BIG INNOVATION CENTRE

APPG AI 2018 FINDINGS

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All Party Parliamentary Group on
Artificial Intelligence












A report created by Big Innovation Centre, the Secretariat for the All-Party Parliamentary Group on AI.

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ABOUT APPG AI

PURPOSE

THE APPG AI WAS SET UP IN JANUARY 2017 WITH THE AIM TO EXPLORE THE IMPACT AND IMPLICATIONS OF ARTIFICIAL INTELLIGENCE.

The APPG AI addresses the economic, social, and ethical implications of developing and implementing Artificial Intelligence. We aim: to unpack the term, to gather evidence to better understand it, to assess its impact, and, ultimately, to empower decision-makers to make policies in the sphere.

In 2018, APPG AI focused on gathering evidence on six policy areas:

- AI & Data
- AI & Skills
- AI & Accountability
- AI & Innovation & Entrepreneurship
- AI & Trade
- AI & Infrastructure

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KPMG	Shamus Rae
Microsoft	Michael Wignall
PwC	Rob McCargow
Oxford University (Computer Science)	Michael Wooldridge

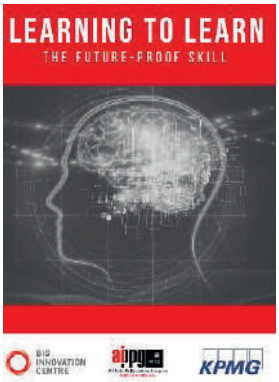
ACHIEVEMENTS

EVENTS

17

7	4	3	2	1
EVIDENCE MEETINGS	ADVISORY BOARD MEETINGS	DINNERS	RECEPTIONS	TECH WORKSHOP

PUBLICATIONS



LEARNING TO LEARN: THE FUTURE PROOF SKILL

A thought-provoking report exploring AI's impact on skills – how AI transforms the skills individuals need as 21st century citizens and how it transforms the way we develop those skills.

AI IN UK INDUSTRY LANDSCAPE OVERVIEW

A 2200-page mapping of the AI industry in the UK, profiling 1000 companies, 600 investors, 80 influencers, and 35 tech hubs and research institutes.

MEDIA

27,035 Unique Visitors
37,227 Hits

2020 Tweets
2501 Followers
2817 Likes

ENGAGEMENT

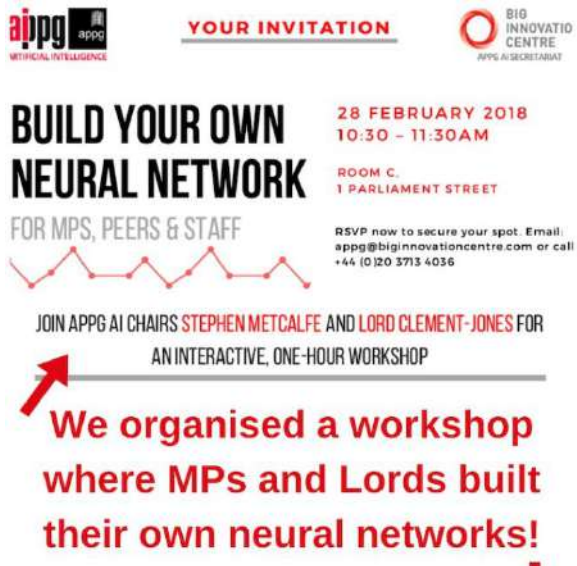
879 ATTENDEES(based on RSVPs)

33 ORAL EVIDENCE

37 PARLIAMENTARIANS ENGAGED

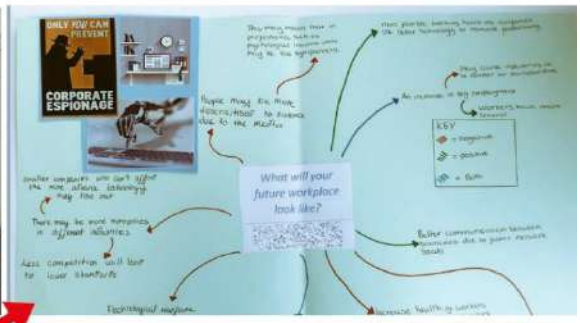
29 WRITTEN EVIDENCE

HIGHLIGHTS



We organised a workshop where MPs and Lords built their own neural networks!

We held a debate following the Lords Select Committee AI Report!



We launched a school competition asking children to envision their futures with AI!

We launched our Learning to Learn report at KPMG!

We held SEVEN standing room evidence meetings!

2018 RECOMMENDATIONS

Advances in Artificial Intelligence (AI), and their increasing commercialisation and deployment in our lives, are transforming our economy and our society. AI has the potential to revolutionise the way we work, the way we learn, the way we interact, and the way we live for the better; but, at the same time, AI is posing a complex set of economic and socio-ethical concerns we must urgently address.

In this context, **as the UK works towards building a society empowered to reap AI's benefits and protected against its potential hazards, our evidence has highlighted four areas we must prioritise.**

We call these the four keys to embracing the AI revolution.

The Four Keys to Embracing the AI Revolution

To harness AI as a force for good, we need to make sure the right policies and structures are in place for all four of these areas.

But, to do so, we must foremost understand what the current landscape looks like.

Therefore, our first recommendation is for policymakers and relevant stakeholders to:

1.1► Horizon-Scan: Systematically horizon-scan the evolving, complex and far-reaching AI ecosystem in the UK and internationally.

AI is being developed at such a remarkable speed and unprecedent scale that we are having trouble keeping up to date with its current status and impact.

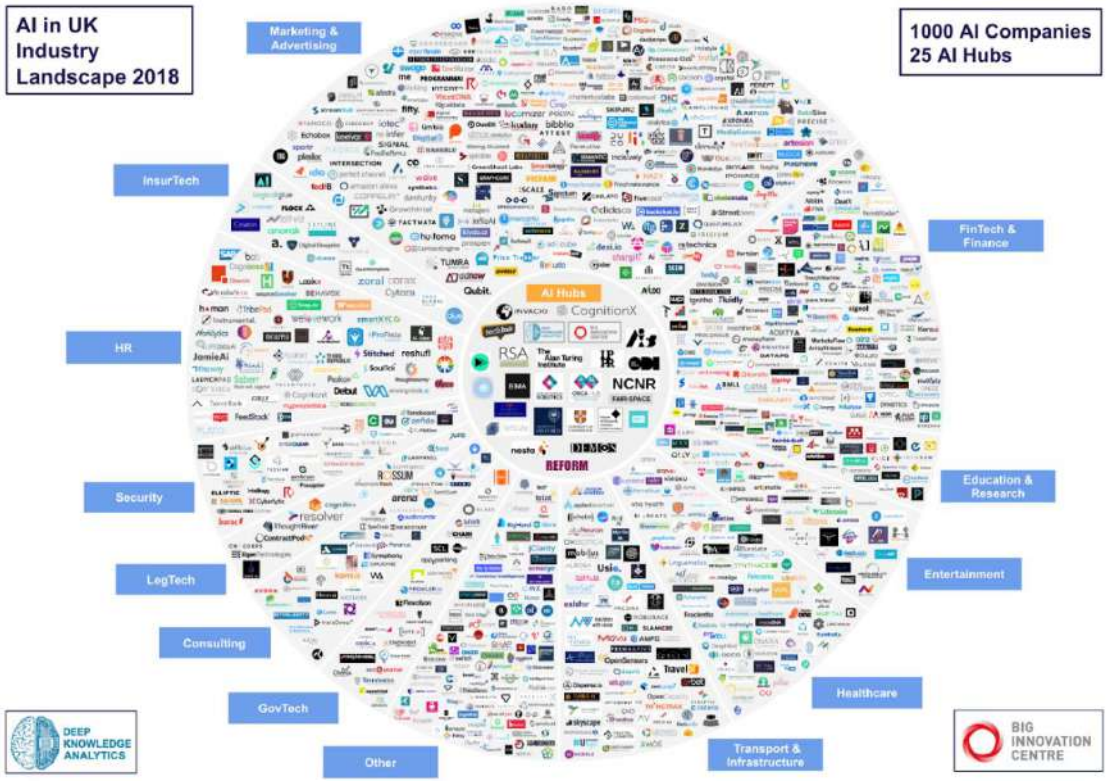
A systematic process for horizon-scanning the everchanging AI ecosystem (AI supply chain of companies, technologies, investors, hubs, influencers) will help provide strategic foresight for how UK should address AI, insight on emerging AI trends, and assessment of their potential impact on the economy and the society.

Thus, we call for the **use of AI technologies and data analytics to paint a more exhaustive and accessible picture of the AI ecosystem; and to inform UK policymaking by giving stakeholders 'actual time' knowledge on AI industry trends, skill shortages, market dynamics, regional disparities, inequality risks, and more.**

Ultimately, this process of horizon scanning is essential for policymakers to shape the right policies and to build the right structures across the four key areas we must now focus on – Education, Enterprise Adoption of AI, Citizen Participation, and Data Governance.

Tool with quarterly updates is displaced at:
https://www.appg-ai.org/evidence/ai-in-uk-artificial-intelligence-industry-landscape-overview-q3-2018/

The Current UK AI Ecosystem



EDUCATION

Our evidence over the past two years has shown that education is at the heart of both the opportunities and the risks in the narratives forming around AI.

We need skills to survive and thrive with AI and processes to reap the benefits. Ai, itself, can stimulate the learning environment with new tools we have yet to acquire. We need this virtuous circle of success unearthed and it all starts with education for learning to learn.

AI's impact on our education system has the potential to be revolutionary. With AI, every child across the world can have access to personalised learning that is active, authentic, and cooperative. However, at the same time, the introduction of AI in our society is challenging whether our current education systems are fit for the unfolding transformations.

We recommend policymakers and relevant stakeholders:

2.1 ► Adopt our education system to build and incentivise broad skills across the spectrum, paying attention to **critical thinking** and **creativity skills**. Science, Technology, Engineering, the Arts and Mathematics (STEAM) should be educated as interdisciplinary, problem-solving tools at all levels.

2.2 ► Develop and encourage codes of conduct and ethical principles for effective and ethical uses of AI technologies in education. Keep in mind all education and learning environments should ensure students become AI-ready, **equipped with the digital understanding of AI's socio-ethical implications**.

ENTERPRISE ADOPTION OF AI

Enterprise adoption of AI is steadily growing as more and more companies realise the opportunities that AI offers. However, our findings reveal there are still many barriers that companies need to overcome to ensure they get adoption and implementation right.

Adoption of AI can lead to increased productivity and commercial profits, however many companies across the UK lack the financial resources needed to roll out such a project. Unfit data infrastructure and employee backlash are other challenges.

We need to think in operational excellence of AI at all workplaces, understand and ensure service excellence from AI tools to workers, and guarantee high quality product excellence for customers. This would arguably outweigh the challenges and stimulate adoption despite its increased efficiency.

To break these barriers and others, we recommend policymakers and relevant stakeholders:

3.1 ► Engage with the APPG AI to **develop protocols and accreditation schemes identifying and encouraging practical guidelines for adopting AI.**

3.2 ► With the Department of International Trade and industry, **formulate best practice on business to customer interactions** where relationships are increasingly being designed by algorithms and other AI systems locally and globally. Do not overlook the impact of these transactions on **vulnerable groups of society such as children or disabled persons.**

CITIZEN PARTICIPATION

As AI is impacting all of us – regardless of demographics, industry, or region - it is absolutely critical to engage a diverse set of voices in the discussions around AI governance. This has been repeatedly stressed throughout our evidence gathering.

AI technologies do indeed promise us many opportunities on a national, social, and individual level; but these AI technologies also have complications and hazards. The wider society needs to co-create our future, designing the opportunities and de-risking the risks. We need to engage industry, civil society, regulators and the public in the conversations around what is AI, what is it not, how is it being used, what is its potential, and what are its implications.

Once citizens are aware of AI and its consequences, they will be empowered to engage in making decisions around it. People across the UK must have the digital understanding needed to live with AI.

We recommend policymakers and stakeholders:

4.1 ► Launch a nation-wide public awareness campaign to inform UK citizens of key AI implications, **build trust and confidence** in how to use AI technologies, and boost the digital understanding skills individuals need to live *with* AI.

4.2 ► Create a cohesive and strategic engagement plan explaining how different Government bodies and initiatives (i.e. AI Office, Centre for Data Ethics and Innovation, AI Council, National Institute for AI) will consult the public and engage them in the policymaking process. Ensure all these processes are committed to diversity and inclusivity.

DATA GOVERNANCE

Lastly, our evidence has emphasised the need to consider the interconnection of AI and data, as it is impossible to separate the former from the latter. Access to accurate and quality data is critical to make AI work. In fact, it is argued that AI can only be as good as the data from which it draws inferences.

While personal data has become one of the driving forces of the AI revolution, the value it generates is not distributed fairly. Issues like this raise questions on how data should be collected, used, and managed. Ultimately, a key challenge has evolved around data ownership and user rights.

Automated Decision-Making needs protocols around Algorithmic Biases and Accountability. Inequality needs to address Technological Unemployment, Monopolisation, and Inclusivity. Security concerns need to be rethought taking into account threats from Cybersecurity to Long-term Extinction of human kind.

We recommend policymakers and stakeholders:

5.1 ► Review the existing regulatory framework related to data capitalism and ensure it is fit for purpose for AI. Address issues of concern like access and control, algorithmic decision making, transparency, platform control, profiling or ‘grooming’ and more.

5.2 ► Partner with relevant stakeholders to **pilot alternative data ownership and user right models,** experimenting with creative commons of raw data, behavioural data and machine data. Create a preventive policy addressing data monopolies.

AI & DATA

Details

- Date: 22 January 2018
- Time: 5:30 – 7:00 pm
- Location: Committee Room 1, House of Lords
- Participants: 162 registered attendees

Speakers

- Elizabeth Denham, UK Information Commissioner, Information Commissioner's Office
- Professor J. Mark Bishop, Director of The Centre for Intelligent Data Analytics and Professor of Cognitive Computing at Goldsmiths – University of London
- Stephen Chandler, European General Counsel, NVIDIA
- Tim Pullan, Founder & CEO, ThoughtRiver

Questions for Inspiration

- How do we ensure consumers are protected when it comes to data?
- What do businesses/people need to do to prepare for the GDPR (General Data Protection Regulation)?
- How can the 'right to explanation' be enforced? Should it?
- What should data governance structures look like?
- How can access to data be democratised? How can potential monopolies be prevented?
- How should the public sector take more advantage of the data revolution?
- How can we deal with unintended stereotypes and prejudices in data?

Background: Setting the Scene

Prime Minister Theresa May, in her speech at the 2018 World Economic Forum Annual Meeting, highlighted the need for UK to lead in AI and its deployment in a safe and ethical manner. The Prime Minister, said: "Harnessing the power of technology is not just in all our interests – but fundamental to the advance of humanity. But this technological progress also raises new and profound challenges which we need to address."

AI could add £630 billion to the UK by 2035 (Accenture)

The unprecedented impact AI has (and will continue to have) on society has been made clear throughout the APPG AI's Evidence Meetings. Accenture estimates that **AI could add an additional £630 billion to the UK economy by 2035**, increasing the annual growth rate of GVA from 2.5% to 3.8%. PwC refers to AI as "the biggest commercial opportunity in today's fast changing economy," **predicting UK GDP to be 10.3% higher in 2030 as a result of AI.** The evidence gathered thus far has mirrored Hall and Pesenti's review of AI, urging the UK to seize the opportunities of these emerging technologies and to deliver on their economic potential.

UK GDP could be 10.3% higher in 2030 as a result of AI (PwC)

Big Data could benefit the UK economy up to £241 billion between 2015 to 2020 (SAS)

The dependent relationship between AI and data has also been recurrently emphasised. In fact, without data, AI systems would lack the raw material essential for their creation, development, and sustainability. The amount of data generated, collected, used, and managed has now reached previously unimaginable numbers. A research report by SAS and the Centre for Economics and Business Research states that **Big Data will benefit the UK economy up to £241 billion between 2015 and 2020.**

To tap into these game-changing opportunities, however, government must work with industry and the wider public to build an environment in which the gains are widely distributed, and potential harms are mitigated. The introduction of these new technologies and socio-economic forces are disrupting much of what we know today and creating a new set of challenges to address (i.e. algorithmic accountability, data privacy, technological unemployment, skill shortages, AI bias, cybercrime, etc.).

Data issues play a large role in any AI debate. Studies by the Information Commissioner's Office (ICO) show that **only one in four UK adults currently trusts businesses with their personal information**.

The General Data Protection Regulation **(GDPR),** voted on in April 2016 and fully enforced in the UK from May 2018, is a step in this direction. Its purpose is to protect the personal data of individuals and guarantee people with a 'right to explanation' for all decisions made by automated systems.

However, this is only one step. The government acknowledges that more has to be done and, hence, has announced the establishment of the **Centre for Data Ethics and Innovation** to advise on the measures needed to enable and ensure safe, ethical and innovative uses of data-driven technologies. The building of "**Data Trusts**" across the UK regions has also been prioritised in order to educate individuals on their rights and facilitate the sharing of data between organisations holding data and organisations looking to use data to develop AI.

Business, academia, and the wider public must take their share of responsibility, working closely with government in a combined effort to help harness technology as a force for good.

Parliamentary Meeting Overview

The APPG on AI met on 22 January 2018 to further explore the topic of 'Data and AI' and to start discussing practical steps for how to reap the benefits and mitigate the risks.

The meeting was co-chaired by **Stephen Metcalfe MP** and **Lord Clement-Jones** and had a total of 162 registered attendees.

As the UK prepared for the full enforcement of the General Data Protection Regulation (GDPR) in May, it only follows that a large chunk of the conversation centred on its implementation. However, the group also zoomed in on topics related to children's data, accountability, user rights, and public sector data.

Elizabeth Denham, UK Information Commissioner, was first to provide evidence. She reminded the Committee Room that algorithms have existed for years, but what is new is the amount of data that now goes into them. Our responsibility, she noted, is to ensure data policies help distribute gains fairly and, simultaneously, protect human values such as privacy. She continued to say that UK is well positioned to handle the challenge because various stakeholders, including government and business, are determined to get it right.

"We are lucky in the UK because businesses and government want to get this right. The social will needed to push for solutions is there." -Elizabeth Denham, ICO

She considers the GDPR an important step in sharpening our regulatory toolkit in the UK and encouraging automated decision making that is fair, accountable, and accurate. However, she realises that **the implementation and administration of the GDPR is just as important**.

"The public is often unaware that their personal data is being used in a decision-making process and, hence, doesn't know they are entitled to make a demand for an explanation. Government must invest in ICO and other organisations to educate the people." - Professor Bishop, Goldsmiths University

Next to provide evidence was **Professor J. Mark Bishop** from The Centre for Intelligent Data Analytics. Commenting on Britain's historical leadership role in technological applications and social practices, he called for the government to continue to lead in this technological revolution, "as an educator of the public, as an exemplar of good data practice, as a facilitator of the generation and manipulation of data through cutting-edge, industry driven innovation, and as a protector for individuals in their interaction with an increasingly complex and interconnected world."

He saw the GDPR through a positive lens as it will give a subject the right to demand an explanation, but also recognised some of its pitfalls:

- First, **modern machine learning is so complex that providing a subject with a simple explanation will be difficult**.
- Second, the public is poorly educated about how their data is used and what their rights are.

Lastly, Professor Bishop made two recommendations for the UK to position itself in the forefront of digital rights worldwide. He suggested to:

- keep the right to human intervention on the part of the controller in cases where legal consequences follow.
- extend the right to explanation of the purpose of processing to all cases.

The third to speak was **Stephen Chandler**, European General Counsel for NVIDIA. Commenting on consumer protection on the UK, he noted that AI has no direct interest in the personal nature of data but only about recognising a correlation between a mathematical pattern and an output.

"Data governance is needed to ensure accuracy. When you use flawed data, your output is also flawed. Governance structures need to ensure input is accurate." – Stephen Chandler, NVIDIA

Nonetheless, personal data can be retrieved from AI systems and this could pose potential security concerns.

He argued that the two main issues with the GDPR are (1) the strain between data retention and flawed output, and (2) the inability to seek full transparency in algorithms. He noted it is important to rethink concepts of transparency and explainability by focusing on extracting only the key factors for how an AI reached a decision.

Most important, he suggested that the **UK needs to address accountability matters** and decide how to audit AI by following principles of purpose, transparency, and accuracy.

The last speaker to provide evidence was **Tim Pullan**, CEO of ThoughtRiver, a leading legal technology that uses AI to automatically risk profile contracts.

"Encouraging the growth of data is not incompatible with protecting citizens." – Tim Pullan, ThoughtRiver

Acknowledging data-driven knowledge as a driver for both the UK economy and "a liberal enlightened society," he urged policymakers to ensure data protection law guards society from potential drawbacks. Furthermore, he reminded the audience that action does not necessarily have to be just legislative.

Tim noted the government's vital role in enabling a regulatory environment for industry-level data trust schemes that make datasets widely available to innovators. Referring to the increasing use of corporate data as a marketing tool, he also suggested policymakers to **consider regulating algorithms that target vulnerable groups such as gamblers and/or children**.

Individuals shouldn't be expected to protect themselves through mechanisms such as consent, he argued, sharing that **it would take 70 years for an average individual to read every consent statement he/she came across**. In fact, Tim continued, most consumers lack awareness about what consent means and that itself is a fundamental problem. In addition, large companies will have a difficult time complying with the GDPR and this could create future economic risk.

He called for the government to look at practical measures to remove any regulatory barriers to the pursuit of AI, including the use of data for these purposes.

One possible solution is to establish an environment in which we control our data via personal data stores and allow corporations to access it around contacts. He suggested policymakers to look at the model first proposed by Doc Searle at Harvard in the late 1900s.

Many in the Committee Room raised questions around education. The Right Reverend Dr. Steven Croft commented on how fast technological capability is advancing compared to public awareness and asked the panel who they think should be responsible for educating the public about the value of their data and their user rights.

"How would you go about educating the public to understand the value of their data and to get them to understand the use of that data?" – Stephen Metcalfe MP, House of Commons

The panel agreed that various stakeholders share responsibility. Elizabeth Denham commented that the law is now catching up to technology; and, hence, **government, business, regulators, the community, and the family all need to work together to raise public awareness.** "It will take a village to raise that child," she said but added that she was confident the UK was well placed to address the challenge.

Stephen Metcalfe and Lord Clement-Jones thanked the committee room, highlighting the importance of data and AI in our societies today, and encouraging all stakeholders to engage with the issue.

AI & SKILLS

Details

- Date: 26 February 2018
- Time: 5:30 – 7:00 pm
- Location: Committee Room 2, House of Lords
- Participants: 133 registered attendees

Speakers

- Jonnie Penn: AI Researcher, Cambridge University; Google Fellow, European Youth Forum; Co-Founder, The Buried Life
- Robert Bolton: Partner in KPMG's Global HR Center for Excellence, KPMG
- Kevin Green: Chief Executive, The Recruitment and Employment Confederation
- Beverly Clarke: Author of "Computer Science Teacher"
- Ali Shah: Head of Emerging Technology & Strategic Direction, BBC

Questions for Inspiration

- What are the right skills fit for an AI-filled world? Should we put more emphasis on STEM or soft skills and creativity?
- What are the practical steps of putting AI into schools?
- How can industry help in upskilling the UK workforce?
- How do we ensure groups who are at high risk of job automation reskill?
- What are the implications for lifelong learning?
- How can AI technologies be used as a tool to boost skills?

Background: Setting the Scene

The UK economy and society depends largely on the skills and knowledge its people possess. For all individuals, skills are a significant determinant of social mobility and wellbeing. For all companies and organisations, regardless of size, skills are critical for productivity. In fact, BEIS estimates **20% of UK economic growth, in recent decades, is the result of improved skills across the workforce.**

Building the right skills is key – for the success of the individual, the organisation, and, ultimately, the nation. But, what does this really mean? What are the right skills? What are the practical steps for building these skills? And, of particular significance for the APPG on AI, *how do technological advances - in fields like Artificial Intelligence - affect skills?*

In our past evidence meetings, almost **all experts who provided oral evidence highlighted the importance of skills in preparing people for the transformations and disruptions AI is likely to bring.** Although there has been a debate over how many jobs will actually be created and how many will be lost, our community seems to agree that skills play a critical role in ensuring individuals can remain competitive, successful, and fit for the labour market of an AI-filled future.

AI's impact on skills is twofold.

1. AI is changing the types of skills individuals will need to survive and thrive.	• Science, technology, engineering, mathematics, and digital skills – as these are the skills needed to build and manage AI technologies. • Transferable soft skills, including creativity, cognitive, and adaptability – as these are the skills humans will have a long-term advantage in.
2. AI is changing the way individuals develop skills.	• The application of these technologies in various learning environments, to improve the development of skills.

First, AI is transforming the types of skills individuals will need.

Notably, the disruption triggered by profound technological progress is causing a misalignment between the supply and demand for skills. AI is disrupting both the demand side of labour (changing the quantity and quality of jobs available in the market) and the supply side of labour (challenging the skill gaps amongst a growing population of potential employees). Simply put, **the skills available in the labour market do not match those required by employers in the evolving AI-driven economy.**

So, exactly what are the skills employers seek yet individuals lack?

These skillsets can be thought of in two broad categories:

1. A new demand has grown for the skills needed to build and manage advances in AI technologies – most of which are linked to science, technology, engineering, mathematics, and digital competencies.
2. Moreover, there is also a growing demand for transferable soft skills (i.e. creativity, adaptability, and cognitive skills) as these are the skills humans will have a long-term advantage in.

Second, AI is transforming the way skills are developed.

The way individuals, across all stages of education, learn and develop skills is also transforming. In other words, individuals can use AI as a tool to develop the skills for success. A teacher can now use a machine learning algorithm which analyses and finds correlations between data points to quantify his/her student's understanding of a specific topic. Children can have a digital tutor to help them in courses they are struggling in. The applications of AI in education are enormous and so is the potential.

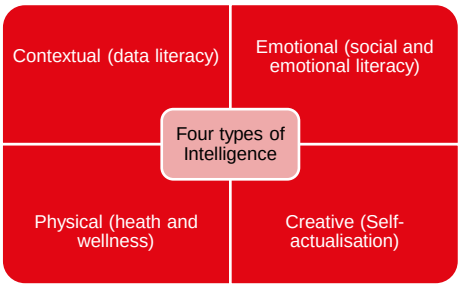
Parliamentary Meeting Overview

The APPG on AI met on 26 February 2018 to further explore the topic of 'AI and Skills' and to start discussing practical steps for how to prepare individuals across the UK with the skills they will need ahead.

The meeting was chaired by **Lord Clement-Jones** and had a total of 133 registered attendees.

Five experts, from different backgrounds, were invited to provide oral evidence on AI's implications on skills; and what government, business, and the wider public can do to prepare.

Jonnie Penn, an AI researcher at the University of Cambridge, was first to speak. He focused on 'four types of intelligence' that have value in the modern world. Contextual intelligence, referring to data and digital literacy, tends to be the category we put most emphasis on, Jonnie said. However, research shows that 17% of the UK population lacks basic digital skills and only 9% has heard of the term machine learning. Therefore, Jonnie urged policymakers to do even more to build intelligence in this area. Responses can be simple like implementing universal infrastructure to ensure all individuals have access to high-quality internet.



Moreover, Jonnie emphasised the need for creative intelligence in today's society. Citing a recent interview with DeepMind's Demis Hassabis, he shared that the best way for young people to prepare for the labour market of the future is to:

- **learn how to learn, practice self-actualisation, and practice creativity.**

He also discussed the need to create policies which focus on the building of social and emotional literacy, as well as intelligence related to health and wellness.

Next, **Beverly Clarke** took the microphone, speaking from the educator perspective and providing the group with a tangible example of how AI can be introduced into UK schools.

Beverly has recently partnered with NVIDIA and Computing at Schools to create a teaching kit for year nine pupils to explore what AI is, learn about its use cases and implications. The project is made of six lesson plans and there has been great interest from teachers across the UK who are now piloting it.

Beverly argued that more must be done! AI must be formally included in the GCSE curriculum as it is one of the most important technological advance of our period. Her goal is for everyone in the classroom to have a general understanding of what AI is by the time they graduate. She called for immediate funding to be released in order to successfully introduce AI into schools.

The Chief Executive of the Recruitment and Employment Confederation (REC), **Kevin Green**, was next to provide evidence. Speaking about the current UK labour market, he reminded the stakeholders that UK has a record 32 million people in work now. However, the threat of automation due to technological advances can disrupt the labour market and have profound consequences. Job automation will not only involve manual activity and jobs in the middle are likely to be affected, Kevin added, causing a hollowing effect which will result in a two-tier labour market.

"We need to find new institutions that give advise to individuals, to help them progress and develop." *-Kevin Green, REC*

Government and business need to start thinking now about how to prepare for this shift because, as Kevin mentions, today's job automation is unfolding faster than ever before. Employers should rethink their selection processes when recruiting. Government must pass policy which will move away from knowledge-based exam factories towards a more balanced approach based on creativity, team work, collaboration, and

self-driven learning. Furthermore, government needs to develop an all-age work advice service to facilitate transitions and progression. Lastly, the Apprenticeship Levy should be broadened into a training levy that can meet the training needs of workers in non-permanent roles.

Robert Bolton, a Partner at KPMG's Global HR Center of Excellence, was the fourth expert to provide oral evidence on AI and skills. Looking at the workforce of the future, he focused on three key trends: (a) atomisation of traditional jobs, (b) an emerging skills agenda, including non-STEM skills, and (c) the end of a one-size fits all model. Robert noted the **shift from mapping people to jobs to mapping skills to work**, and asked stakeholders to focus on the effects of AI on the task level. The future is about humans and machines working together, he argued, and companies must ensure the right systems are embedded to make such a relationship work.

More than just STEM skills there are other types of skills needed in the modern world. These include: design thinking, systems thinking, innovation and creativity, evidence-based practice, and interpersonal skills. We must work together to boost skills across all these areas in order for UK to be prepared for the emerging workforce.

"The future will be man and the machine working together, but we have to reinvent the organisation to ensure productivity." - Robert Bolton, KPMG

Robert called for policymakers and government to:

- Embed the 'learning to learn' approach within all education policies, from lower education to higher ed.
- Encourage lifelong learning, via direct government provision but also employer incentives encouraging the adopting of platforms for career long learning.
- Nudge the right organisation leadership practices. The adoption of a simple 5Cs framework is a good place for an organisations to start: what is the employer doing to address Cost, Capacity, Capability, Compliance and Connections of the workforce over the short, medium and long term.

The last member of the panel was **Ali Shah,** Head of Emerging Technology & Strategic Direction at the BBC. Speaking from the perspective of a practicioner of AI, he urged stakeholders to break down the conversation around AI into concrete parts that are easy for the public to understand.

Ali has realised that it takes a broad set of skills to make, manage, and sustain AI systems; and, thus, it is absolutely vital to create diverse teams that represent diverse backgrounds in order to have successful systems.

He urged all stakeholders in industry, academia, and government to ensure ethical implications are embedded within all curriculums, the BBC, for example, is training its product managers and engineers on what unintended consequences might be, as well as the opportunities and risks of AI. Ali stressed that such an approach is important in order to create technology that all will benefit from.

Leverhulme Centre for the Future of Intelligence's Dr. Stephen Cave asked a question that much of the room seemed to be thinking. Looking beyond what skills will be needed to work in an AI economy, he asked: "what skills are necessary to live in an AI society?"

Jonnie Penn, building on this point, said: **"The conversation around skills is based on prosperity. Ultimately, we are trying to decide what skills we need to prosper."** We should be having broader conversations on what we want in this world, what we mean by citizenship, what we qualify as prosperity, etc. Citizens should be encouraged to prototype their ideas. **Young people want to aspire and be valuable in society; and, hence, adults should provide a narrative for younger generations to speak and participate in shaping the future.**

Lord Clement-Jones thanked the room for their engagement with this timely issue. He stressed the need to build policies encouraging wider skills and lifelong learning – as well as a **bottom-up approach to really understanding what our values are and what we should be striving towards.**

AI & ACCOUNTABILITY

Details

- Date: 12 March 2018
- Time: 5:30 – 7:00 pm
- Location: Committee Room 2, House of Lords
- Participants: 108 registered attendees

Speakers

- Tracey Groves: Founder and Director, Intelligent Ethics
- Aldous Birchall: head of Financial Services AI, PwC
- Robbie Stamp: Chief Executive, Bioss International
- Sofia Olhede: Professor and Director of Centre for Data Science, UCL
- Tom Morrison-Bell: Government Affairs Manager, Microsoft

Questions for Inspiration

- What is the path towards accountable automation?
- How do we make ethics part of business decision-making processes?
- How do we assign responsibility around algorithms?
- What auditing bodies can monitor the ecosystem?
- Can AI systems be transparent?
- How do we ensure explainability of AI enabled decisions?

Background: Setting the Scene

Technological advances in AI have the potential to improve accountability, making (i) governments more accountable to citizens, (ii) corporations more accountable to their shareholders, customers, and society (iii) and individuals more accountable for their own actions.

For example, AI tools can be used to facilitate democratic consultation, enabling elected officials to engage with citizens when passing policy on matters ranging from health to education to national security. Predictive algorithms can be used by corporations to recognise opportunities or threats that might arise when implementing a new product or service. Visual recognition systems can be used by society to hold individuals responsible for potentially illegal activity.

Yet, on the other hand, **although AI is in many ways improving accountability, it is also simultaneously challenging its definition, which is based largely on existing notions of transparency and explainability.**

Accountability : /əˌkaʊn.təˈbɪl.ə.ti/ :

The fact of being responsible for your decisions or actions and expected to explain them when you are asked

The increasing deployment of AI in the lives of individuals is posing socio-ethical questions for what it means to be accountable in the modern era and where responsibility lies if something goes wrong. Specifically, AI is challenging how transparent and explainable a decision-making process can be and ought to be.

At the moment, the way AI systems work as they move from one point to the next is complex and abstruse. It is difficult (and sometimes impossible) to explain the logic underpinning how an AI reaches a specific decision, especially in a language that can be easily understood by today's wider society.

As AI progresses in technological capacity (moving from weak to strong applications known as general AI), the process becomes even harder to understand. Ultimately, this proves true not just for the average citizen but also for the experts who build the systems.

This is known as the "black box problem."

To add to the black box problem, corporations developing and deploying AI systems are worried that transparent systems risk sensitive material being shared with competitors and their stakeholders.

Even if scientifically a decision-making process enabled by AI can be explained and even if a company is willing to be transparent, the majority of the population lacks the capacity to make sense of the explanation. The lack of understanding amongst the average citizen on how AI systems work makes the explainability issue even more complex.

Consequently, **both limited transparency and explainability on decisions enabled via AI systems have made the issue of accountability a high concern for policymakers globally.**

If AI is increasingly being applied to help make life-changing decisions, then it stands to reason that those decisions should be held to the highest scrutiny. This is particularly true in areas of high social impact such as health, security, education, etc.

Ethical implications are largely intertwined within this debate, triggering us to ask complex and multidimensional questions. Should we use AI systems in our decisions if we cannot explain their

It is difficult to accept something that cannot be understood. It is difficult to trust something that cannot be explained.

processes? Who is accountable for an output if the decision-making process is inexplainable and/or lacks transparency?

Ultimately, **the accountability of this technology is essential to build public trust and confidence in its development and deployment within society.**

Over the last couple of months, there has been a growing dialogue of uncertainty around if, when, and how AI is being (or should be) used to make decisions. Breaking news such as the Facebook and Cambridge Analytica data misuse scandal and the death of a pedestrian caused by an autonomous vehicle have only further spotlighted the urgency of addressing the AI and accountability issue.

AI systems have been let loose and if policymakers want society to benefit from the mass opportunities they offer, they must take action to combat the current lack of accountability in the systems - addressing issues related to transparency and explainability.

Parliamentary Meeting Overview

On 12 March 2018, the APPG AI convened an Evidence Meeting to discuss these critical matters around AI and accountability. Chaired by Lord Janvrin, the meeting had a total of 108 registered attendees, five of which were selected experts from industry and academia asked to provide oral evidence.

The first to speak was **Tracey Groves**, Founder and Director of Intelligent Ethics, an independent consulting practice advising clients on the topics of AI and Ethics.

When looking at the topic of accountability, Tracey highlighted three key factors to ensure ethics become part of decision-making processes. **These are education, empowerment, and excellence.** First, businesses should inspire curiosity across departments and levels, she said, and implement a leadership development programme which educates individuals to assess ethical dilemmas in a critical manner. Second, to build trust in an organisation, Tracey stressed empowerment. Two-way engagement programmes between leaders and employees that create intelligible accountability of decisions is essential. Third, businesses must design and monitor key performance indicators of ethical culture and behaviours.

Tracey argued that it is not only the responsibility of government to address the issues of accountability. Industry, academics, and regulators have a huge role to play. She said: **"Government should place pressure on corporates to evidence and demonstrate ethical business conduct and accountable decision-making, through deeds not just words."**

PwC's **Aldous Birchall** was next to speak, providing a practical approach to addressing some of the issues around AI and accountability. He stressed that both business managers and data scientists need bigger awareness on the impact of algorithms in society. As a potential solution, he suggested a ground-up approach in which software engineers are trained and educated on ethical consequences.

"AI is software built by humans. It doesn't exist in a context free setting. To assign responsibility for an adverse event caused by AI, we need to establish a chain of causality from the AI agent back to the person or organisation that could be reasonably held responsible for its actions." – Aldous Birchall, PwC

Organisations need qualified senior representatives that can be held accountable for AI deployment, he argued. **Each technology (or project) should have a chain of causality from the AI agent back to the person (or organisation) that could be reasonably held responsible for its actions.**

Organisations should **"reflect the risks of deploying AI in their governance structures and link ethical policy to AI software development and deployment."**

Aldous urged existing regulatory bodies to become experts in their areas, developing AI specific capabilities required to monitor their spaces. Government should intervene when there are potential risks in areas such as health and security.

The third presenter was **Robbie Stamp**. Referring to the fictional character Marvin the Paranoid Android, Robbie illustrated many of the social concerns surfacing around AI recently.

Robbie called for Ethical AI Governance to establish the ethical boundaries for how AI is put into a wider ecosystem. These governance structures should have monitoring and feedback loops to constantly review things are working as planned.

"Because AI is not human it cannot 'a priori" be ethical. It cannot be meaningfully sanctioned, nor feel guilt, shame or remorse." *-Robbie Stamp, Bioss International*

A potential Ethical Governance framework should consider five key questions when deploying AI.

1. **Is the work Advisory, leaving space for human judgement and decision making?**
2. **Has the AI been granted any Authority over people?**
3. **Does the AI have Agency (the ability to act in a given environment)?**
4. **What skills and responsibilities are we at risk of Abdicating?**
5. **Are lines of Accountability clear, in what are still organisations run by human beings?**

Sofia Olhede was next in line, providing the perspective of a technologist. Sofia stressed the need for collaboration to develop standards that will enable accountability.

"Algorithmic bias threatens AI credibility and fuels inequalities. Algorithms are like humans; they learn from what data they have been exposed to." *-Sofia Olhede, UCL*

She asked the group to realise that there isn't only one measure of performance. More often, much of the algorithms are based on average notion of performance but this average does not reflect the spread of outcomes a person may encounter. In some cases, it might be preferable to apply a different measure.

Furthermore, Sofia highlighted the urgency to address algorithmic bias as it threatens AI credibility and fuels inequalities.

Ethics boards, both public and private, are one way to set and develop standards. **Organisations are developing internal ethics boards and bodies such as the new Centre for Data Ethics and Innovation could be ideal to connect them all.**

Last to speak was Microsoft's **Tom Morrison-Bell**. He provided the group with three use cases for how Microsoft is using AI projects and technologies to make social impact. The first was an application called Seeing AI that narrates the world for the low vision community. The second was AI for Earth, an initiative to enable organisations to explore available AI tools, learn how to use them, and discover how these tools can help solve environmental problems. The third was Inner Eye, applying machine learning to build innovative tools for the automatic, quantitative analysis of three-dimensional radiological images.

Tom's use cases are few of the many ways AI can be deployed to improve society, but he noted that not all organisations might have the resources to build such impactful projects. Nonetheless, he urged industry to adapt key principles that will ensure their processes are ethical internally and externally.

Lord Janvrin thanked the panel and audience for their participation, inviting them to build on the conversation and carry it forward in their own communities, in hopes to encourage public engagement and awareness. He commented: "**Both the development and deployment of AI should be inclusive, but so should be the conversations around the socio-ethical concerns and implications."**

AI & INNOVATION AND ENTREPRENEURSHIP

Details

- Date: 11 June 2018
- Time: 5:30 – 7:00 pm
- Location: Boothroyd Room, Portcullis House
- Participants: 129 registered attendees

Speakers

- Kay Firth-Butterfield, Head AI and Machine Learning at WEF's Center for the Fourth Industrial Revolution
- Pete Trainor, Co-Founder of Us AI and Best-selling Author
- Felicity Burch, Head of Innovation and Digital Policy at CBI
- James Simpson, Lighting Design and Visualisation at Royal Opera House
- Jane Calvert-Lee, Director of External Affairs at IORMA and Visiting Professor at University of East London
- Chris Gayner, Director of Labs at Symphony Ventures

Questions for Inspiration

- How can companies/organisations lagging in innovation catch up?
- How do we scale the AI driven businesses?
- What should be the role of the industry-led AI Council?
- How can we use media to boost innovation?

Background: Setting the Scene

AI promises both to improve products, services, and organisations, and, by enabling the automation of many tasks, to greatly increase the efficiency with which they are produced. But it is likely to have a much larger impact on the economy by serving as a new way to reshape the nature of innovation in the UK – to ensure innovation happens faster and at larger scale.

However, organisations in the UK are facing many challenges in adopting AI within their organisations to ensure that this innovation takes place. Some industries are further along the process than others. In whole, there are still barriers that need to be broken for AI to be adopted.

It's not just big technology companies that are pushing the development. Instead, AI innovation is a result from the work of research laboratories, digital platforms and an evergrowing ecosystem of startups. They are the breeding ground for new technologies such as image recognition, natural language processing or automated driving. Thus, establishing good conditions for these players is a prerequisite for a country's success in AI and subsequently its future economic competitiveness.

The role of policymakers in providing effective incentives for innovation, competition, and entrepreneurship is huge. Our businesses need clear rules and structures that enable safe and ethical innovation in AI.

Parliamentary Meeting Overview

On 11 June 2018, the All Party Parliamentary Group on Artificial Intelligence held its fourth evidence meeting to explore AI's impact on transforming and boosting innovation across the UK. The group came together to discuss how stakeholders can help organisations lagging in innovation catch up, how UK AI companies can be scaled, and what the role of the industry-led AI Council should be in the process. Lastly, given the media's influence in business and public attitudes towards technologies, the group asked what role the media can play to ensure innovation is smart and beneficial.

Head of AI and Machine Learning at the World Economic Forum's Center for the Fourth Industrial Revolution, **Kay Firth-Butterfield,** was first to provide evidence on the topic. Kay – also an Expert Advisor of the APPG AI – shared with the group the mission of WEF's new center in San Francisco, emphasising the need to look at the issue on an international level.

"The issues related to the advances of AI technologies span national borders. These issues have to be addressed internationally and require collaboration and cooperation." – *Kay Firth-Butterfield, World Economic Forum*

One of the many projects she is currently working on is in partnership with the EU government, aiming to develop best practices for the procurement of AI. Much of the focus of these best practices will be on developing clear guidance for when and under what conditions AI should be procured in hopes of boosting innovation.

Next to speak on the issue of AI and innovation was **Pete Trainor,** Co-founder of Us AI. Over the last three years, Pete has helped to pioneer an entirely new approach to AI focused services, one that looks at 'self-evolving systems' and 'minimum viable personality' to help solve societal and human issues.

"Our survey highlights that many companies don't understand what AI really is. If their clients ask for AI, they say they are doing it. Policymakers can help inform business to understand the use cases and the implications." – *Pete Trainor, Us AI*

Pete shared with the Parliamentarians and wider audience the results of an industry first piece of research conducted by the BIMA (British Interactive Media Association) AI Think Tank. The research relied on the views of 298 individuals (67% Male / 33% Female / varying roles from C-suite down to data, implementation, design and QA) from 240 U.K

based, digital, media, startups and advertising firms. The results highlighted multiple areas of both positivity and concern. Most notable in the results is the increasingly problematic effect of the media, and the online narrative surrounding the topic of AI. The report highlights that many of the companies don't feel like they are lagging in the adoption of AI, but they also still don't fully understand 'what it is'. Pete stressed that Government can play a pivotal role in informing business what AI is and what it is not.

Head of Innovation and Digital Policy at the Confederation for British Industry (CBI), **Felicity Burch** was the third expert asked to give evidence. Noting the vast opportunities AI can offer, Felicity also highlighted the clear barriers to adoption that can slow down uptake. CBI research shows these barriers depend on a business's approach to innovation and their comfort in taking on new technology.

"AI is set to transform industry, but firms face challenges in delivering this transformation." – Felicity Burch, CBI

For pioneers – businesses that are actively exploring the different applications of AI, though still face tests in mastering the technology – key issues are:

- Shortage of specialist AI skills
- Security and privacy requirements
- Raising investment capital

Followers are starting to get to grips with the potential of AI, but face specific barriers mainly tied to lack of knowledge and understanding. For them key issues are:

- Shortage of specialist AI skills
- Identifying return on investment
- Internal understanding of AI

Focusing on the wider business environment factors, Felicity also highlighted the need for stakeholders to ensure quality data sets are available for companies to utilise. She emphasised the need of coordination amongst various stakeholders and various initiatives. The AI Council can serve as a bridge between the public and private sectors – bringing in key industry concerns on AI that can be addressed by policy change e.g. on the need for AI skills.

From the Royal Opera House, **James Simpson,** added to the conversation focusing on the role of the creative industry in the AI era. How can the creative industry innovate using AI? What are the implications of AI on the creative industry?

The creative industries could be uniquely affected by AI systems which can automate the design process. As creativity is a significant part of British culture and workforce, it is important that these tools are understood and adopted in a way that doesn't undermine the humanity in creativity or the sincerity of a human-designed product.

Fourth to provide evidence was **Jane Calvert-Lee,** from Iorma - the Consumer Commerce Centre which acts as a neutral resource for businesses and governments that recognise the need to understand and respond to the ways in which the 7.5 billion global consumers are changing – in the products and services they want and need, and the ways they want to obtain and pay for them.

"Among the sectors where AI has had the greatest impact already include food and agriculture, energy and manufacturing, financial services, healthcare, transportation and logistics."– Jane Calvert-Lee, IORMA

Noting the differences across industries and organisations, Jane highlighted that some are innovating using AI at much faster speeds and larger scale than others. Ultimately, she said: **"Companies either have to wise up to the possibilities that AI offers them - or their competitors - or they will fail."**

Commenting on the need to scale AI business in the UK, Jane spoke about alternative funding to your traditional bank, including crowd and peer to peer

funding and groups of business angels. Jane commented on IORMA welcoming the Government's announcement that a proportion of the £2.5bn investment fund at the British Business Bank should be reserved as a growth fund for SMEs with a substantive AI component.

Last to provide evidence for the APPG AI was **Chris Gayner,** Director of Labs at Symphony Ventures. Chris added to the conversation, focusing on the need for AI talent in order to assure organisations across the UK innovate. He said: "Critically, the primary source of new innovation around AI in corporate and public environments – university graduates, computer science enthusiast and developers - are being branded the 'Ad Generation' – as a significant portion of this talent pool is attracted to the high salaries being offered by companies such as Facebook, Google, Amazon – charged with the task of building better performing platforms for advertisers and fast-moving consumer products and services."

According to Chris, there are several reasons why innovation is still slow. The existing regulation around data, for one, does not allow publicly traded organisations to innovate quickly. There are also challenges around understanding the black box nature of more complex automation tools (such as deep learning) and then how to effectively manage the various components of a system that is potentially influencing core business operations – think AI to manage the recruitment process.

"Policies need to be developed in such a way not to restrict or limit innovation (in the context of monopolistic behaviour) but rather offer practical, flexible frameworks in which all businesses have the same fighting chance to evolve." -Chris Gayner, Symphony Ventures

Chris added: "Critically, sources of innovation have a direct impact on adoption speed. The innovation happening within AI is reliant on data, models and analytical tools – largely being created, and thus owned, by a small group of technology vendors and large technology services firms. This is not to suggest monopolisation or collusion, but rather suggestive that without a mature market place for Intelligent Automation skills, products or services – the innovation agenda is being defined behind closed doors, amongst a select group of individuals. This means the capacity for AI advancement is limited, as is the overall the direction of travel."

He asked for Government to provide funding to companies willing to build and share new data models, and build greater incentives for co-creation and education – particularly for legacy businesses in which disruption will have a big impact on customers lives.

Lord Clement-Jones wrapped up the session, thanking those who provided oral evidence, and encouraging the Parliamentarians and wider audience to take their suggestions to make policies that promote innovation across the UK. He stressed the importance of promoting broad skills because we will need individuals across disciplines with the critical thinking and creativity skills to tap into the mass opportunities of AI in a way that is safe and ethical.

AI & INFRASTRUCTURE

Details

- Date: 9 July 2018
- Time: 5:30 – 7:00 pm
- Location: Committee Room 4A, House of Lords
- Participants: 108 registered attendees

Speakers

- Will Cavendish, Global Head of Digital Services, Arup
- Antony Walker, Deputy CEO, TechUK
- Tomas Romero, Global Consulting Partner, WiPro
- Marko Balabanovic, CTO, Digital Catapult

Questions for Inspiration

- What physical and digital infrastructure do we need for a transforming AI society?
- How can we ensure all regions across UK have access to top-notch AI infrastructure?
- How do we make sure our infrastructure is secure against internal and external security threats?

Background: Setting the Scene

The readiness of the UK to seize AI benefits and ensure they are distributed widely and fairly across society depends very much on the digital (and physical) infrastructure in place.

Having top-notch digital infrastructure - meaning **broadband coverage and access to high-speed internet -** is a prerequisite for both the development and deployment of AI.

The government, over the last year, has committed to delivering this infrastructure across the UK. Their promise is to reach 95% superfast broadband coverage, invest over £1 billion to develop 5G mobile networks, and extend full fibre broadband to build the next generation digital infrastructure. Recent announcements include the launch of a **£190 million Challenge Fund for Local Full Fibre Networks and a further £159 million investment for the 5G Testbeds and Trials programme**. Initiatives such as these will ensure AI businesses have access to modern infrastructure nation-wide and, hence, can thrive.

However, an important part of building the digital infrastructure needed for the 21st century largely relies on access to large datasets. Therefore, building the right **data infrastructure** to sustain the evolving socio-economy is of high-most priority for survivability and thrivability in this modern era.

The government is committed to opening up more data in a way that makes it reusable and easily accessible. The AI Sector Deal states its desire to work with industry towards interoperable and, where possible, open data standards.

Furthermore, **Data Trusts are being created across the UK to allow the sharing of data while also protecting individuals' rights.** The vision for Data Trusts is that: "they will allow 2 or more parties in any sector to partner in data sharing agreements, shape the agreements according to their needs and enable multiple organisations to work together to solve a common problem."

Additionally, as **computing power** is necessary for most advanced AI systems being created today, the University of Cambridge Research Computing Service is making the UK's fastest academic supercomputer available to AI technology companies. This new AI supercomputer is a £10 million partnership between the Engineering and Physical Sciences Research Council (EPSRC), the Science and Technology Facilities Council (STFC) and the university.

UKRI has also created the eInfrastructure Advisory Board (eAB) to advise the CEO of UKRI on High Performance Computing (HPC) Research infrastructure, and will be developing an eInfrastructure development roadmap, as well as other HPC related projects.

Moreover, on an organisational level, companies must also rethink and transform their infrastructure to match the changes AI technologies bring with them. Building AI-ready infrastructure for an organisation means necessary **data storage capacity, networking and AI data needs, and deliberate and strategic planning.**

Lastly, and most importantly, as stakeholders work towards transforming existing infrastructure to prepare society and the economy to reap the benefits of AI, they must also pay close attention to how AI technologies themselves can be applied to improve our infrastructure – making it more sustainable, efficient, and fit for the future.

Parliamentary Meeting Overview

APPG AI met on 9 July 2018 to discuss the infrastructure that needs to be in place for the UK to reap the full benefits AI offers, as well as how AI systems can be used to improve our current physical and digital infrastructure across the nation.

The meeting was chaired by Lord Clement-Jones and included a total of 108 registered attendees from government, business, academia, and the wider civic society. Asked to provide oral evidence were Will

"The most immediate opportunities lie in using ML to improve the efficiency and effectiveness of infrastructure build, operations and maintenance – such as more efficient construction projects; improved supply chain optimisation; better and cheaper asset management; predictive asset repairs and wider maintenance; and transport, energy and water system optimisation." – Will Cavendish, Arup

Cavendish (Arup), Antony Walker (TechUK), Tomas Romero (WiPro), and Marko Balabanovic (Digital Catapult).

Will Cavendish, Global Head of Digital Services at Arup, was first to address the APPG AI Officers, Advisory Board, and wider audience. Previously he was Strategy Lead, Applied at DeepMind, responsible for understanding the ground-breaking developments taking place in AI, and working with key partners to apply them for public good in areas such as health and energy.

His evidence focused on the significant role AI can have in transforming infrastructure. Obstacles, however, including the limited amount of data sets currently out there are stopping us from realising these benefits. He urged government to open up data for UK businesses to utilise. Furthermore, Will asked the group to think in 'better infrastructure' rather than 'smart infrastructure' and consider innovative ways to improve current business models within energy, water, and transport infrastructure systems.

Will suggests: "the agenda should focus not on AI per se, but rather the benefits that it can bring to the UK in terms of better services and a more prosperous economy; and the need to ensure this is done in a way which is ethical, safe and fair."

TechUK's Deputy CEO, **Antony Walker,** spoke next, looking at infrastructure through a broader lense. In the senior leadership team of the UK's leading digital technology trade association and previously Chief Executive of the Broadband Stakeholder Group (BSG), the UK's independent advisory group on broadband policy, Antony is closely involved in the development of broadband policy development in the UK.

Antony identified six components underpinning the relationship of AI and infrastructure:

- Connectivity
- Data infrastructure
- Access to high performance computing
- Security
- People/Skills/Talent
- Coordination

There are steps taken in regards to each of these components to ensure infrastructure is upgraded to fit the evolving economy and society. Antony confessed that more has to be done in the area of coordination to ensure different policies, initiatives, and groups are brought together. The AI Council, he argues, is well placed to take on such a role.

He suggests this is a critical time to get the infrastructure right as potential returns are getting much greater because AI acts as a multiplier.

Tomas Romero, WiPro's Global Consulting Partner and Sector Leader for Energy, Utilities, Natural Resources and Construction, was the third panelist. Agreeing with Antony on his definition of infrastructure, Tomas asked the group to add one additional component: education. Having had significant experience in other countries such as Australia, Tomas suggested that other governments are investing a lot of their attention in educating their citizens to be prepared for the changes of the modern world filled with AI.

"To ensure all regions see development, last-mile connectivity needs to be encouraged." -Tomas Romero, WiPro

Tomas thinks the talent of a nation is a key part of its infrastructure. Further investments into schools are necessary to train teachers and students for these transformations. Furthermore, education has to be restructured to promote lifelong learning.

Lastly he also emphasised the need for access to high quality data. He recommended to create a positive regulatory framework for data sharing between organisations with unique propositions. For example, the ability to centrally host data in a government backed liability free digital environment encourages organisations to share data with each other more proactively.

Last to provide oral evidence was **Marko Balabanovic,** the CTO of Digital Catapult. Marko is a creative technology leader with over 20 years' experience developing innovations in academia, corporations and start-ups in both the UK and US.

He spoke on behalf of Digital Catapult's mission to accelerate infrastructure in the UK. AI, Marko states, has the potential to improve productivity and raise growth. However, limited access to large data sets and advanced computation make many UK companies disadvantaged when applying the latest AI techniques such as deep learning.

"The UK should invest more to provide access to the latest AI computation systems for growing UK companies, building on programmes showing early success such as Digital Catapult's Machine Intelligence Garage." – *Marko Balabanovic, Digital Catapult*

In fact, Digital Catapult's research showed that 60% of UK companies stated that access to and expertise around computation is holding them back from innovation.

Marko asked the UK to invest more to provide access to the latest AI computation systems for growing UK companies, building on programmes showing early success such as Digital Catapult's Machine Intelligence Garage. This programme has already helped 19 start-ups since launching six months ago, and even in that short time four are gaining investment or being acquired.

Lord Clement-Jones thanked the four panellists and asked the Officers, Advisory Board, and wider audience to ask any questions and/or pose any comments they had on the topic of AI and Infrastructure.

Justin Madders asked the panel to share their views on public versus private investment to initiatives building the infrastructure needed for AI to take off. The panel shared their worries about monopolies being created, especially around data ownership. But, ultimately, they agreed it should be a combination of public and private investment to make sure our nation is prepared for the transformations these technologies are bringing.

Thanking the panel and the audience, Lord Clement-Jones brought the session to an end. He concluded that the right balance between speed and 'getting it right' is the challenge in order to build infrastructure in the UK that ensures individuals and organisations benefit from the mass AI opportunities but also are protected from the hazards.

AI & TRADE

Details

- Date: 15 October 2018
- Time: 5:30 – 7:00 pm
- Location: Committee Room 1, House of Lords
- Participants: 104 registered attendees

Speakers

- Dr Mike Short, Chief Scientific Advisor, Department of International Trade
- Dr Matthew Howard, Director AI & Cognitive Analytics, Deloitte
- Anna Dingley. Executive Director, SparkCognition
- Andrew Burgess, Author, The Executive Guide of AI

Questions for Inspiration

- How has AI changed trade internationally and within national borders?
- How can industries shift their business models to adapt AI?
- How do we shift from e-commerce to ai-commerce?
- What changes have to be made to UK taxing frameworks?

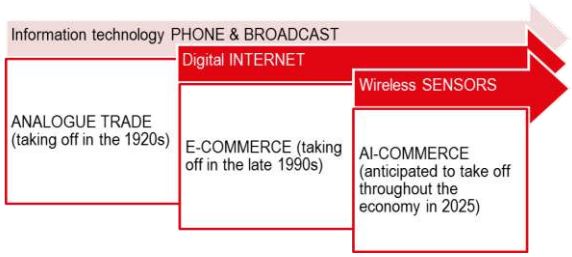
Background: Setting the Scene

Globally, AI is changing the factors for success across all industries – completely transforming the productivity of organisations in developed, emerging, and frontier markets. Overall, AI can enhance the quantity and quality of available goods and services – and also improve the speeds they are made available.

AI technologies have the capability to offer products and services tailored to the personalised preferences and needs of each customer. Also, AI technologies can make products and services accessible to a wider group of individuals - breaking conventional geographic and social boundaries.

For the UK to benefit from these two key AI trends, **the nation needs to build an innovative trade ecosystem which encourages the shift from e-commerce to *AI*-commerce.** We can map a technology trade trajectory from analogue trade (broadcasting and phone orders) to e-commerce where the Internet sparked a revolution for procurement through online catalogues, the shopping basket, new business models around peer-to-peer auctions, price comparison sites and online payments. **The current revolution in AI commerce disrupts everything once again – particularly all we know related to supply and demand economics about how markets work.** Conventionally, markets tend to be classified by their degree of competition or the number of buyers and sellers bargaining a price. The e-commerce revolution enforced this model; however, AI-commerce serves as a completely disruptive force, transforming these specific market structures.

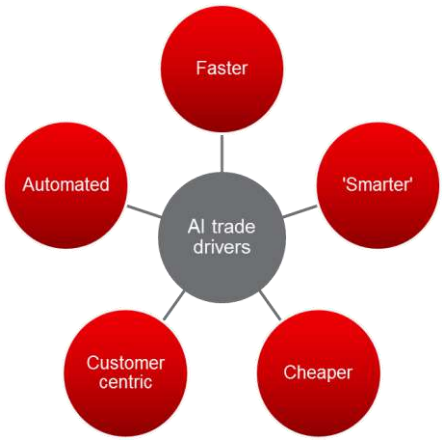
Technological Trade Paradigm



Supply chains are being completely reconfigured and most commercial market transactions underpinned by AI commerce do not take place in competitive market arenas as we now know them. Individuals and businesses are involved in ongoing, more intensive bilateral relationships in which they exchange data and information. The new market institutions in which trade itself is conducted are 'intelligent agents' (such as chatbots and Alexa) interacting directly with consumers and clients, 'Internet of things' organising the buyside (e.g. via connected homes and smart grids), 'information exchanges' via online emerging data driven platforms, and the contract itself, which will be processed through a blockchain mechanism and smart contracts.

The drivers of AI commerce are transaction cost efficiency as trade processes increasingly become faster and 'smarter' via connected data. Despite being automated, trade will also become personalised and customer-centric. Most of all, it has the potential to become much cheaper.

Five AI Drivers



This trade transaction is different from the exchanges in traditional markets, as we commonly tend to think of them. Till now, the market offerings of products and services - the conventional source of market competition – were the most important element for organisations. However, now these market offerings have become less significant and other factors are critical to survive and thrive in today's competition. The relational exchanges between buyers and sellers are still competitive but the focus now lies on the first factor, **personal and business data access.** We can think of it as a 'social contract' underpinning the trading contract, as you cannot trade unless you disclose your data in public or privacy commons. The 'social contract' for data

exchanges will probably underpin all AI trade contracts in goods and services in the future. A second factor in market competition is the **AI technology capabilities** of the trading organisations, and the ability to build and control unique platforms (the third factor) on which users can connect. We need to ensure that the UK invests in the new market institution platform solutions which the public and private sector can subscribe to or adopt in their route to markets. In consequence, organisations regardless of size will be equipped to reap the benefits of AI and to compete in the emerging trade scene.

For international trade, the trade models that are likely to be most useful in understanding the impact of AI are those that account for the points of scale, knowledge creation, and the geography of knowledge diffusion. These models suggest that whether AI-focused trade policies are optimal will depend very much on the presence of scale and the absence of rapid international knowledge diffusion.

Parliamentary Meeting Overview

On 15 October 2018, the APPG AI community – made up of policymakers, industry, academics, and representatives of the wider society - met to discuss AI's impact on trade. Co-chaired by Stephen Metcalfe and Lord Clement Jones, the group aimed to address how AI has changed trade in the UK and internationally - as well as how organisations can use AI to boost trade.

For industry to pick up on AI solutions and thrive in this transforming market arena, the panel and audience pinpointed a few areas government and regulators can assist. First, policymakers can help reduce perceived risk around adopting AI – particularly for small and mid-sized companies. One of the largest barriers to AI adoption is the lack of trust in the ecosystem. Government can help build this trust, protecting organisations from some of the existing perceived risks. Second, government must incentivise public and private investment to help UK start-ups scale. Third, policymakers must address critical data issues including privacy and explainability. Fourth, policymakers can help increase the understanding of AI technologies across UK sectors, industries, and regions. Only once the civic society understands AI and its use cases will they be able to adopt it successfully in their organisations.

First to speak was **Dr. Mike Short**, the Chief Scientific Advisor for the Department of International Trade. AI is key in today's transactions, Dr. Mike Short argued, and it will be increasingly so in the future as AI will be used more and more in online transactions, automated and driverless cars, health, finance, and across all industries. The Department of International Trade is therefore making sure they support the adoption of AI domestically and overseas.

For AI to be adopted though, the government must increase access to data. "Organisations need access of data both nationally and internationally" Dr. Mike Short said, recommending that the policymakers address this urgent matter.

Dr. Matthew Howard, Deloitte's Director of AI and Cognitive Analytics, agreed with Dr. Mike Short that access to data is key for UK businesses to operate and trade in the future. In addition, he added three main areas that UK policymakers must address to help businesses use AI in their day to day operations.

"There is a perception you need a PhD to work in AI – you don't. Clearly we need great academics, but we also need strong, business focused data scientists working at the commercial sharp-end of 'business AI.' -*Matthew Howard, Deloitte*

- First, he spoke on the need to bridge the technical and commercial knowledge gap. He asked for a more proactive coordination plan between academia, business and government to bridge the existing skills gap.
- Second, he called for greater prioritisation of scalable pan-industry solutions for investment. Matched funding vehicles are highly effective, but many programmes are industry-selective rather than focusing on cross-sector opportunities with the most widespread impact.
- Third, he urged for government to continue to pass favourable policies for the flow of data, people, ideas and services amongst partners worldwide. He commented: "Post-Brexit, the UK must continue to be a favourable business environment; The UK must be internationally-recognised as a great place to build businesses at the centre of European and world technology and trade."

"My vision to ease these constraints is for a democratised AI. This is where AI is being used everyday by citizens, consumers and businesses in an open, transparent way." -Andrew Burgess, Executive Guide for AI

The third to speak was **Andrew Burgess**, AI advisor and author of the *Executive Guide for AI*. As AI has the potential to improve the lives for all and improve organisations across sectors and industries, stakeholders must ensure it is available easily and without restrictions. Andrew called for government to push for democratised AI – where access to create AI is easily available and delivers real value to society. For AI to work, he says: "AI will work best if it is a grassroot movement."

One of the chief roles for government is to equip individuals with the right skills to reap the benefits of AI, Andrew argues. This means restructuring educations systems in classrooms and jobs.

Andrew stressed: "AI will succeed as a business tool only where it can be used easily and effectively. For the UK to become a go-to source of AI capability, and a central hub of trade in AI, then we really need to focus on the people; both the users and the creators of the technology."

Once AI can be seen as a tool - once it has been democratised - then we will see the real value flow.

The last speaker was **Anna Dingley**, Executive Director of industrial AI company SparkCognition. Addressing the question of how AI is changing trade nationally and internationally, she noted the transformations AI technologies are bringing for both developed and developing countries. Due to the economic potential of AI, AI can be adopted by *all* to increase efficiency, reach wider markets, and boost productivity.

"AI can be used in a global context to bring economies of scale and address vastly more amounts of data, and at the same time can bring a more extreme level of personalisation and localisation for services." -Anna Dingley, SparkCognition

Regarding business models, Anna noted some interesting changes afoot. Subscription models are becoming the norm for making new purchases. In the business world too, subscription or licensing models are now the standard way for contracting due the requirement for updates and longer-term technology development partnerships. There is also more collaboration between companies that would have usually been competitors – so called "co-opetition" – in the race for market share. Incumbents and new entrants are acknowledging their overlaps but collaborating in other areas to develop corporate ecosystems and deliver particular industrial AI solutions.

She called for the UK to support such collaborations and to build taxing frameworks that can easily adapt to change. Regulation doesn't have to stifle with innovation and we need consistent messages to be open to business.

Following the evidence, Stephen Metcalfe MP and Lord Clement Jones opened the floor for questions and comments. The session concluded that AI has the potential to revolutionise trade, disrupting supply chains and making transactions much more efficient. Furthermore, the room agreed that regulation can actually help companies adopt AI and ensure the full potential is reached. However, policymakers must be careful to pass the right policies which will encourage open innovation while also protecting the wellbeing of the society and its individuals.

AI & ‘NEXT STEPS’

Details

- Date: 5 November 2018
- Time: 5:30 – 7:00 pm
- Location: Committee Room 4A, House of Lords
- Participants: 135 registered attendees

Speakers

- Dr. Scott Steedman, Director of Standards, BSI
- Prof. John McDermid OBE, Director, Assuring Autonomy International Programme, University of York
- Christina Blacklaws, President, The Law Society
- Adrian Joseph, Partner: AI & Advanced Analytics, EY
- Dr Spiros Denaxas, Associate Professor, UCL

Questions for Inspiration

- What are the practical steps of setting international rules, norms and standards?
- What is our vision of the new AI and data driven world?
- What does it mean to be human in 2025 and 2052?
- Is the roadmap national or international?

Background: Setting the Scene

Artificial intelligence has quickly become the most powerful narrative of our century. Its impact has been seen across regions, industries, and sectors.

Although AI offers many opportunities for both our economies and our societies, it simultaneously raises many concerns - related to matters including security, inequality, privacy, employment, and education.

Recently, countries worldwide have been launching national AI strategies to reap the benefits of AI technologies and protect their nations from potential harms. However, it has become very clear that **many issues related to AI cross national borders.** No nation alone can address these issues without working together. While each country must consider its specific needs, we need a global framework to help us solve complex and pressing global issues.

Global coordination is essential to truly address the heart of these concerns. Policymakers and other stakeholders need to coordinate in order to champion AI and its implications on society.

The UK's Prime Minister has said: **"When technology platforms work across geographical boundaries, no one country and no one government alone can deliver the international norms, rules and standards for a global digital world."**

Organisations like the **IEEE Standards Association** and the **British Standards Institution** are bringing together stakeholders across industries and sectors to build standards guiding the development and deployment of these technologies. International organisations including the OECD and the United Nations are forming high-level groups to further explore AI's impact on an international scale. Governments are forming partnerships, committing to collaboration when addressing some of these issues related to cybersecurity, taxation, and data regulation.

Together, stakeholders worldwide are trying to agree on a vision our policies and strategies should aim to move towards. As AI transforms nearly everything around us, we need to convene individuals from different backgrounds to discuss our vision for a new AI and data driven world. **We are in a pivotal time in history in which we can decide what our future looks like – what good looks like and what good doesn't look like.**

The very essence of what it means to be human is changing as AI becomes an increasingly bigger part of our daily lives. Children are now being brought up in a society in which technologies affect them from the very day they are born. AI technologies are part of the homes they grow up in as well as the teaching environments they learn in. Data is being collected from the toys children play with, the learning material they engage with, the social platforms their parents are subscribed to, the health providers they visit, and much more. As this generation enters adulthood, it follows that their lives will be dramatically different from those of today.

What it means to be human will be completely different.

Parliamentary Meeting Overview

On the 5th of November, the APPG AI brought together policymakers, industry representatives, academics, philanthropists, and members of the public to discuss next steps in our journey towards an AI and data-driven world. There were 135 individuals who registered to attend the evidence meeting. Five speakers were invited to provide their insights on questions around international norms and standards, what it will mean to be human in the future, and the debate between national and international roadmaps.

Stephen Metcalfe MP welcomed the attendees. After providing a short overview of the APPG AI programme for 2019, he asked the panel to provide the Parliamentarians and the wider audience with their views of what our next steps should be.

"The UK government has been praised for the approach taken in the AI Sector Deal and for driving the role of bodies such as the Alan Turing Institute and the Centre for Data Ethics and Innovation. That said, more needs to be done if the UK is to assert leadership in AI standards." – Scott Steedman, BSI

Dr. Scott Steedman, Director of Standards at BSI, spoke first on the work the British Standards Institute is doing to provide the infrastructure for the standards needed around AI technologies. He emphasised the need for standards in AI ethics before the technology becomes ubiquitous.

Given the global nature of technology development the goal for all participants is international standardisation which incorporates the views of the widest range of stakeholders and has international recognition. Practically, given the speed of change and the potential societal impact of AI, there is a need to develop and pilot standards at the European and national level that can meet short term needs and become base documents for international standards in due course.

Scott urged stakeholders to prioritise global standards first, regional standards second, and national standards third. Addressing the Parliamentarians, Scott urged the government to engage with standards bodies and the wider community to ensure the new standards developed reflect the interests of the society.

Professor John McDermid, Director of Assuring Autonomy International Programme at University of York, spoke next. Professor John argues that rules, norms and standards (especially at a technical level) tend to be domain specific. Government must collaborate with organisations like BSI and ISO to set these but should also be conscious that technology moves fast and standards take a longer time to be create. Thus it is important to use mechanisms such as Publicly Available Specifications (PAS) to develop material quickly and to evolve it as the technology changes. Pragmatically: work locally; develop PAS or similar; influence globally. To do this requires support, as it is necessary to establish collaborations between organisations with different skills. The Regulators Pioneer Fund and the Industrial Strategy Challenge Fund are potentially important mechanisms for enabling this.

"Having international rules and norms is important economically, to avoid unnecessary costs in assurance, and obstacles to the uptake of technology." -John McDermid, Uni. of York

Lastly, answering the question on what it will mean to be human in the future, Professor John confessed: "The same as now!" The environment in which humans live and work will be richer due to the development of AI, including RAS. It is not realistic to believe that such systems will supplant humans, or make humans subservient.

The third speaker was President of The Law Society, **Christina Blacklaws.** Christina's evidence reflected the work of the Technology and the Law Policy Commission to examine the ethical implications of artificial intelligence (AI). She summarised most of the work they've done in three points: impact, fairness, and expert approval. She reminded the audience that moving forward we need a multidisciplinary approach that reflects a diverse range of voices.

- Impact: The use of algorithms in the justice system can have enormous benefits or devastating consequences, depending on how they are coded, the data they use, the situations and circumstances they are used in, the knowledgeability of the users, and the perceived fairness and legitimacy of the algorithms.
- Fairness: The key question is how can we ensure that algorithms are used in the right areas/spheres, using the right datasets, in a way that is fair, non discriminatory, and that there is proper human oversight and remedies for the users and those on the receiving end of decisions.

- Expert approval: There are various models that can be used to achieve those aims, but so far we have heard a lot of experts suggesting we need a multi-disciplinary panel of experts from various sectors that would approve, or do an accreditation, of specific algorithms for use in specific circumstances, according to specific set of criteria, both ethical and practical.

Ernst and Young's **Adrian Joseph** spoke fourth on the panel, agreeing with the others on the need to approach these issues through an international lens. He focused on four myths around AI, five predictions for the future, three challenges for the economy and the society, and three recommendations for policymakers to take on. The three challenges policymakers and other stakeholders must address are:

- Data: Generally, the state of data in business is that much of the data currently in use lives in legacy systems, and the data quality can often be unreliable.
- Trust: It is important to create a culture of trust around AI. People must be able to trust both the data and the algorithms.
- Skills: Need for workers with higher cognitive skills, social and emotional skills, advanced IT and programming skills.

He suggests policymakers help build trust around AI, focused on values of: Performance, Bias, Resiliency, Explainability and Transparency. Furthermore, Adrian called for the creation of an ethics code of conduct, and investment into the creation of modern skills.

Last to speak was **Dr. Spiros Denaxas,** Associate Professor of Biomedical Informatics at University College London. He called for increased data access and the building of a talent pipeline. The skills required to build and evaluate reliable and responsible AI approaches, especially in healthcare, are much broader and diverse than STEM subjects that the current focus is on.

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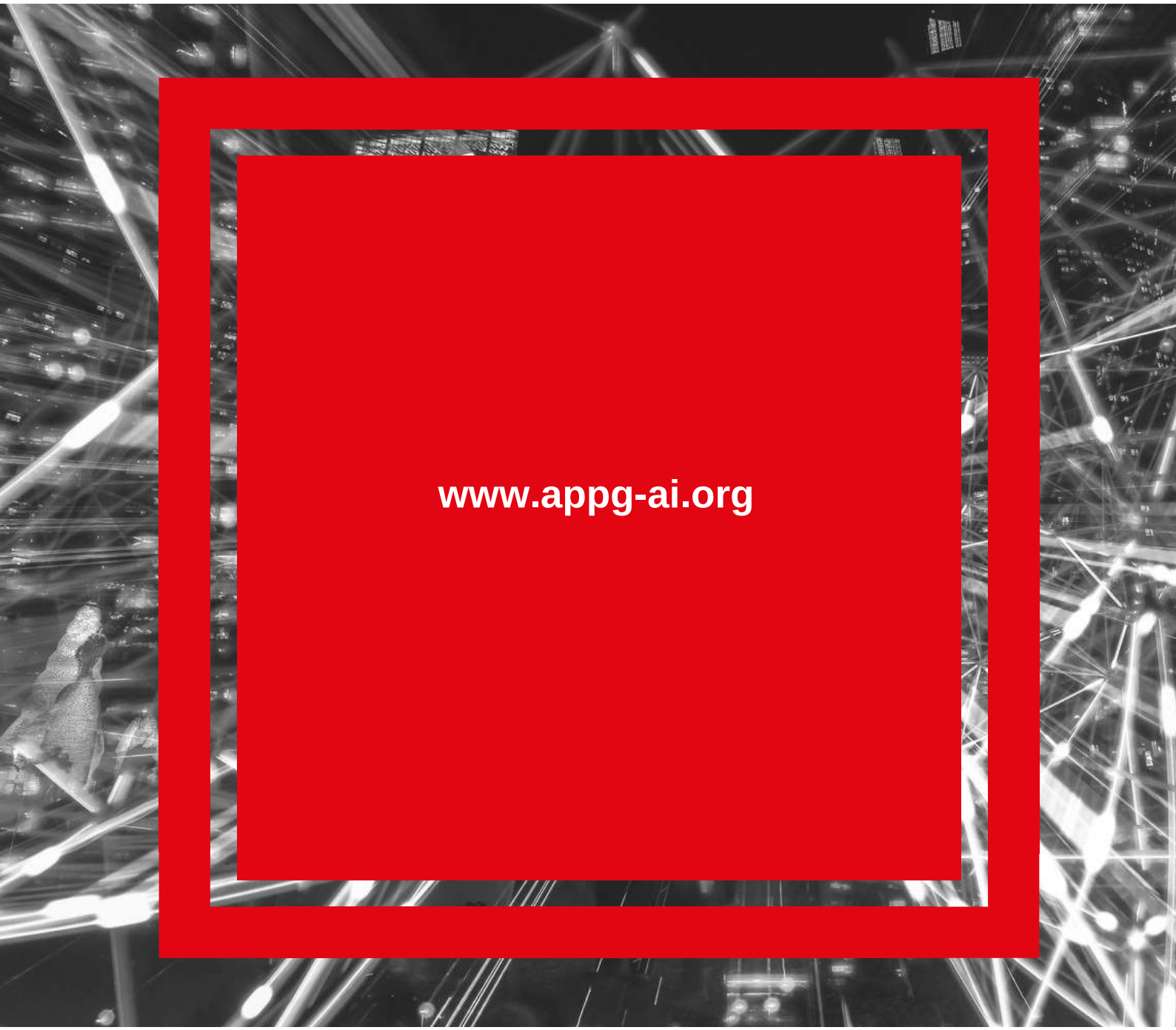
To overcome these challenges, Spiros recommended:

- The UK should Invest in a robust national infrastructure which empowers patients to see what data is recorded, when, by who and how it is being used for their care. Patients should be aware when a decision with regards to their care is based on an algorithm or not. Furthermore, patients should be able to decide who uses what data for research and what are the benefits of such research to their health or the health of others.
- Comparably to genomics, the branch of molecular biology concerned with the structure and evolution of our genetic material, we need to establish a complementary phenomics discipline to systematically investigate, refine and redefine disease classification from information about health states (things that are observable, e.g. symptoms), health traits (things that can be measured, e.g. blood pressure) and their variation over time.
- We should proactively promote capacity building in skills from relevant social sciences that are required to understand the ethical, social and political challenges of AI in healthcare. In parallel, we should advocate and reward reproducible research, enable the sharing of algorithms and the use of open standards in research.
- Finally, we should encourage and reward the next generation of health researchers to go out there and co-design, co-create AI tools and approaches with clinicians, patients and the public.

Stephen Metcalfe thanked the panel and highlighted the opportunities and, also, disruptions brought about by AI technologies. He called for policymakers to address these matters urgently and, most importantly, ensure the wider public is informed and empowered to deal with the transformations unfolding.



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