had the necessary **skills and knowledge to understand where value could be gained** from using AI; and only 18% agreed there was sufficient provision of **training and development** in AI skills available to the current UK workforce.
- 81% of respondents agreed there were significant barriers in **recruiting and retaining top AI talent** in their sector/domain within the UK.

Data, infrastructure and public trust

- The overwhelming majority of respondents (88%) agreed that the UK should seek to lead the development of **data governance on AI.**
- Over three quarters of respondents (77%) agreed that **increased regulation of AI** was a priority in order to improve and maintain public trust in its development and use. At the same time, 77% of respondents agreed there were immediate steps that most organisations in their sector/domain could take to build **trust and transparency in the use of AI**.
- Opinion was mixed on whether UK business had sufficient **access to the technical capability,** such as high performance computing, required to make the best use of AI: 39% of respondents agreed; 38% disagreed; and 23% neither agreed nor disagreed.

National, cross-sector adoption

- 80% of respondents agreed there were particular areas in their sector where the **adoption of AI** was low, but its potential benefits were high.
- However, opinion was mixed on whether legislative changes are required, with only around half (51%) believing that legislative changes would encourage the adoption of AI in their sectors; and over a third (36%) still undecided.
- Almost three quarters of respondents (72%) agreed that the Government should take steps to increase **buyer confidence and AI capability** across all sectors, with 70% of respondents agreeing that national, cross-sector adoption of AI is dependent on Government initiatives and investment.

Notes on the report and survey

The information contained in this report represents only the views of those who participated in the survey. It should be read in the context of the demographic data provided in the 'Breakdown of respondents' section below.

Each section of the report is split into two parts. The 'quantitative answers' provide the results of the survey's multiple choice (Likert scale) questions, while the 'qualitative answers' are overviews of the respondents' free-text answers, as summarised by staff at The Alan Turing Institute.

The annexes at the end of the report provide additional details about the survey responses and the respondents' demographics.

The survey was intended to allow various stakeholders in the AI community to offer their views on a set of questions related to the challenges and opportunities for AI policy over the coming decades. Accordingly, it is not research and its use in guiding any policy decisions should be done in full awareness of the limitations of online surveys.

This survey was one tool of many used by the AI Council to gather evidence and policy advice, with the aim of informing the Government's strategy-making process, led by the Office for AI.

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Breakdown of respondents

A total of 413 individual responses were raised across the survey. A series of optional demographic questions were posed in order to better understand the background of respondents. This section set out a summary of responses to those questions.

A total of 413 people participated in the survey. Among these respondents, the majority were from industry (44%) and academia (32%), with a large minority from the public sector (15%).

Respondents were primarily from professional, scientific and technical sectors (29%), followed by information & communication (18%), health (12%) and education (11%).

Further information on responses to the demographic questions can be found in annex 4.

16) Which best describes your area of work? *(402 responses)*

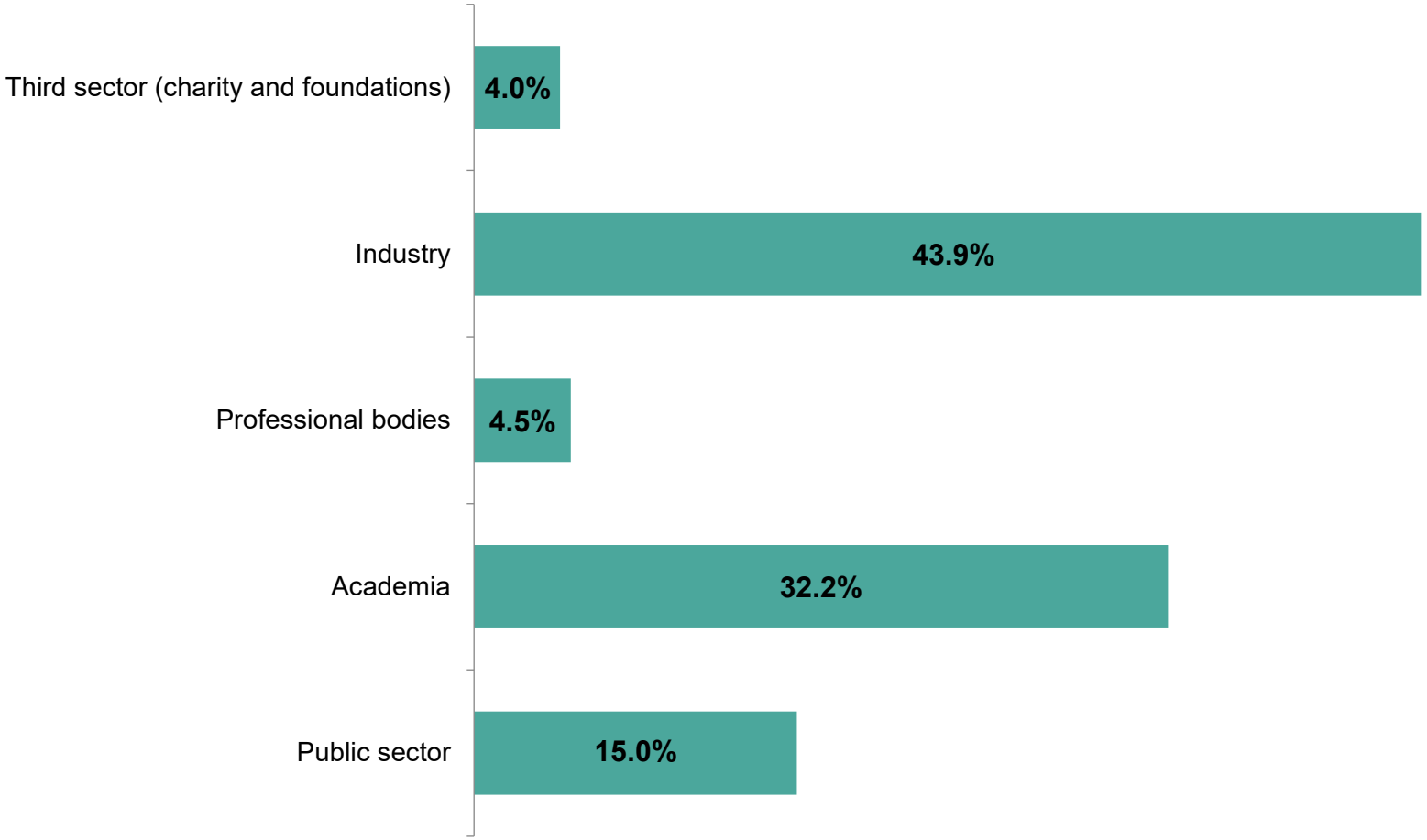


Figure 1. The majority of respondents came from industry, closely followed by academia and with a substantial proportion from the public sector.

17) Which sector best describes your work? *(400 responses)*

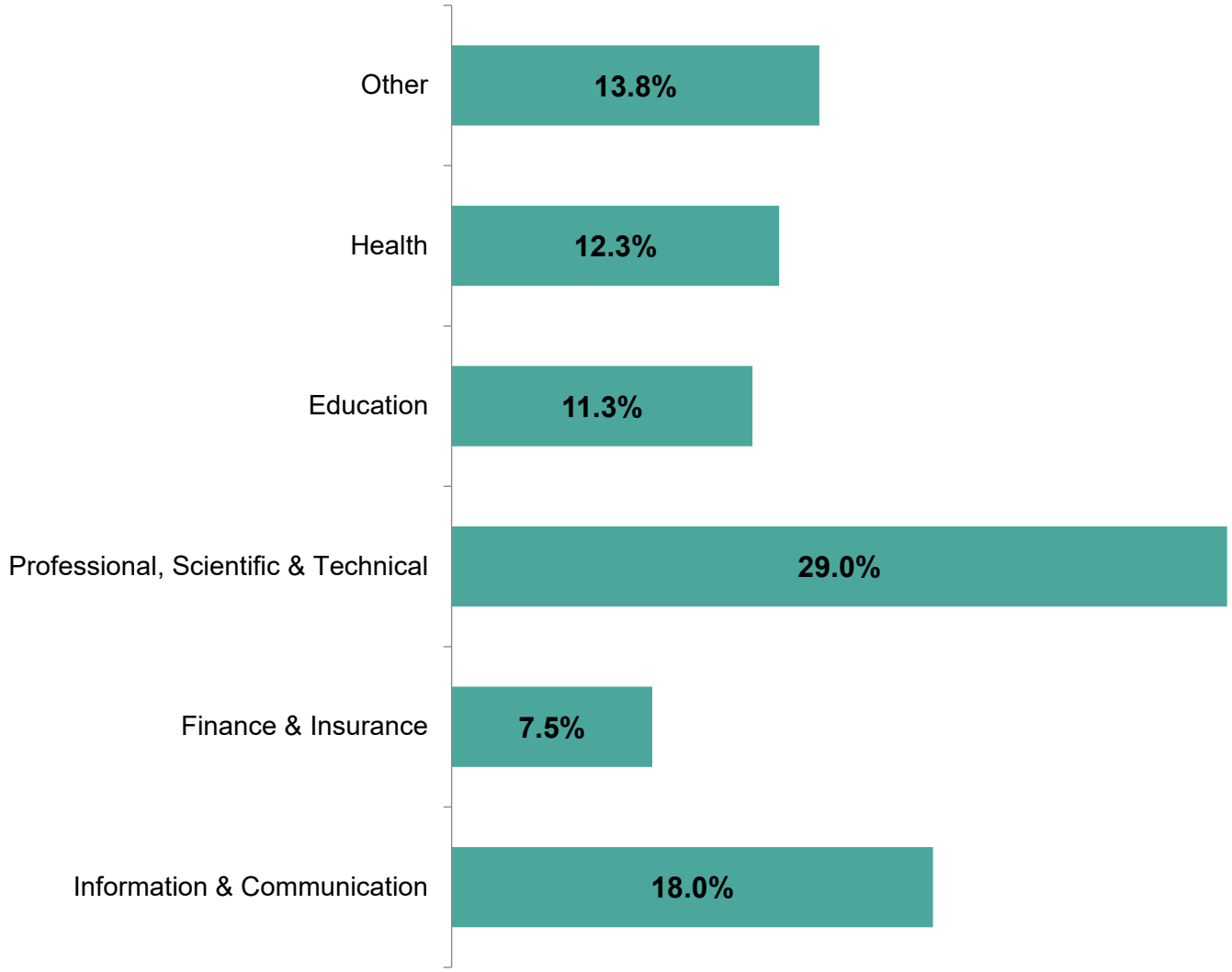


Figure 2. Respondents were primarily from professional, scientific and technical sectors, followed by information & communication, health and education.

Research and innovation

Quantitative answers

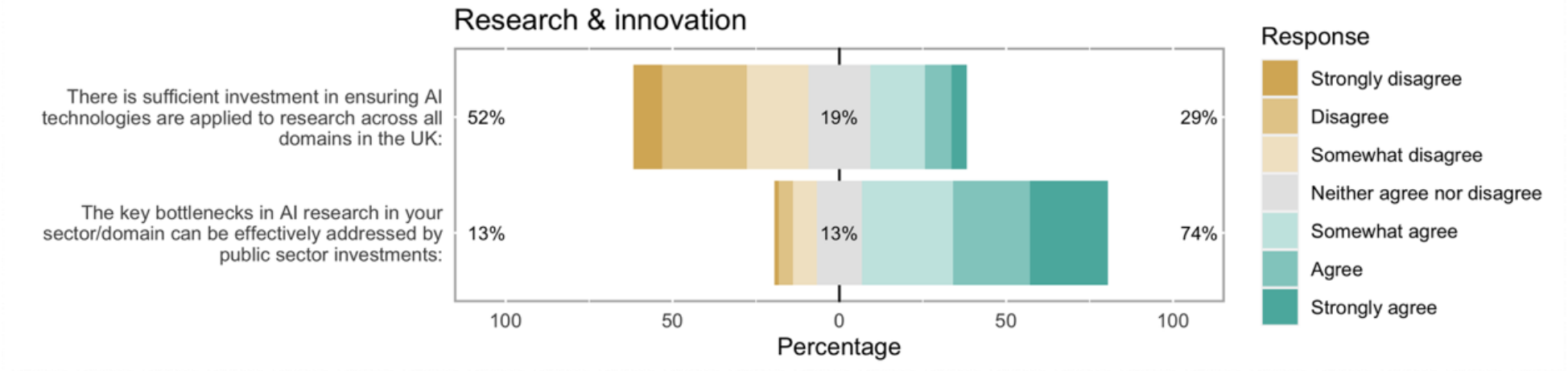


Figure 3. Around half of respondents disagreed that there is sufficient investment in applying AI technologies across research domains. A large majority felt that there were bottlenecks in AI research that could be addressed with public investment.

Qualitative answers

1. **What are these key bottlenecks and how can Government investment address them?** *(284 responses)*

A range of bottlenecks in AI research were listed by respondents. Among them were:

- Computational resources.
- Regulation.
- Ethics and standards.
- Access to talent.
- Funding.
- Access to data.
- Fundamental AI research.
- Training and education.

Respondents who listed **regulation** as a bottleneck raised various issues. Some suggested that there should be greater pressure on businesses to be more transparent, for example requiring bias estimates for the outputs of AI technologies, while others suggested that a key focus should be on ensuring that current regulation is clear and comes from a single body. Others argued that businesses are currently held back in their adoption of AI by uncertainty over what they are and are not able to do within the current regulation.

Regarding **ethics**, some respondents stated that standards in trustworthy AI are currently not well defined and that regulation could potentially help in this instance by providing guidance to businesses on the level of assurance that they should seek from AI initiatives. Issues of liability, accountability, explainability and robustness of AI systems were also raised.

Access to talent was also cited as a significant bottleneck by some. According to these respondents, the pay gap between industry and academia makes hiring academic researchers challenging; competition with major international technology companies also leads to a lack of availability of senior researchers for academia in the UK.

Funding was raised by a large number of respondents. There were calls for more investment for start-ups, mid-TRL level technologies and fundamental research. Funding for reproducible and robust research was also highlighted as currently lacking.

Access to data was another major theme highlighted by respondents. Some respondents posited that the UK Government could play a role in addressing this through open access to datasets that are assured Government data. Others suggested that the Government should work with industry to make datasets available for wider use.

Finally, many respondents mentioned **training and education** as bottlenecks in AI research. Some thought that the focus of education should be on users and the general public more broadly, enabling more informed use of AI, which they felt was currently lacking. Other respondents noted that more could be done to provide access to courses below PhD level, including retraining or upskilling those currently in work.

Quotes:

"The primary bottleneck is access to training data. Where large US web companies have access to vast amounts of data (Google etc.), UK companies do not.

The UK Government can address these issues through the open access of training datasets… created using assured UK Government data. …imagine being able to create datasets from Defence doctrine…or indeed from the Chilcott report.

The second bottleneck is in the testing of AI systems…The UK Government could assist in developing AI by publishing standardised and verified tests…

The final bottleneck…is an AI skills gap…There are many…who desperately need AI skills, but do not have the resources, or indeed the time…To have better higher education funding…would assist people…in developing proper AI skills."

2. **What investments are currently working well, if any, in supporting AI to be applied across all domains of research? What could help existing investments be leveraged further?** *(202 responses)*

Answers varied between more general comments about funding to narrower, domain-specific investments.

In general terms, respondents suggested that existing funding mechanisms from Innovate UK, EPSRC, UKRI and ISCF were working well, although some respondents did argue that there was a lack of funding focused on SMEs from these streams. Respondents also highlighted the need for funding to cover overheads.

Other investments that were mentioned by multiple respondents as being effective were The Alan Turing Institute and Centres for Doctoral Training.

In terms of what could help investments be leveraged further, respondents argued for investments to complement high-profile research that features in the media, such as for research in validity testing and technology assessment. Investment to translate academic research to industry, as well as supporting start-ups, were also raised as areas for improvement. Some respondents felt that large technology companies were primarily driving development in AI, with the risk that benefits from socially advantageous AI could be lost.

Some respondents suggested that further investment in UK-wide, cross-sector collaboration in AI was needed. For example, some felt that AI uptake was patchy across sectors and across the UK: finance was regarded as relatively strong whereas utilities and local government were perceived as weaker.

The issue of access to the right data was cited as a barrier to certain sectors using AI. Investments that serve to curate high-quality datasets for other sectors to use would be one way of accelerating AI innovation. One respondent also suggested that the Government should introduce a national policy on using public sector data for private sector and public sector research.

In more domain-specific responses, finance and pharmaceuticals were cited as examples where investment in AI was more concentrated. Conversely, some respondents were concerned by the seeming lack of investment in AI in the social sciences.

Other investment ideas that were suggested by respondents included:

- Green technology investments.
- A reconfigured Future Fund as a vehicle for matching funds from the private sector.
- Continued R&D tax credits.
- UK AI co-investment with trade partners/allies.

Skills

Quantitative answers

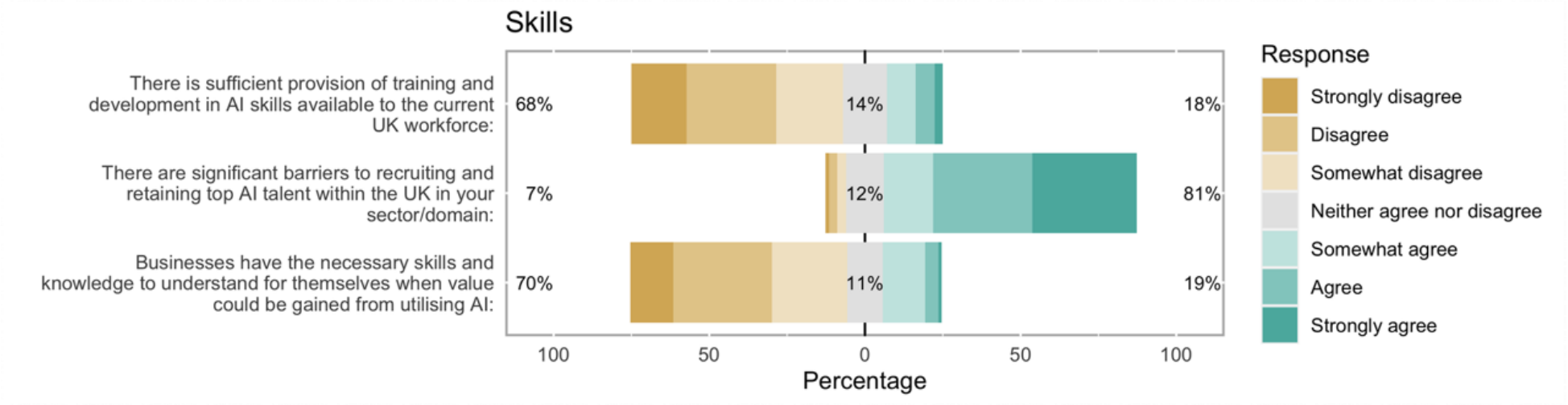


Figure 4. According to the majority of respondents, there is not sufficient provision of training and development in AI skills for the UK workforce, there are significant barriers to recruiting and retaining AI talent, and businesses lack the necessary skills and knowledge to fully realise the value of AI.

Qualitative answers

3. **If there was one incentive that the Government could put in place to reduce barriers to recruiting and retaining top AI talent, what would it be?** *(284 responses)*

Rather than focusing on incentives that the Government could implement in the short-term, most respondents took this question in a more long-term and high-level direction. The most common response was to **relax immigration rules**, particularly by offering new visas specifically for skilled AI academics and professionals or lowering the bar to existing visa routes. Respondents repeatedly emphasised the restrictive nature of visas in the UK relative to other countries and felt that this harms the UK's ability to compete for top talent globally. Many highlighted that strict immigration policies are risking the flight of skilled individuals.

The second most cited incentive was **increasing pay**, especially as a means of counterbalancing the ability for overseas 'big tech' firms to concentrate top talent away from UK firms, the public sector and academia (even if these big tech firms do employ many people in the UK). Respondents suggested offering tax breaks to firms that encourage them to hire (particularly for UK firms and SMEs) and directly raising academic and public sector salaries. Less common, but cited by a few respondents, were various forms of **government investment into industry**, by offering general tax breaks or R&D grants to firms, and even levelling-up different regions of the UK to make them more attractive places to work.

Increasing the talent pipeline through **education** was another popular suggestion. This included increasing data and mathematic literacy in schooling as well as introducing AI earlier on. Incentivising the higher uptake of higher education courses on data science and AI was repeatedly suggested, for example by funding new AI and data science scholarships and grants. An increased **training** offering was also felt to be an important incentive. Respondents mentioned offering more upskilling in AI, embedding training in higher education courses and funding AI apprenticeships more widely. With both training and education, several respondents emphasised that ensuring access for **underrepresented groups** would help to widen the talent pool.

4. **What enables businesses, that have the necessary skills and knowledge, to understand and deliver value from using AI?** *(261 responses)*

By far the most popular answer was an **awareness of the applications and limitations of AI by business leadership**, not just technical employees. The ability for leadership to determine the commercial applications of AI, identify which business functions it can improve, and perform an informed **cost/benefit analysis of implementation** was seen as paramount. A key theme emerging from this set of responses highlighted the view that AI has become a buzzword and its capabilities are frequently oversold. Respondents suggested **training** aimed at business leaders and management as a valuable solution to equipping decision makers with the necessary technical insight. Several stressed the importance of learning from **case studies** of businesses that have successfully used AI technologies. Related to the above, a frequent response was the importance of integrating AI into the **business model or growth strategy**, rather than it being peripheral.

Several respondents emphasised the importance of a robust understanding of the **ethics** involved in AI use. A lack of this understanding can generate reticence in implementing AI, or an inability to effectively anticipate ethical issues or risks. A clear ethical framework was called for by multiple respondents, with one explaining that the current Government framework "raises the issues, but does not give practical answers". Finally, more than ten respondents felt that **partnering with academic and research institutes** was an important factor in enabling businesses to gain value from AI.

Quote:

The following captures many of the most common responses about what enables businesses to make the most of AI:

"A synthesis of technical, applications and sectoral knowledge, plus key entrepreneurial business skills, together with access to compute resources."

5. **What do you think is currently working well, if anything, in providing training in AI skills to the current workforce?** *(204 responses)*

Higher education courses were the most frequently cited response, with a particular emphasis on MScs and PhDs. A number of respondents identified **Centres for Doctoral Training** (CDTs) as valuable and worthy investments, with CDTs being the most frequently mentioned individual initiative across all responses. A large number of respondents praised the quantity and accessibility of **online courses**, naming providers such as Coursera and edX.

However, a similar number of responses expressed the sentiment that **nothing was working well** in the training landscape or that there was insufficient training available.

Many respondents answered the question by suggesting how training in AI skills could be improved, rather than what is currently working well. Several of these identified a need to widen training to beyond AI specialists, teaching data literacy and a basic understanding of AI to those in business, medical, legal, academic and creative professions.

Quote:

"Creation of a National Centre for Computing Education: as the tech industry continues to make an increasingly significant contribution to the UK's economy, it is important that computer science teachers are trained and supported to teach the latest digital skills, at all education levels."

Data, infrastructure and public trust

Quantitative answers

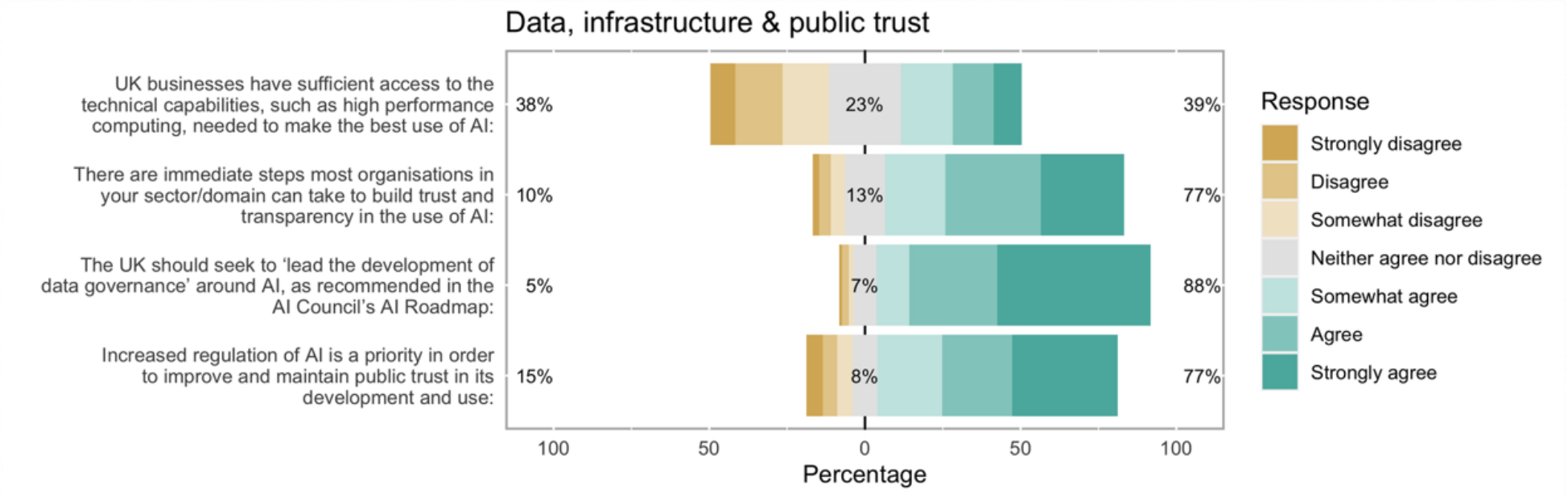


Figure 5. Respondents' views were mixed as to whether businesses have sufficient access to technical capabilities. However, respondents largely agreed that immediate steps could be taken by organisations to build trust in AI, that the UK should lead the development of data governance around AI, and that increased regulation of AI is a priority.

Qualitative answers

6. **Which aspect of governance is the most important in your sector/domain and for which particular applications of AI?** *(257 responses)*

The majority of respondents argued that AI governance cannot be developed in isolation from data governance. Many respondents also argued that one of the barriers to developing good data governance is that large organisations, such as private companies and government, have **vast access to individual data**. This allows large organisations to set their own standards for data use and access which are not necessarily in the best interest of individuals.

Respondents argued that **democratising the ownership of datasets** is important in improving data governance, as well as better stewardship of publicly held data so that data subjects are aware of what personal data are held about them, how the data are being used, and the process for withdrawing them. Sharing of public sector data via data-sharing intermediaries, primarily for training machine learning models for research and industry, would advance AI adoption. The European Data Governance Act was cited as good practice for reinforcing trust in data-sharing intermediaries.

Many respondents said that the UK needs to work with international partners, such as the EU, to develop good data and AI practices, via global public consultation, and to build on previous expert work, for example that carried out by the Open Data Institute (ODI) and the Ada Lovelace Institute. This was also cited as an area where the UK can take a leading role internationally. WTO e-commerce rules were cited as an example of poor governance, as the rules undermine the ability of sovereign parliaments to regulate independently.

Importantly, it was repeatedly argued that any data and AI governance framework needs to be usable and practical in order to be effectively deployed by organisations and should include practical guidance on data collection. One suggested approach was to develop data trusts and foundations in the UK, particularly in the private sector. Some respondents also flagged that technical and non-technical **AI safety** was the top issue to safeguard critical infrastructure and to avoid the weaponisation of military/nuclear AI.

More specifically on regulation, some respondents argued that **overregulation** was a real risk that could inhibit innovation in AI sectors. It was consistently argued that light-touch regulation, developed in tandem with companies that develop AI, would be the best approach to regulating new uses of AI. Any governance system needs to be carefully framed as a shared vision of introducing ethical and non-exploitative AI to the public.

Prioritisation of **human engagement and social research** into how these technologies are used and perceived was also mentioned. Many respondents argued that the citizen need should be embedded into any governance system, which will build trust between AI and citizens, reduce bias in AI models and help evaluate what level of bias, if any, is acceptable in AI models. In addition, user-centric data portals would allow users to access high-quality citizen-generated data or public sector datasets. More generally, it was argued that the public perception of AI technologies needs to shift, as the public currently have less confidence interrogating algorithmic decisions than human decisions.

Many respondents provided examples from specific sectors. It was argued that in education, publisher monopolies for subscriptions to educational platforms are dangerous. There was also a lot of interest in health data, specifically in providing appropriate access to, and privacy constraints for, health data across the lifecycle, and avoiding the effects of biased training sets. Data provenance, quality, access and accountability were emphasised as important considerations, particularly in handling health data but also in other domains.

Of the respondents who thought that data quality and standardisation were key issues, some argued that we need a way of understanding the value of an organisation's data systematically. Others said that data and the results from AI algorithms need to be reproducible, to ensure that AI is as fair as possible. Where data are crowdsourced, there also need to be mechanisms for ensuring standardisation and consistent data quality to maximise the benefits of analysis. COVID-19 case rates were cited as an example of where data was collected inconsistently, leading to false conclusions being drawn from the data.

Quote:

One stakeholder argued that the AI / data science project process needs to be broken down into parts, and that governance has different meanings at each stage.

"[Stages:]

1. *Data preparation – which I mean to include data sharing, data acquisition, data quality assessment, data pre-processing, etc.*
2. *Calculations – which I mean to encompass all manner of mathematical processing applied to the data, from simple derived mathematical quantities through to complex ML/AI and modelling. This means to include R&D before operationalising/productionising.*
3. *Serving results out to stakeholders and users – ranging from decision makers, specialists, or the citizen. The clear focus is on user need, and that the information presented to them is fit for purpose.*

This entire pipeline has to have standards, governance and practices. It is all important, for the output of the pipeline to be trustworthy.

There will be standards, governance and practices that will be very data-centric, and others that should be more focused on the algorithms, let's call it 'AI-centric'. It all has to fit together across the pipeline and use case in question, otherwise the pipeline won't be trusted."

7. **Which steps can organisations take to build trust and transparency? And if there are no immediate steps, what else could be done?** *(264 responses)*

The most common response was that more **education and explanation was needed around AI technologies** to avoid the perception that they were a 'black box'. Many felt that the following would all build trust with stakeholders: clarity of decision-making; evidence that the system did not embed bias or was not used for weaponisation or societal control; human review for edge cases; and the option for a non-AI service or to speak to a human operator. Respondents also stressed that positive and simple use cases of where AI had worked well would improve realism about what AI can do and its limitations, and also help to improve trust and provide assurance that the AI was fit for purpose and being used for the right reasons.

Going further, many respondents called for active **public engagement and communication** of AI technologies. There were suggestions that AI could be made more user-friendly through initiatives such as: a scheme resembling energy product labels; one-page documents or visualisations explaining how the AI is used; 'no-code' explanations or public consultation and roundtables by businesses and government when implementing a new AI system; and a BBC series explaining AI. Some respondents also suggested that trusted public figures advocating for safe AI solutions could build trust further, and that explanations should avoid anthropomorphising AI.

Within businesses, some respondents argued that a more **diverse workforce** was needed, and an increased understanding of socio-cultural issues around AI. This could be achieved through **fairer recruitment practices** and **employee training,** such as that developed by the ODI. Respondents argued that training for technical and non-technical staff using AI systems is needed, to help them understand how AI is monitored, how to communicate their work and how to use AI ethically.

In order to **safeguard against unfair/biased decisions** made by AI systems, some argued that there should be edge-case analysis for decisions which fall either side of a certain outcome, to understand why the system has made different decisions for two similar subjects. Other proposals included options for human review of AI-led decisions; transparent data validation and standardised frameworks; algorithmic risk analyses; ethics codes; certification schemes; model cards; and auditing mechanisms for evaluating algorithms. These are needed at all stages of an AI or data science project, from the data collection stage to implementing the model, to the project's results' impact on society.

Many respondents gave specific examples of frameworks and tools which organisations can use to build trust and transparency in AI:

- The Aletheia Framework – a framework by Rolls-Royce for practical ethics in an AI project from start to finish.
- Ethical principles for advanced analytics and artificial intelligence in financial services – a paper by UK Finance.
- The AI Incident Database – a database of harms or near-harms involving AI.
- EthicsGrade – an organisation which grades companies on their AI governance.
- Draft EU legislation on AI.
- Building Trust in AI and ML – a white paper by the software company Workday.

8. **What is currently the largest cause of public mistrust of AI's development and use?** *(280 responses)*

Some respondents argued that we need to be very clear on the distinction between **mistrust of AI models and mistrust caused by misusing the underlying data.** For the former, greater explanations and review of AI models would help, and for the latter, better citizen data protection is needed.

Many respondents argued that a distinction should be drawn between **perception of AI risks vs actual risks of AI**, such as discriminatory AI. For the former, it was noted that popular culture can be extremely damaging, and negative perception of AI in one sector can have a knock-on effect in other sectors, hampering cross-sector adoption. In addition, there is a long-standing concern that AI is a threat to jobs and the tax base. Better use cases, education about AI and data, and explanations of AI 'black boxes' will help to shift perception.

For the actual risks of AI, more diverse researchers and training sets will reduce the impact of discriminatory AI, as well as human review for edge cases or the right to appeal life-changing, AI-made decisions. In addition, respondents argued that public support and trust is dependent on the well-explained scope and boundaries of AI – and that trust will decrease if AI is seen to be enabling a surveillance state, or if there are scandals involving the misuse of AI. Individuals need assurance that decisions are free of bias and that 'big tech' monopolies do not have the authority to set data standards in a vacuum. It was further argued that this cannot be done without a parallel focus on the use and collection of data: individuals need data rights, consent mechanisms and an understanding of what data are held about them, and the right to withdraw personal data.

As with the responses to question 7, many respondents proposed ways to reduce public mistrust in AI. Some highlighted that organisations using AI need to be able to explain the system to the users or citizens whose data they hold, and that significant public engagement will help to overcome mistrust of AI.

As with the responses to question 6, respondents highlighted that a **regulator is needed** that works with the companies, experts and public sector bodies that are using data (particularly personal data), and that improves accountability for organisations that handle large volumes of personal data. The Advertising Standards Authority and the Financial Conduct Authority were given as good examples of how regulatory bodies operate in unrelated domains; for example, a similar body responsible for AI could work with organisations to develop responsible and transparent AI algorithms whose use and processes are publicly justified, standardised, and are not oversold – "a comply or explain" regulatory policy. One response suggested that such a body could coordinate an open AI register, AI inspections and reviews, and AI-certified practitioners, and involve a mechanism for seeking redress against unfair AI-made decisions.

In addition, there is public mistrust of the monopolies held by 'big tech' companies and whether they will use their data responsibly.

Quote:

“Distrust has become mainstream and is accepted by large corporations – for example, the advert for Alexa that uses Pompeii as an example of what you can find out shows a father misrepresenting Alexa’s information as his own knowledge! If AIs such as Alexa are seen as ways for people to succeed in cheating rather than as having legitimate value as information sources, I think the problem will be compounded.”

9. **To make the most effective use of AI, which technical capabilities do businesses currently have best access to?** *(181 responses)*

The overwhelming majority of respondents argued that access to **cloud computing power** is the most important technical capability that businesses need access to. Many argued that this is much more important than high performance computing (HPC), which there is already sufficient access to. Respondents commented that the cost of cloud provision and HPC is often prohibitive for SMEs, and governments don't understand the scale of the cost needed to achieve widespread AI implementation. Some respondents argued that the problem is not the availability of cloud computing capacity; instead, it is the domination of the market by US tech companies who are not incentivised to develop capacity best aligned for UK businesses, ensure this capacity is sufficiently secure for UK security purposes, and provide the ability to access these resources across all sectors. It was argued that UK investment in cloud infrastructure, exascale computing power and broadband infrastructure is needed, without restricting access to overseas providers.

SMEs face multiple barriers to effective uptake of AI. The cost of infrastructure and commercial AI products is often prohibitive, and SMEs do not have enough technical expertise to know how to implement AI across businesses, or what valid results of an AI algorithm would look like. Possible solutions proposed were government promotion and sponsorship of AI adoption, platforms for 'no-code' AI, more general AI and data science literacy, and more AI consultancies.

Many respondents argued that a **lack of skilled researchers**, data scientists, and general AI and data science skills at the management level prevent many companies from successfully implementing AI. In the UK, it was argued that these skills are too concentrated in the south east of England.

Other issues highlighted were: access to publicly available and clean **datasets**, an awareness of the data held by companies, a lack of effective data analytics platforms for understanding internal data, and the high energy use of AI – which businesses need to downscale in order to improve their environmental credentials.

A few respondents argued that what is really needed is UK investment in **fundamental AI research** into areas such as quantum computing and next generation hardware. Some respondents argued that while research is sufficient, it is not sufficiently implemented across the public and private sector, which are not up to date with cutting-edge AI research.

Quotes:

"To give a recent good use case example, AWS and Vodafone have announced a partnership where they'll be putting AWS services within Vodafone's 5G network. This means mobile and IoT developers can integrate their AI/ML tooling into their applications, without adding latency associated with leaving the 5G network and doing the round trip to the cloud. Long-term investment must continue in key computing infrastructure including HPC, AI and quantum, as these will form the technological foundations upon which scientific research and innovation will be possible."

“The UK has enjoyed record years of (VC) investment in the tech sector, and if the investment levels of Q1 2021 are anything to go by then 2021 will beat all previous records. Just to put this into context, there is more VC investment in UK AI tech companies than in the rest of Europe’s tech sector combined. Whilst that is fantastic news, how do these start-up companies…access…the necessary computing power? In other sectors, for example the life science sector, the UK government has intervened over many years by funding shared laboratory facilities (e.g. Stevenage Bioscience Catalyst, The Babraham Institute, etc.) which typically are (financially) out of reach of start-up companies. The result of these interventions has helped the UK life sciences sector become a world-leader.”

National, cross-sector adoption

Quantitative answers

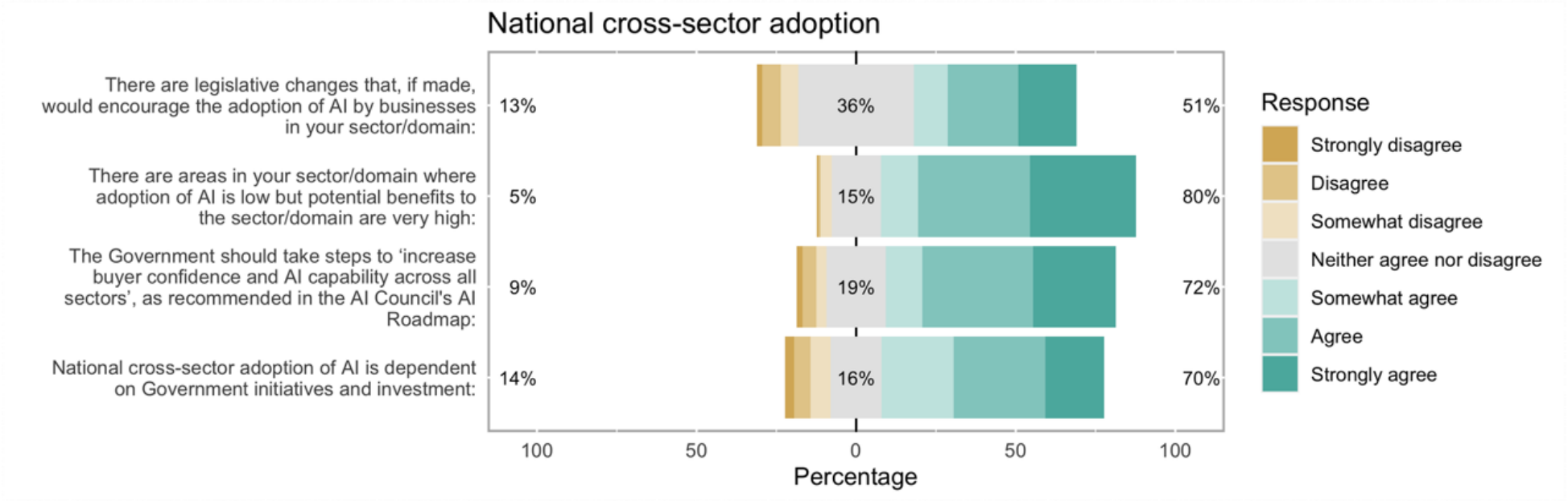


Figure 6. Around half of respondents agreed that legislative changes would encourage AI adoption by businesses, although over a third neither agreed nor disagreed. There was stronger agreement that there are areas with low AI adoption but high potential benefits, that the Government should take steps to increase AI capability across all sectors, and that national, cross-sector adoption of AI is dependent on Government initiatives and investment.

Qualitative answers

10. Which areas are these? *(232 responses)*

Respondents noted a wide variety of areas where adoption of AI is low but potential benefits are high, including:

- General business productivity.
- Creative industries.
- Insurance.
- Transport.
- Finance.
- Logistics and supply chains.
- Smart cities and urban planning.
- Public sector bodies.
- Consumer analytics and online customer experience.

Health was the most prominently highlighted area that respondents listed as having great potential to benefit from ethical and socially responsible AI. Manufacturing and education were also notably highlighted as areas which currently underutilised AI.

Given the recent focus on the health sector during the COVID-19 pandemic, it is perhaps unsurprising that a large proportion of respondents singled this area out. What is more notable, however, is the range of health applications that were suggested as having the potential to benefit from AI, from service delivery to research. Examples ranged from screening, diagnosis, prognostication, treatment selection and response prediction, across areas such as radiology to emergency medicine.

11. **What legislative changes would help?** *(178 responses)*

Respondents generally occupied three broad positions in relation to the question of what legislative changes would encourage the adoption of AI by businesses. Those who:

- Favoured no regulation or clarity on existing legislation.
- Preferred the focus to be on standards rather than legislation.
- Felt regulation had a role to play in some form.

Respondents who were **not in favour** of legislation feared that such laws may stifle innovation. Others stated simply that legislation was not a significant factor in businesses adopting AI.

Advocates of a **greater emphasis on standards** and guidelines raised a diverse range of issues. Relating specifically to the question of whether businesses choose to adopt AI, respondents cited standards around transparency, model explainability, 'acceptable' levels of bias, and where AI can and cannot be used as important factors. Others stated that further legislation should be a last resort and that the focus should be on clarifying existing laws, making them easier to understand for both businesses and the public.

Respondents who were **in favour of regulation** listed several reasons, including:

- The need for legal safeguards for data storage and sharing.
- Regulatory sandboxes.
- Liability.
- Privacy.

Many of these respondents emphasised the need for any regulation to be clear and adaptable to differing sizes of business.

One of the notable themes in the responses to this question was the role of regulatory agencies and how these might interact with many of the main issues raised. Some respondents felt that assurance of fairness, explainability and risk could be carried out by a single regulatory agency. This would provide the clarity that some respondents argued would encourage adoption of AI by businesses. It would be important to ensure that this and any other regulation aligned with international standards and practices.

Other respondents addressed the question through the lens of building trust with consumers and businesses. One suggested way to achieve this was 'data passports', where users decide their own general preferences around how their data may be used, which can then be applied uniformly across websites and business activities. In this case, legislation would have a role in compelling businesses to adhere to the passport. Another idea in this area was 'digital fingerprinting' and 'digital watermarking', tackling the issues of data ownership and how the data are used.

12. **What factors are most influential and how best might they achieve this?** *(189 responses)*

Respondents listed the following as some of the most significant factors in relation to buyer confidence in AI technologies:

- Education and training.
- Certification and trustworthiness.
- Privacy and safeguards.
- Ethics and fairness.
- Explainable technology and transparency.
- Public sector use.
- Benefits to business.
- Use cases.
- Regulation and audit.

Out of the above, respondents highlighted **use cases** as being particularly important in demystifying AI and demonstrating AI capabilities for all sizes of businesses. Respondents noted that use cases not only serve as examples to businesses but can also bolster public trust by demonstrating the socially responsible role that AI can play in society. Several respondents mentioned that these use cases should be applicable to everyday business operations, so as to maximise their relevance across the whole of the UK economy, including SMEs. The use cases could be closely coupled with educational efforts aimed at helping businesses to understand how the cases apply to them.

Many respondents argued that buyer confidence and AI capability across sectors was closely linked to **education and training** in AI. Some respondents called for a focus on educating the general public, while others argued that staff require on-the-job upskilling to assess the need for AI in their workplace and reduce misconceptions. Closely associated with education and use cases was the issue of explaining AI: several respondents noted that AI capabilities were being poorly represented and that overpromises, lack of clarity over capability, and uncertainty over deliverables could all damage business trust in AI use.

To address some of the issues raised around trust as a barrier to adoption, some respondents argued that it was necessary to introduce certification of AI technologies, such as accreditation schemes similar to Trustpilot, ISO or Kitemark. This theme of the Government playing a role in ensuring that there were mechanisms in place to provide assurance for businesses was a component of several responses. Respondents also noted that the Government should set an example in this area by actively using AI and promoting best practices.

A contingent of respondents remarked that the public sector was not best placed to increase buyer confidence. Many of these respondents cited other factors such as simply the efficacy of AI vendors and market forces as the primary drivers of increased buyer confidence. As for how to increase the capability of AI across sectors, many of the respondents within this contingent felt that the Government could play some role.

13. **What would best encourage national cross-sector adoption of AI?** *(186 responses)*

Responses coalesced around similar themes to those related to buyer confidence, including:

- Use cases.
- Education and training.
- Public understanding.
- Public sector use.
- Regulation and audit.

There were, however, some issues that were more prominent with regards to national, cross-sector adoption. The following were common within many responses:

- Funding (including grants).
- National AI strategic prioritisation.
- Alertness to social implications of AI.
- Data infrastructure.
- Connecting industries and academia.

For **funding**, sustained investment in research and development was presented as a catalyst for adoption of AI technologies. Related to funding, respondents suggested various initiatives to support cross-sector collaborations, including topic-based 'hubs' where AI is used to solve an industry challenge, and seed funding for cross-sector projects to build trust and relationships. Suggestions were also made to encourage interdisciplinary activities, within academia but also between academia and industry. Ideas included dedicated funding paths similar to Innovate UK grants but aimed at interdisciplinary work.

Strategic prioritisation to engender and guide cross-sector collaboration was cited as necessary by some respondents. Specifically, there were suggestions that the purpose of any collaboration should be defined by the Government, as was the case with the ventilator challenge for COVID-19. Some respondents were clear that any encouragement around national adoption of AI should be accompanied by efforts to drive AI towards **social goals**, ensuring equal benefit across society, rather than simply focusing on private enterprise.

Making more **public sector datasets** available and removing barriers to data sharing was also cited by some respondents as a way of promoting national adoption and exposing AI to different sectors.

There were a number of respondents who argued that the public sector was not best placed to encourage adoption of AI. Many of these respondents stated that the biggest drivers of adoption are commercial, progressing without Government interventions.

Quote:

"We would encourage the Government to consider the specific barriers to AI adoption, drawing on the lessons from the Business Productivity Review (BEIS) and emerging experience from the Government's Help to Grow scheme. At least at the microbusiness level, the Government might also draw from the behavioural insights-led approaches, like the 'EAST' framework about making change Easy, Attractive, Social (e.g. showing peers have adopted), and Timely. The timeliness should be striking for many firms who have had to innovate to survive during the pandemic and could now be innovating to thrive.

The Government could:

- *Promote AI solutions that incorporate societal and environmental wellbeing. For example, privacy-enhancing AI, disadvantage-busting AI, 'small algorithms' that are easier for SMEs to use and understand, and application of AI to transform productivity outcomes for UK businesses, particularly national infrastructure challenges around transport, healthcare and sustainability.*
- *Create testing and experimentation sites to help develop and deploy AI applications.*

Government investment in and leadership of initiatives to promote understanding of and trust in AI are also likely to address a major barrier to adoption."

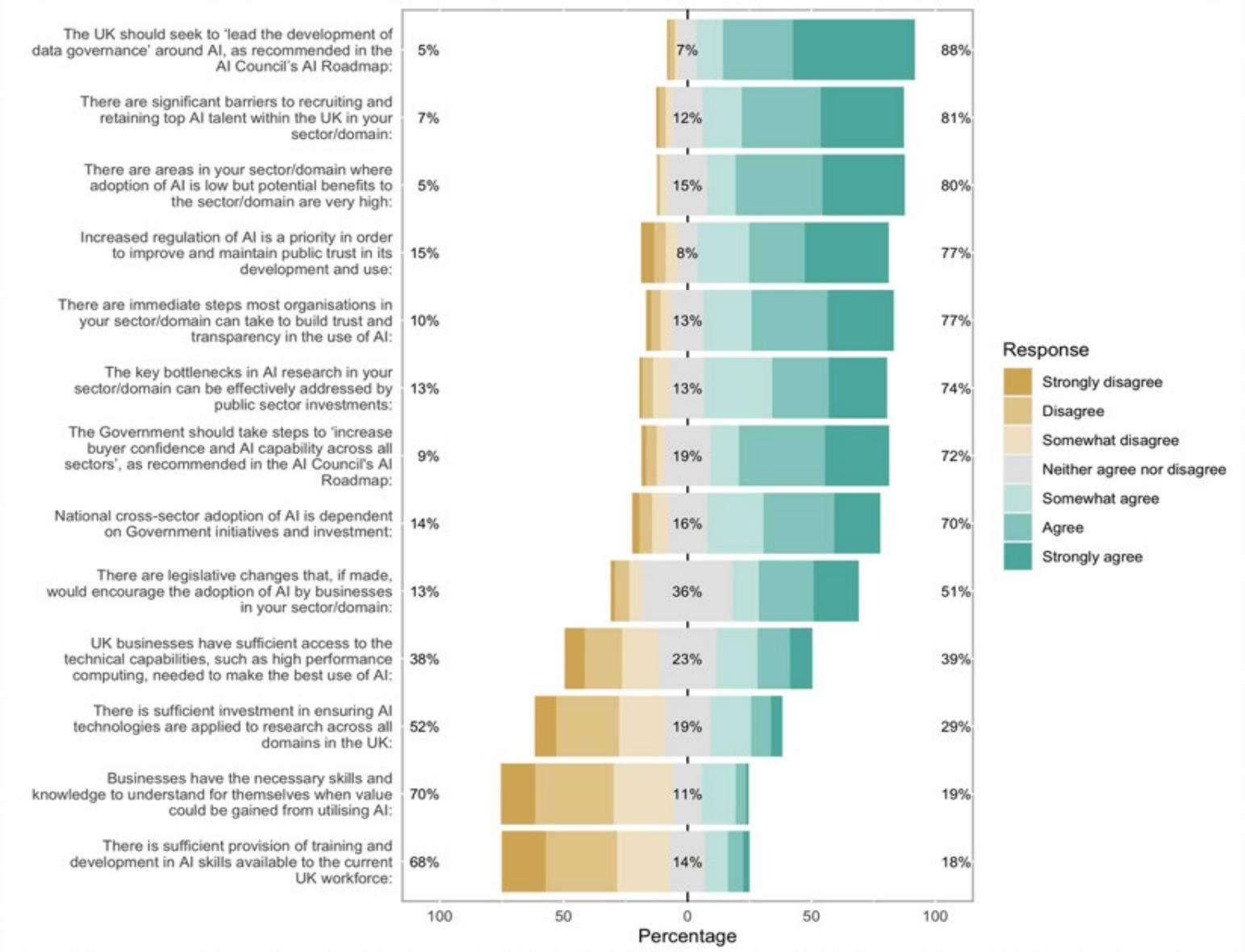
Annex 1: Open question

What else would you like to communicate to the team developing the National AI Strategy? *(221 responses)*

- Share business-applicable research and ensure that AI technologies are developed alongside subject matter experts.
- Clarify ownership and accountability throughout the development cycle of AI.
- Promote data literacy and AI learning for the public.
- Focus on making the UK the best place in the world for AI governance and regulation, from fundamental development through to ethical deployment.
- Focus on skills, academic to industry pull-through, and industrial applications.
- Provide the public with tools to explore AI and understand its potential.
- Focus more on fundamental research in AI.
- Treat compute facilities like other utilities such as water.
- Encourage adoption by developing legislation that requires performance levels of AI systems to be known.
- Use experts to connect problem statements with successful AI outcomes.
- Provide a national business accreditation for AI aligned with ethical and transparency standards as well as benefit to users.
- Encourage a step change in funding from UKRI for AI university-industry collaboration.
- Ensure that the National AI Strategy considers the strategic direction being taken by international partners.
- Legislation in AI cannot lag behind the technology, or issues of fairness and ethics won't be addressed in time.
- Encourage opportunities for disadvantaged people who want to be involved in the development of AI technologies, and ensure that AI is designed with these people in mind.
- Ensure that the Strategy separates public concerns around AI from other more immediate issues of regulating poor-quality, biased AI software found on the market.
- Evaluation of AI models, predictive accuracy, scalability, robustness and interpretability should be available for inspection.
- Encourage certification of AI systems, which work to specification and have been tested for valid outcomes as defined by acceptance testing and have regression testing to ensure there is no drift from defined outcomes.
- Consider where AI is and is not useful, and how to minimise its dependency on real-time internet connections and cloud server farms.
- The Strategy needs to place human flourishing with AI at its centre.
- The Government should invest in its own technical capability to assess and measure AI systems.
- Ethical standards have to be met to build public trust.
- The Strategy should be joined up with the devolved administrations.
- The third sector is currently missing out on opportunities to use AI.
- Large technology firms need to be regulated to build public confidence in AI.
- Immigration policy must not disincentivise talented people from working in the UK on AI.

- The UK Government and industry should participate in the international standardisation workstreams, to support the development and implementation of global, open and consensus-based standards.
- Obligations on AI development should be process-oriented (i.e. management processes requiring proper and adequate risk assessment and treatment) and transparency-oriented, rather than a rigid set of requirements that may create obligations that are impossible to fulfil ("data free of errors") and may not always be the correct ones for achieving the objectives of fostering AI uptake and protecting citizens.
- Education at primary and secondary school level should include AI/computing as a core subject.
- Education should also cover all career aspects related to AI, including data engineers, analysts, data governance/security and cloud architects.
- Do not assume that AI currently applies to all sectors.
- Examine application domains for suitability and invite people to apply methods/technologies to these accordingly.
- New standards in AI are emerging. For a good example see the P7000 series in development by the IEEE Standards Association. These are powerful tools and I would encourage the National Strategy to advocate for their adoption through, for instance, strongly recommending compliance to be demonstrated as a condition of supply when large organisations (and esp. bodies such as the NHS, MOD etc.) are procuring AI systems.
- There needs to be more attention to how AI can be used to improve UK places, through mobility, the built environment, and planning and economic regeneration informed by local data.

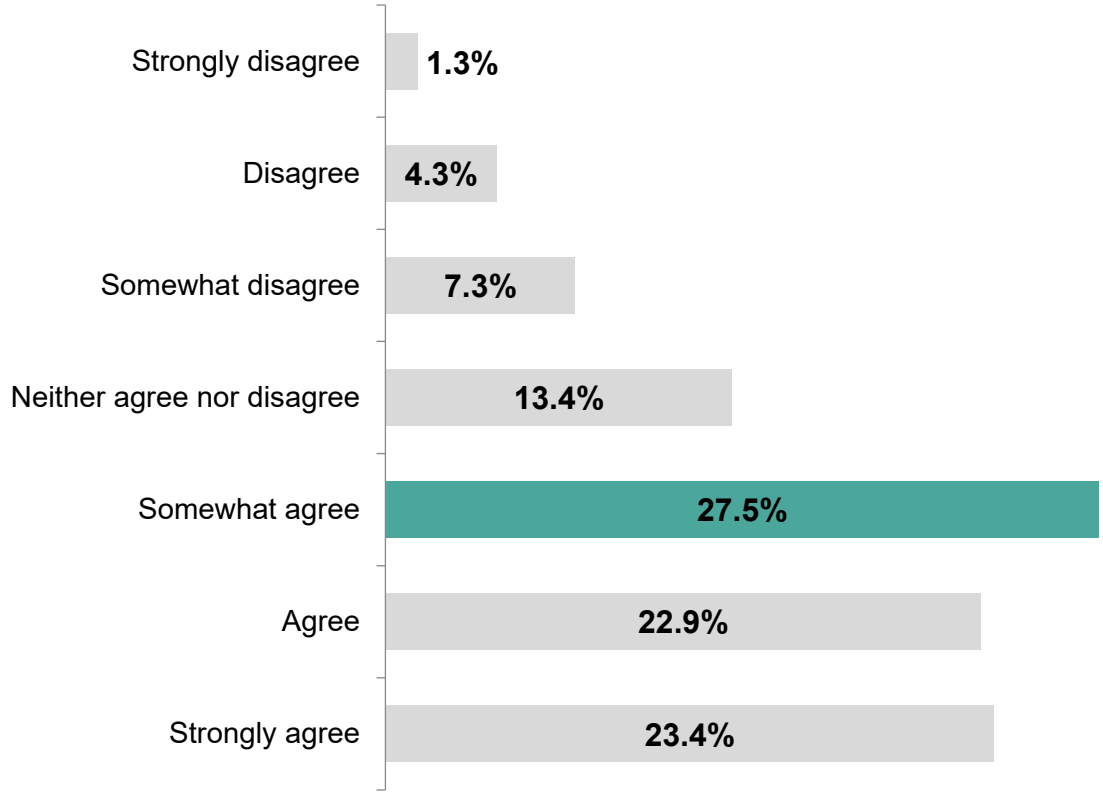
Annex 2: Quantitative summary ordered by distribution of Likert scale responses



Annex 3: Breakdown of quantitative data

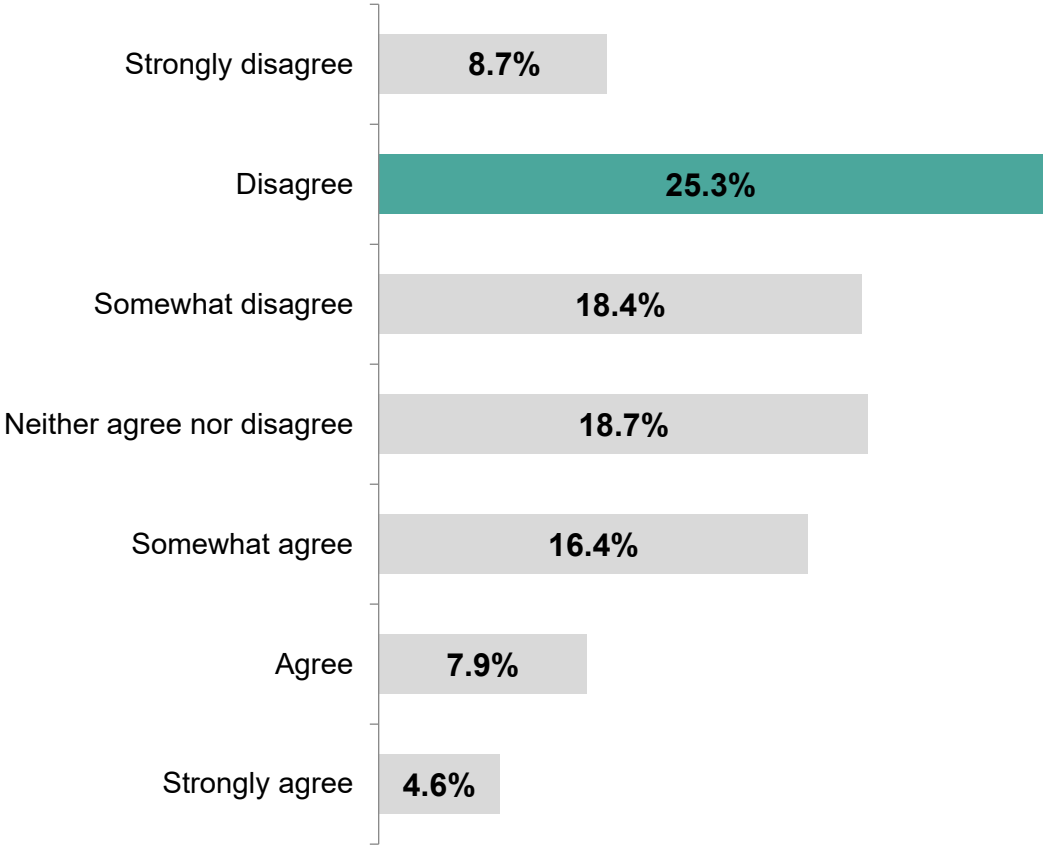
Research and innovation

1a) The key bottlenecks in AI research in your sector/domain can be effectively addressed by public sector investment *(397 responses)*



b) What are these key bottlenecks and how can Government investment address them? *(284 responses)*

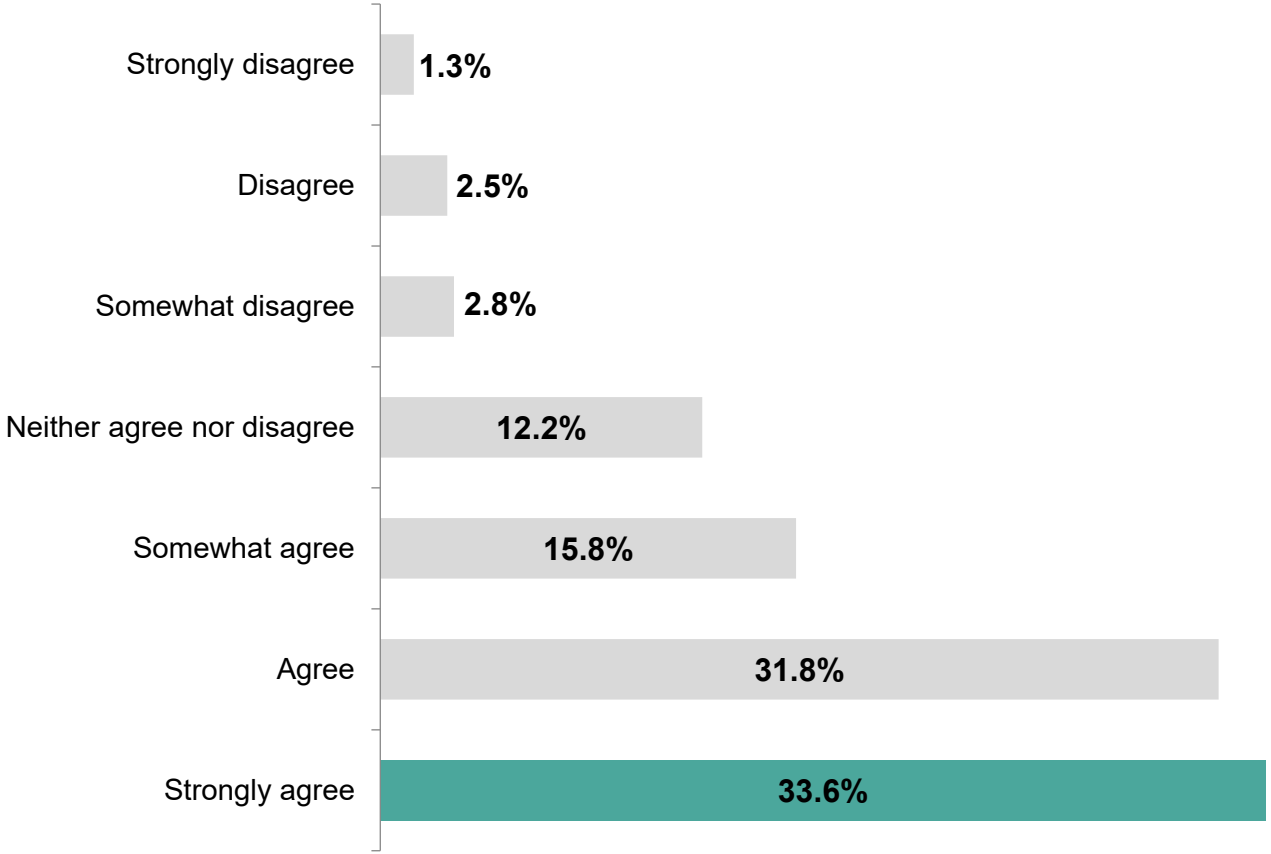
2a) There is sufficient investment in ensuring AI technologies are applied to research across all domains in the *UK* *(391 responses)*



b) What investments are currently working well, if any, in supporting AI to be applied across all domains of research? What could help existing investments be leveraged further? *(202 responses)*

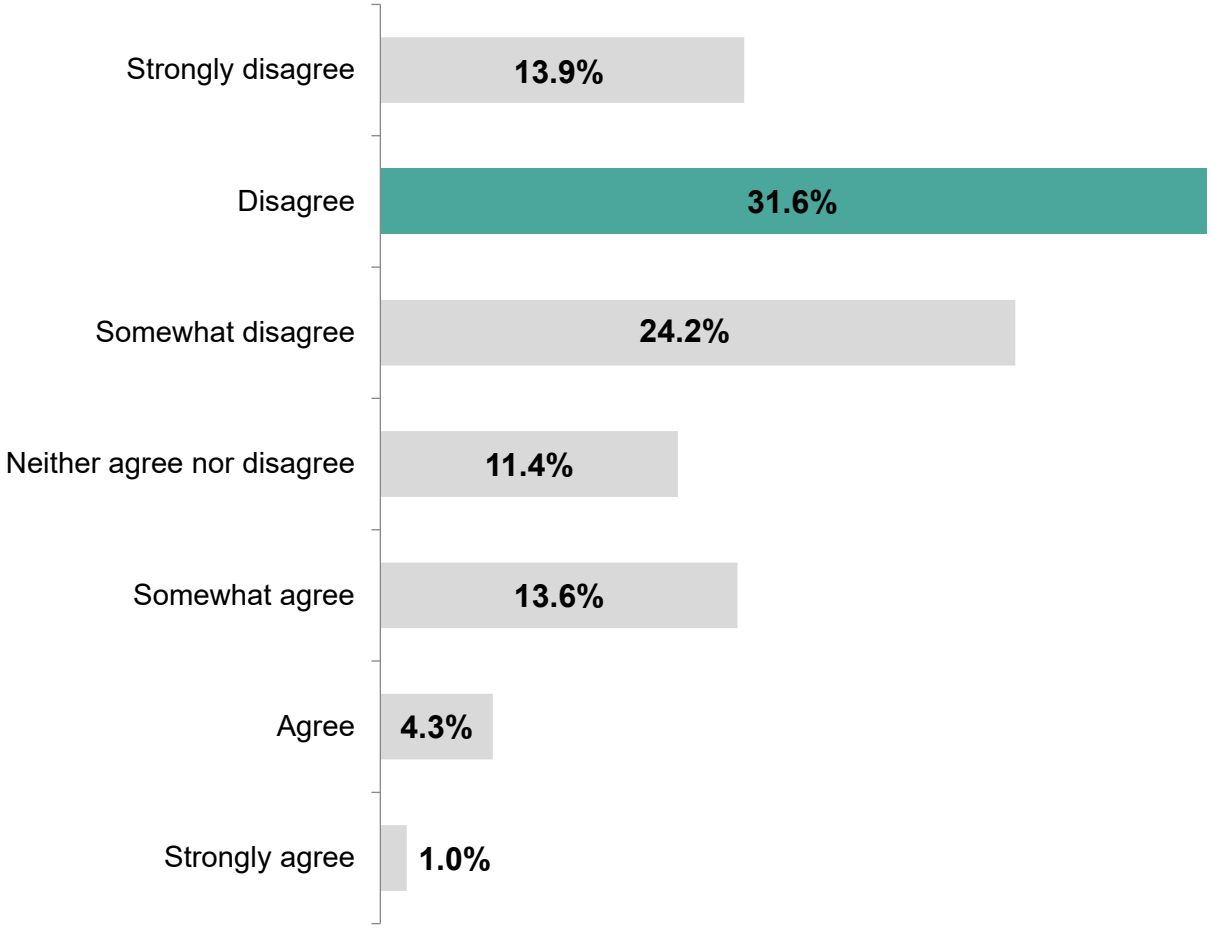
Skills

3a) There are significant barriers to recruiting and retaining top AI talent within the UK in your sector/domain *(393 responses)*



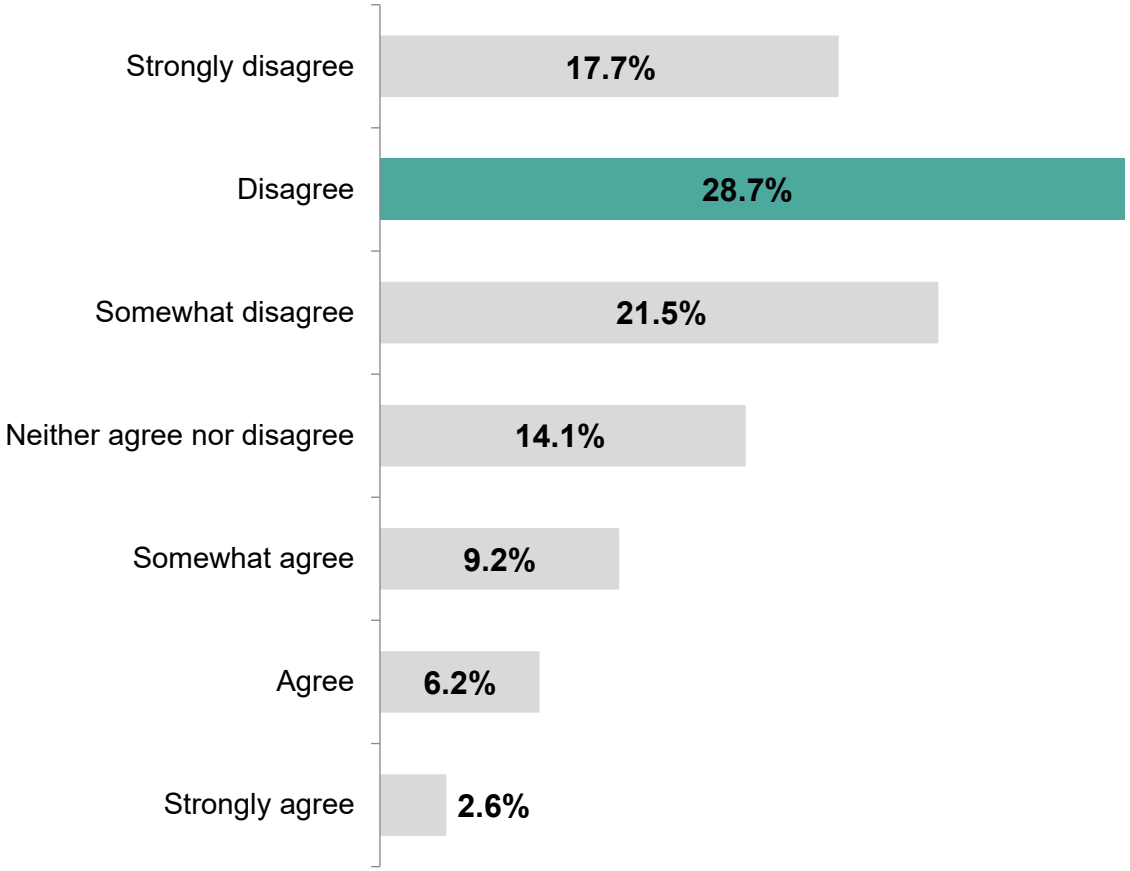
b) If there was one incentive that the Government could put in place to reduce barriers to recruiting and retaining top AI talent, what would it be? *(284 responses)*

4a) **Businesses have the necessary skills and knowledge to understand for themselves when value could be gained from utilising AI** *(396 responses)*



b) What enables businesses, that have the necessary skills and knowledge, to understand and deliver value from using AI? *(261 responses)*

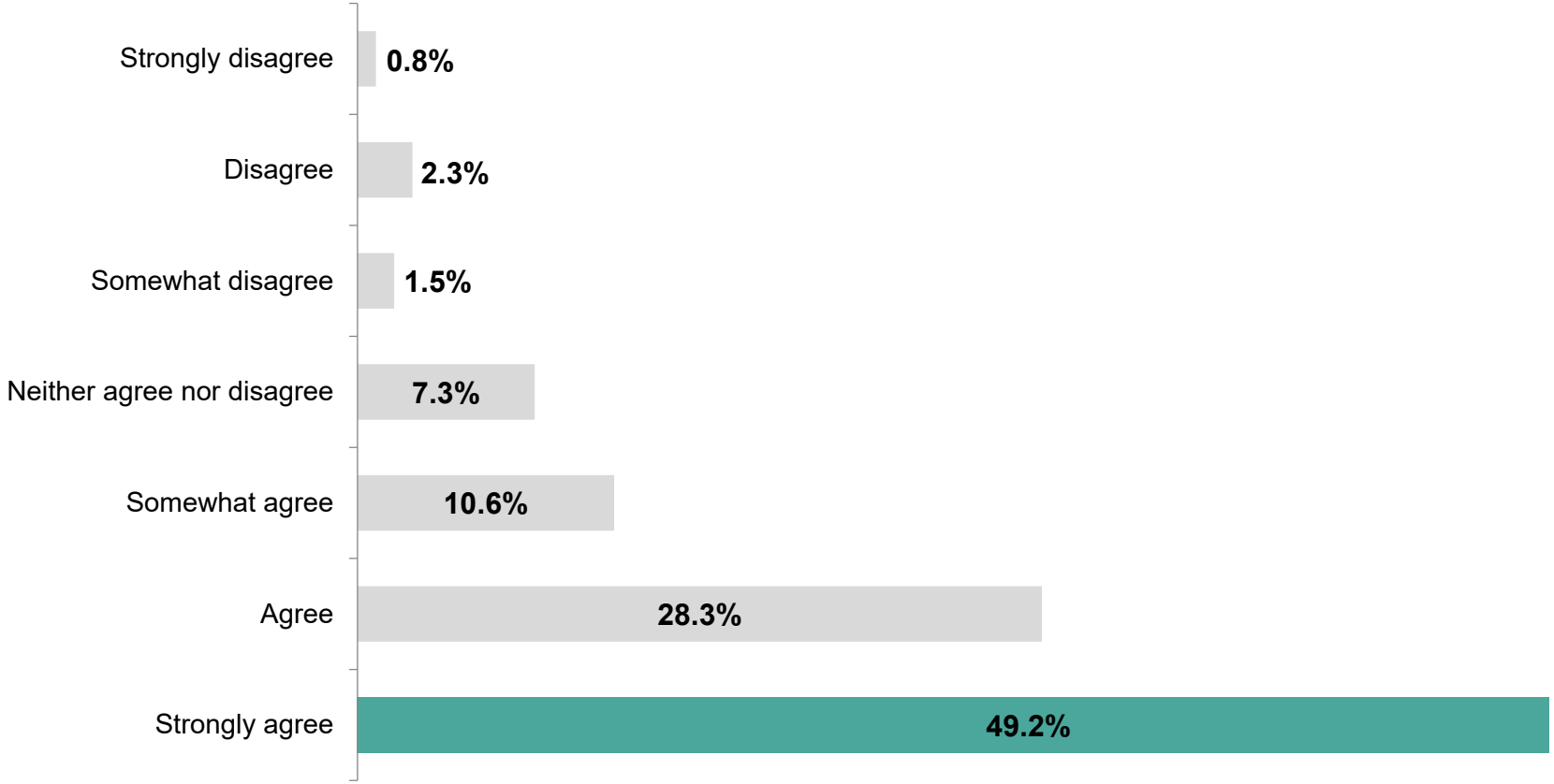
5a) There is sufficient provision of training and development in AI skills available to the current UK workforce *(390 responses)*



b) What do you think is currently working well, if anything, in providing training in AI skills to the current workforce? *(204 responses)*

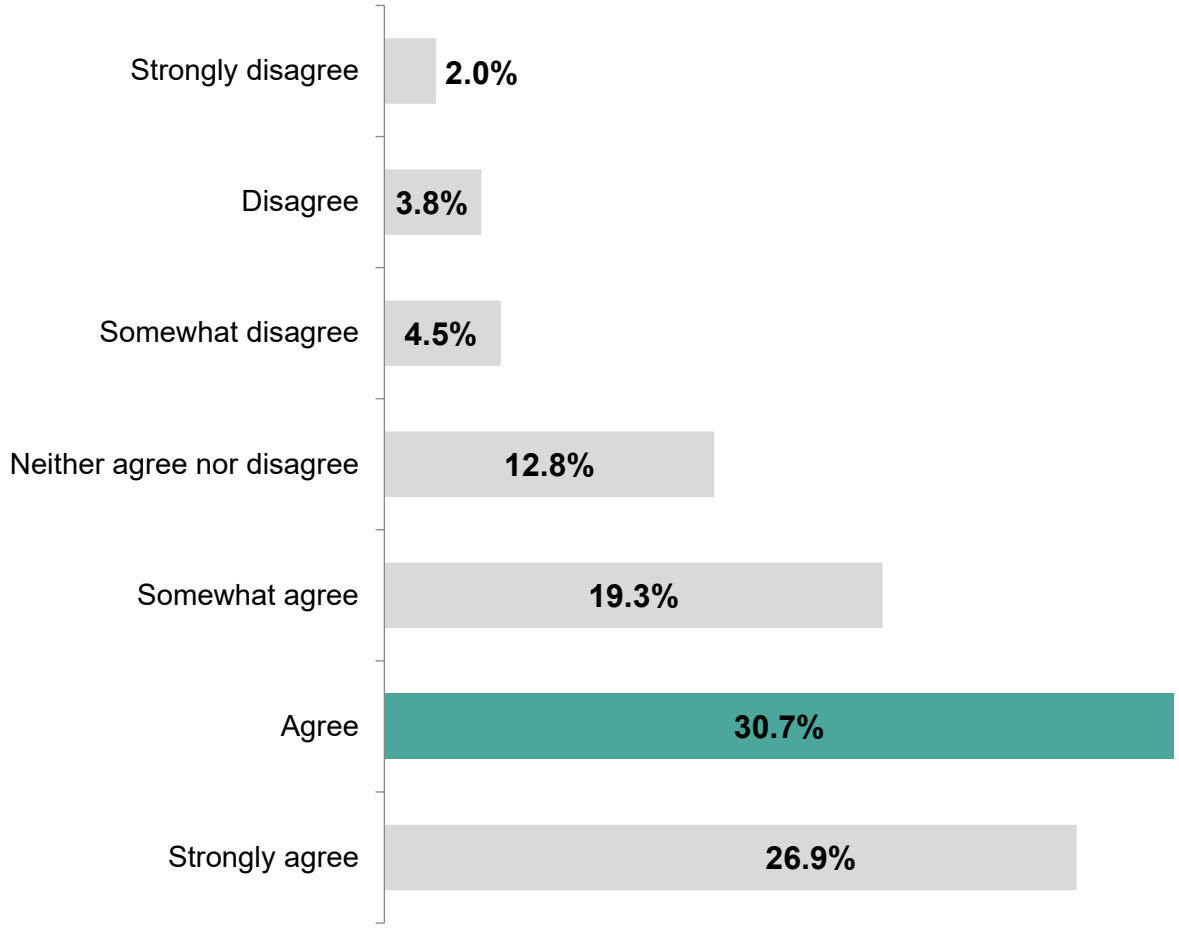
Data, infrastructure and public trust

6a) The UK should seek to 'lead the development of data governance' around AI, as recommended in the AI Council's AI Roadmap *(396 responses)*



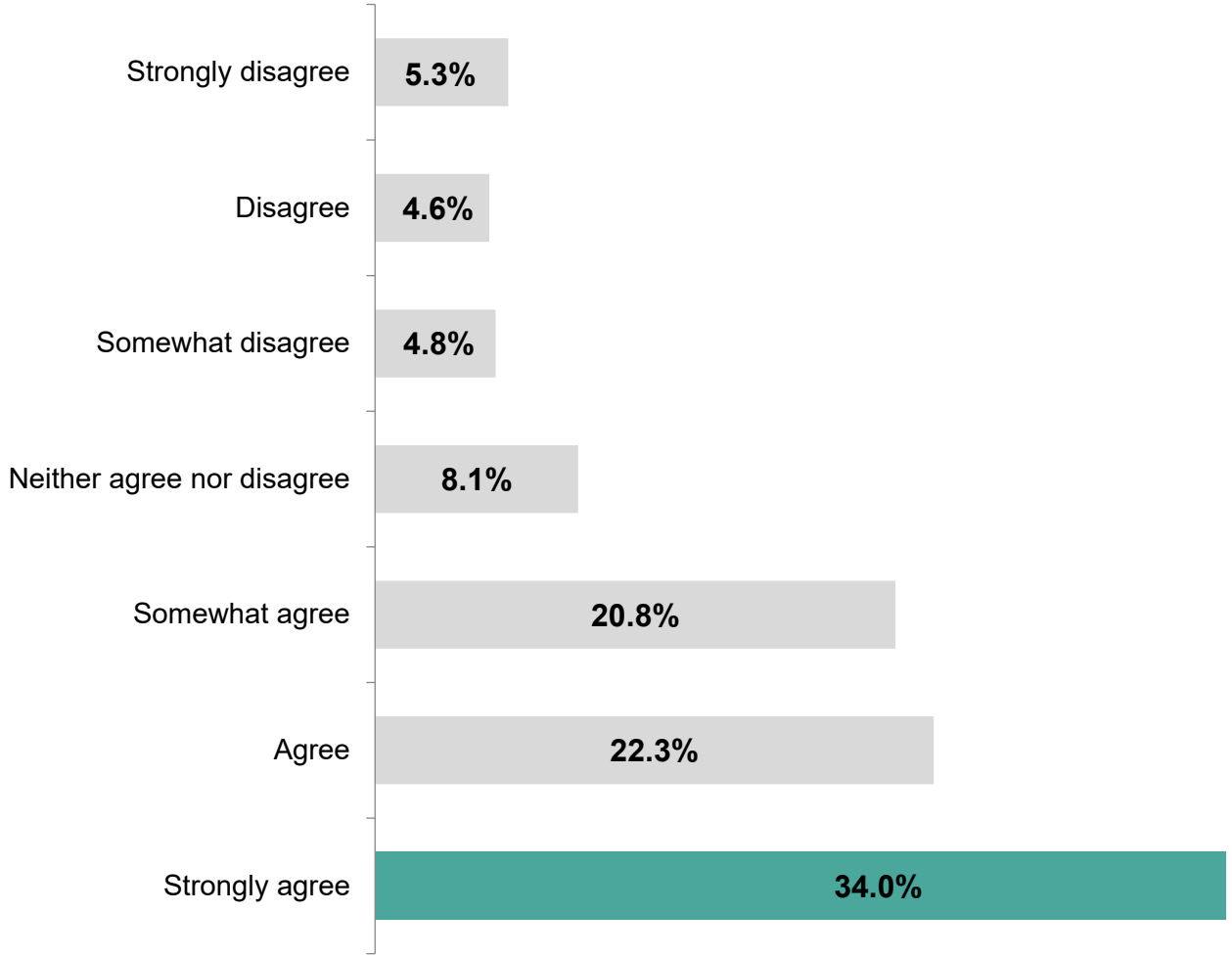
b) Which aspect of governance is the most important in your sector/domain and for which particular applications of AI? *(257 responses)*

7a) There are immediate steps most organisations in your sector/domain can take to build trust and transparency in the use of AI *(398 responses)*



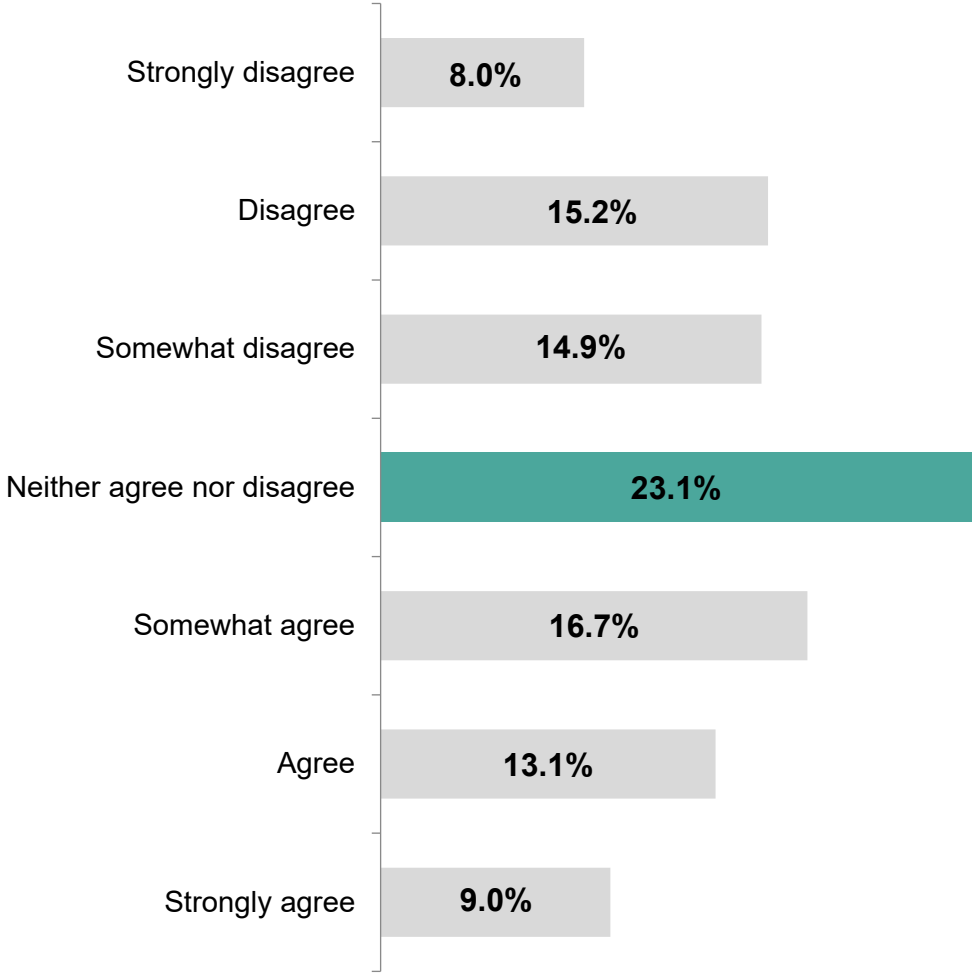
b) Which steps can organisations take to build trust and transparency? And if there are no immediate steps, what else could be done? *(264 responses)*

8a) Increased regulation of AI is a priority in order to improve and maintain public trust in its development and use *(394 responses)*



b) What is currently the largest cause of public mistrust of AI's development and use? *(280 responses)*

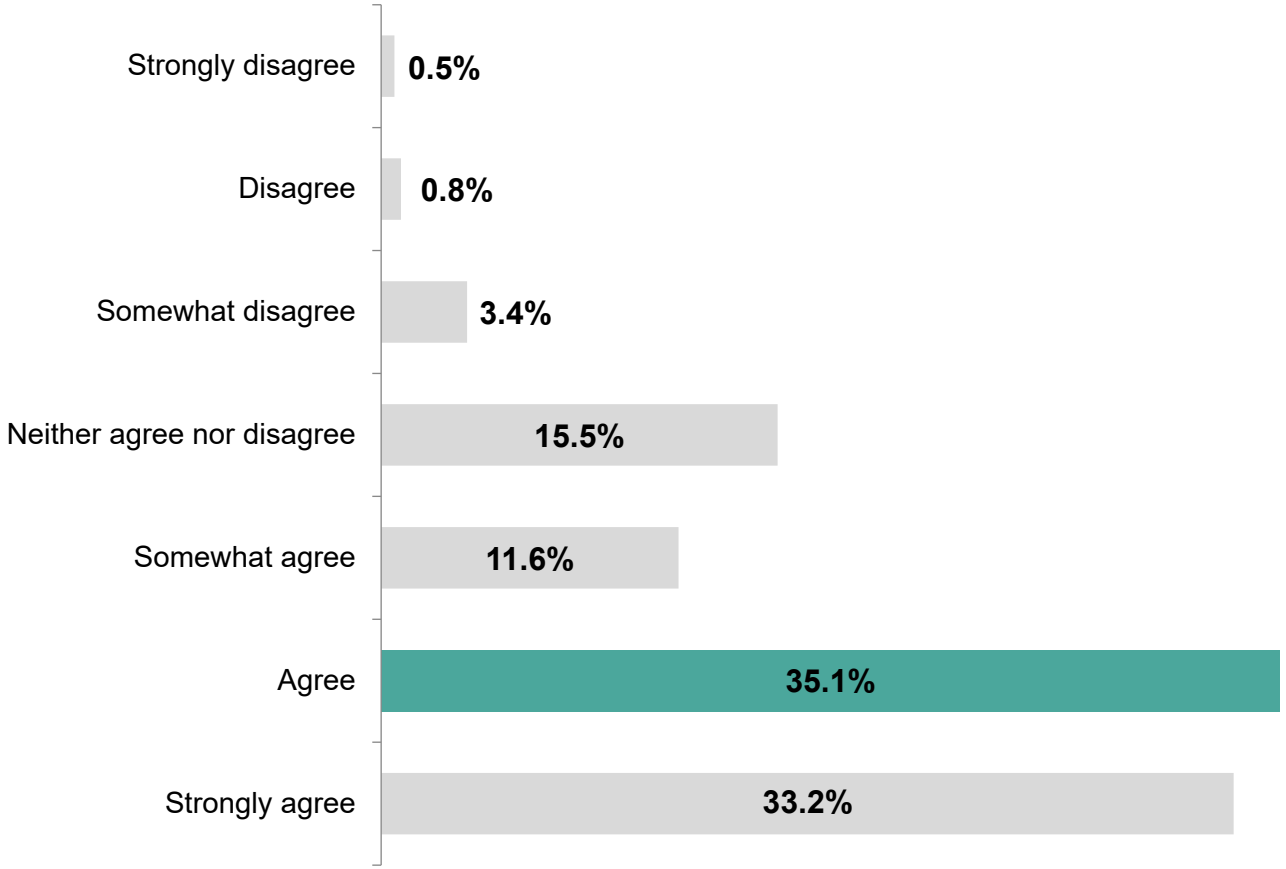
9a) UK businesses have sufficient access to the technical capabilities, such as high performance computing, needed to make the best use of AI *(389 responses)*



b) To make the most effective use of AI, which technical capabilities do businesses currently have best access to? *(181 responses)*

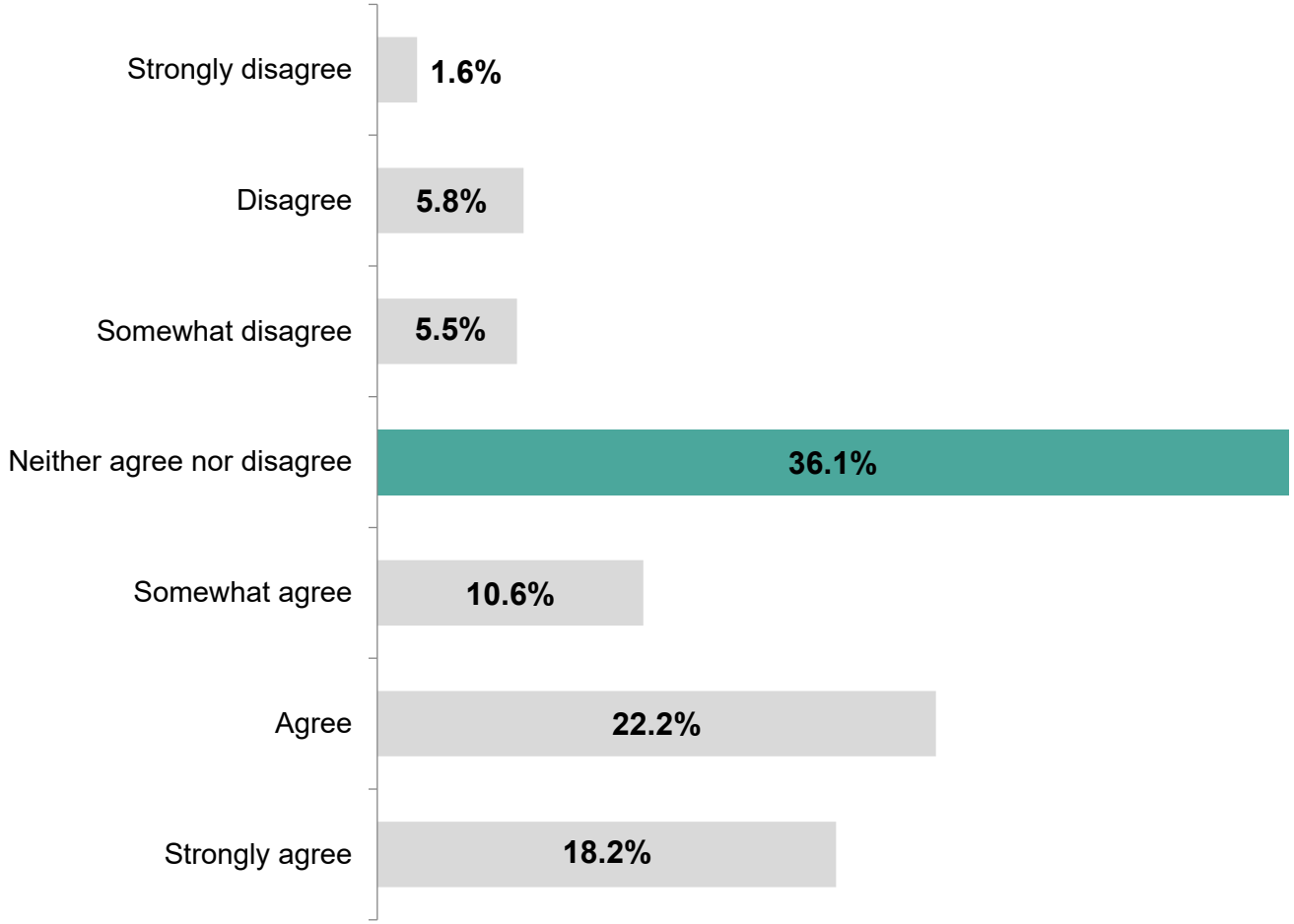
National cross-sector adoption

10a) There are areas in your sector/domain where adoption of AI is low but potential benefits to the sector/domain are very high *(388 responses)*



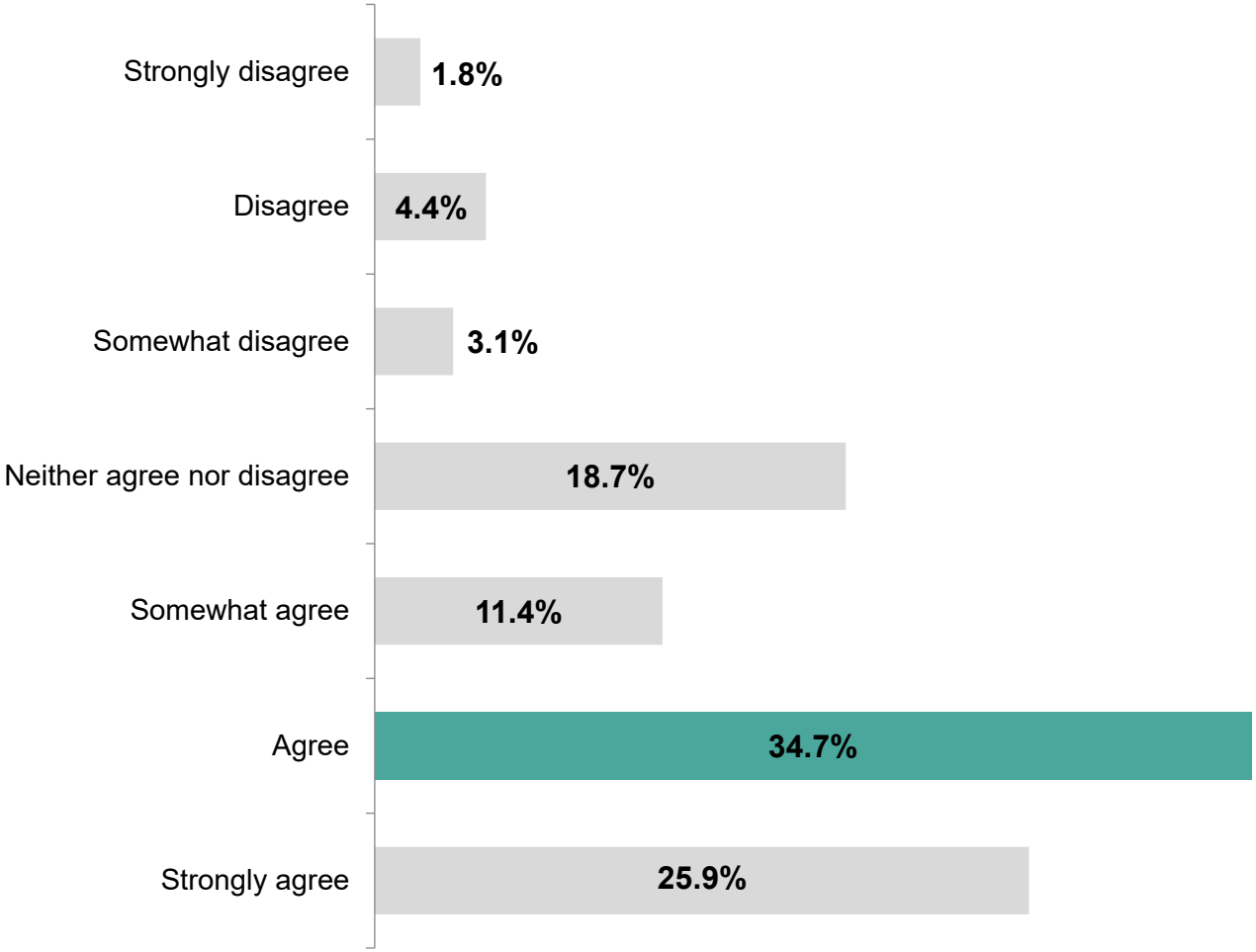
b) Which areas are these? *(232 responses)*

11a) There are legislative changes that, if made, would encourage the adoption of AI by businesses in your sector/domain *(379 responses)*



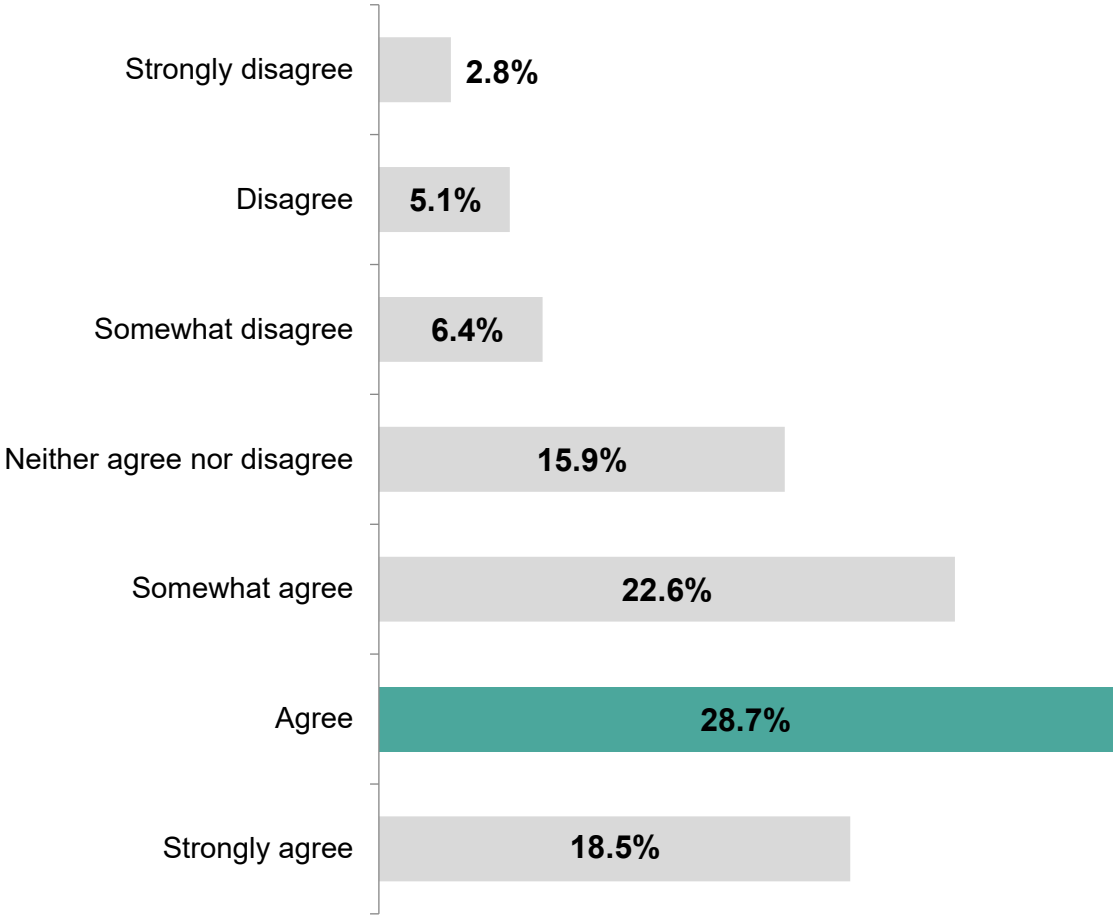
b) What legislative changes would help? *(178 responses)*

12a) The Government should take steps to 'increase buyer confidence and AI capability across all sectors', as recommended in the AI Council's AI Roadmap *(386 responses)*



b) What factors are most influential and how best might they achieve this? *(189 responses)*

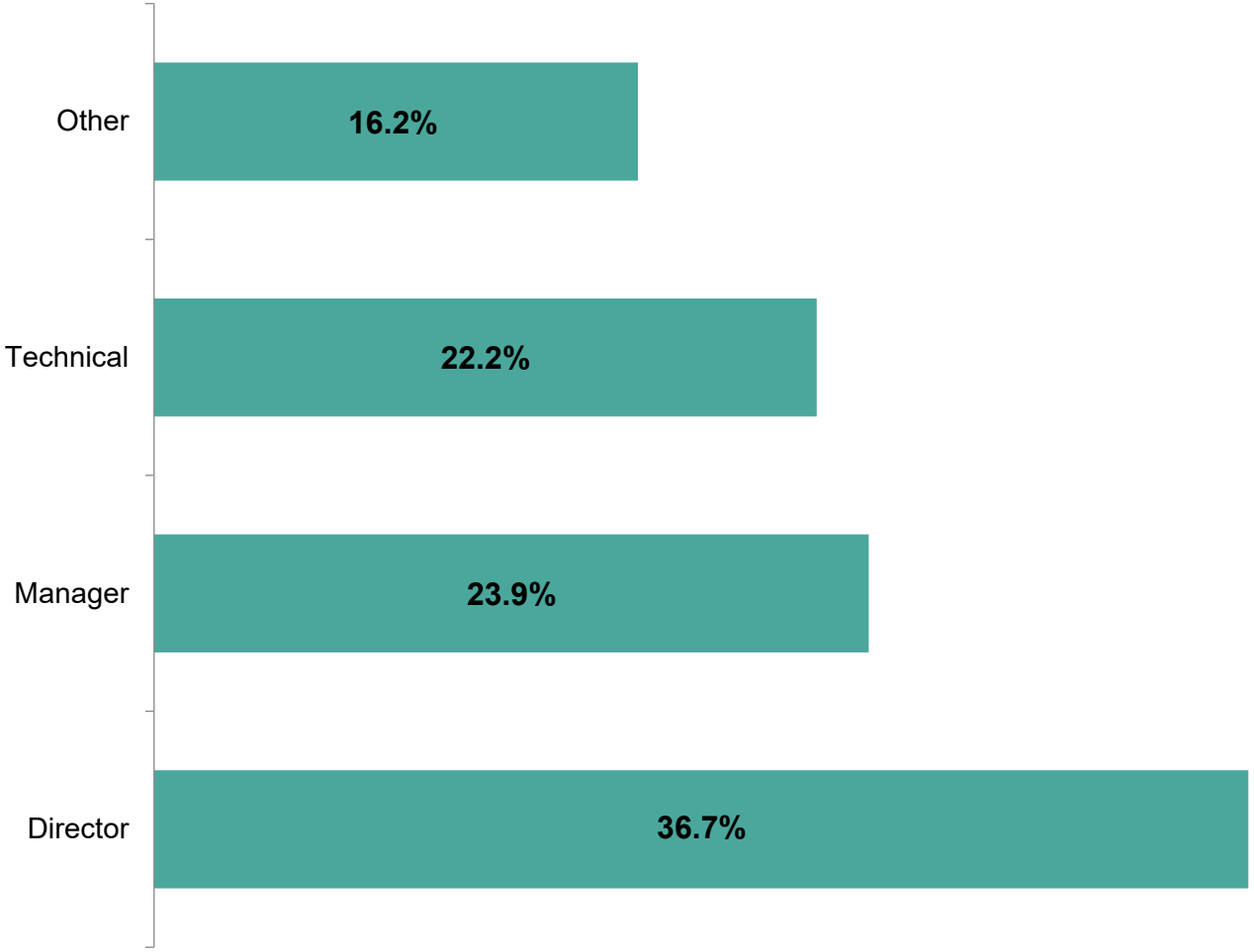
13a) National cross-sector adoption of AI is dependent on Government initiatives and investment *(390 responses)*



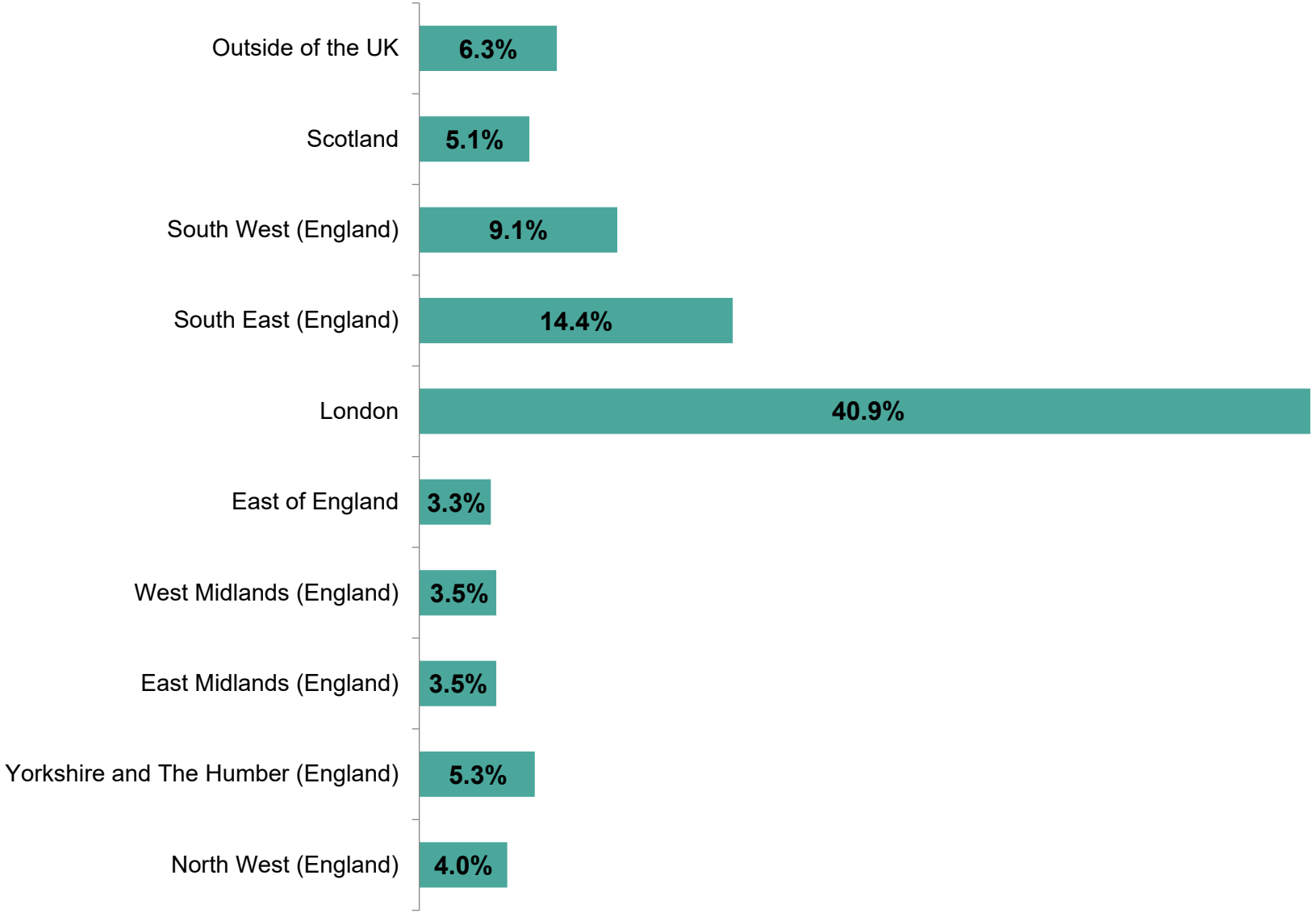
b) What would best encourage national cross-sector adoption of AI? *(186 responses)*

Annex 4: Additional demographic responses

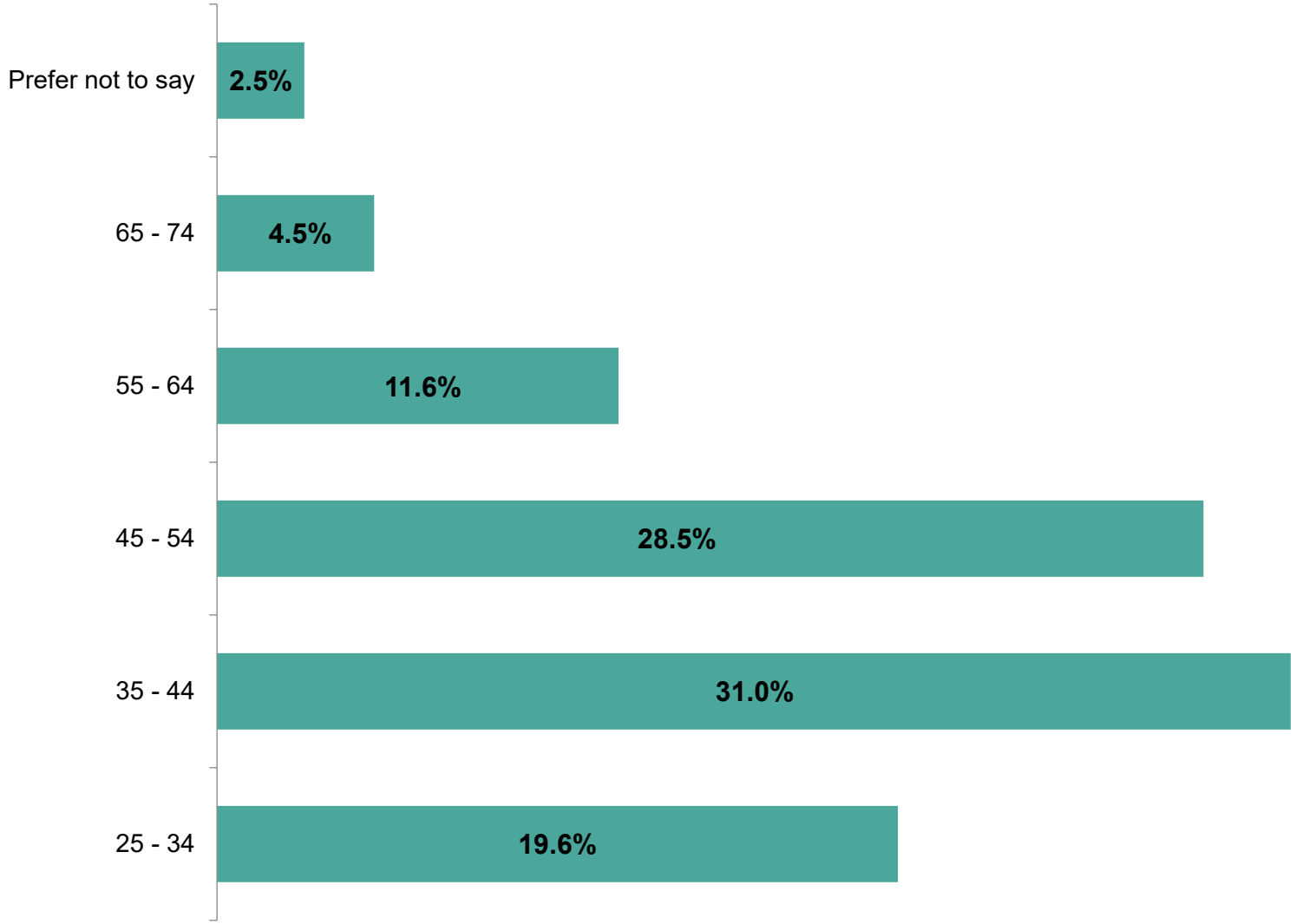
18) Which best describes your position at work? *(401 responses)*



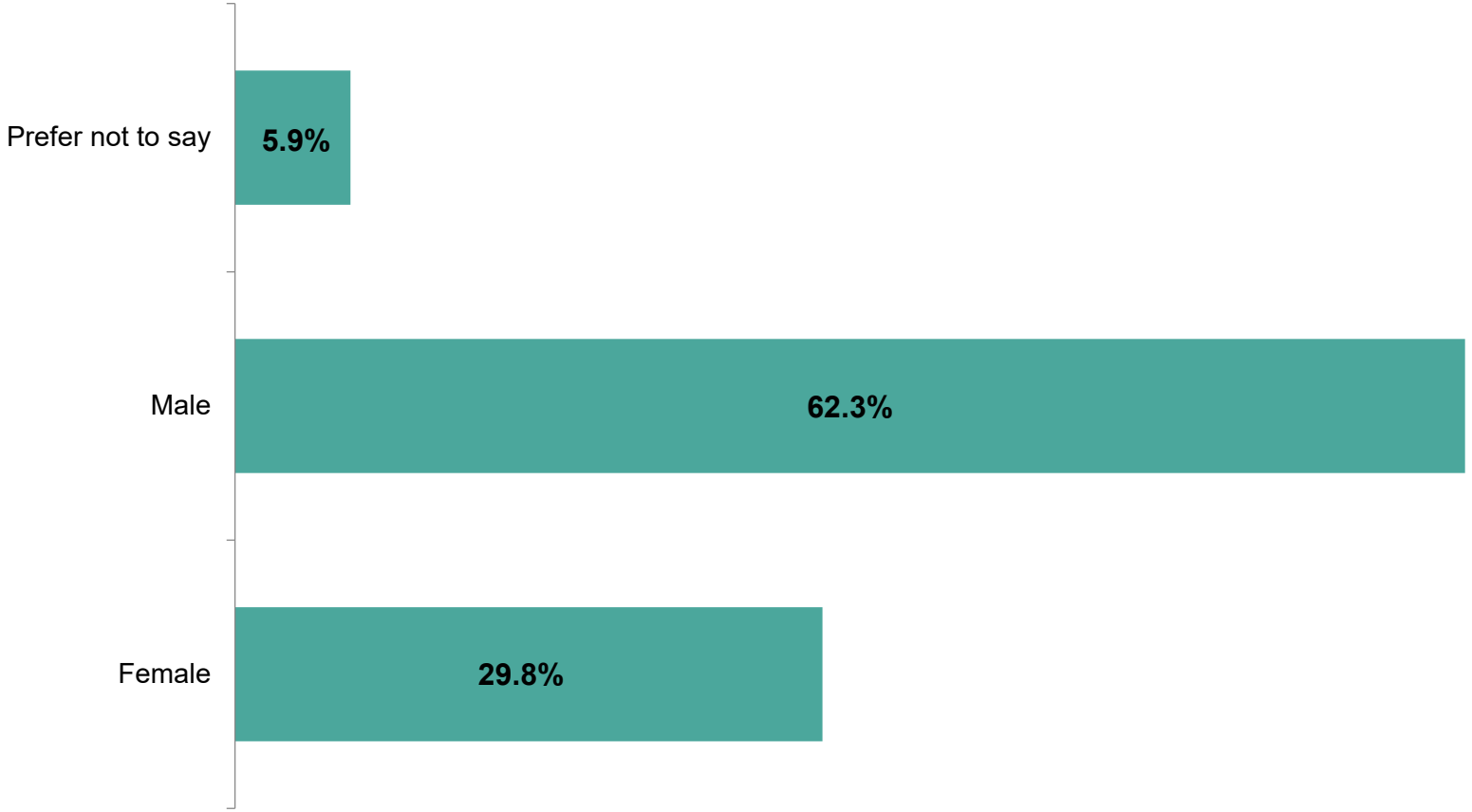
19) Which region do you primarily work in? *(396 responses)*



20) Your age? *(397 responses)*



21) Which gender do you identify with? *(393 responses)*



22) What is your ethnic group? *(392 responses)*