APPG on ARTIFICIAL INTELLIGENCE

EVIDENCE MEETING 5
EDUCATION:
SKILLS

PARLIAMENTARY BRIEF

8 July 2019 | Committee Room 4A, House of Lords
Evidence Meeting 5 | Education: Skills is a Parliamentary Brief based on the All-Party Parliamentary Group on Artificial Intelligence (APPG AI) evidence meeting held on 8 July 2019 at the House of Lords.

This meeting was chaired by Stephen Metcalfe MP and Lord Clement-Jones.

We would like to express our appreciation to the following people for their oral evidence: Wayne Holmes (The Open University), Kiera Newmark (Department for Education), Elena Sinel (Teens in AI), David Nash (ECITB), and Kelly Smith (The Royal Society).

We would also like to acknowledge the APPG AI Education Task Force for the input and feedback: Robert Bolton (KPMG), Dr. Wayne Holmes (Open University), Tushar Srivastava (Nurturey), Elena Sinel (Acorn Inspirations), Dr. Julia Jones (Found in Music), and Anis Mohammed (Infosys).

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Contents

EVIDENCE MEETING 5 OVERVIEW ............................................................................................................. 1
Details ......................................................................................................................................................... 1
Speakers ..................................................................................................................................................... 1
Questions .................................................................................................................................................. 1
INTRODUCTION ......................................................................................................................................... 2
Context ....................................................................................................................................................... 2
Skeleton ..................................................................................................................................................... 2
TRANSFORMING LABOUR MARKET & SOCIETY ...................................................................................... 3
AI Skills for Working ................................................................................................................................. 3
AI Skills for Living .................................................................................................................................... 3
TRANSFERABLE SKILLS ............................................................................................................................ 4
Broad Skillsets ........................................................................................................................................... 4
Agility and Uncertainty ............................................................................................................................... 4
Learning to Learn ....................................................................................................................................... 4
RETHINKING WHAT EDUCATION LOOKS LIKE ..................................................................................... 5
Schools ....................................................................................................................................................... 5
Outside the Classroom ............................................................................................................................... 5
WRITTEN EVIDENCE APPENDIX ............................................................................................................ 6
Kiera Newmark, Deputy Director, STEM & Digital Skills Unit, Department for Education ........ 6
David Nash, Head of Policy and Corporate Affairs, ECITB ................................................................. 8
Kelly Smith, Senior Policy Adviser on Education, Royal Society ....................................................... 9
Wayne Holmes, Lecturer, Institute of Education Technology, The Open University ............ 10
ABOUT APPG AI ....................................................................................................................................... 12
.................................................................................................................................................................. 13
EVIDENCE MEETING 5 OVERVIEW

Details

- Date: 8 July 2019
- Time: 5:30 – 7:00 pm
- Location: Committee Room 4A, House of Lords
- Participants: 113 registered attendees

Speakers

- Wayne Holmes, Lecturer, Institute of Educational Technology, The Open University
- Elena Sinel, Founder/CEO, Teens in AI
- Kiera Newmark, Deputy Director, STEM & Digital Skills Unit, Department for Education
- David Nash, Head of Policy and Corporate Affairs, ECITB
- Kelly Smith, Senior Policy Adviser on Education, Royal Society

Questions

- What skills will our children need to survive and thrive as employees and as citizens?
- How can we ensure a broad and diverse skillset?
- How should various stakeholders address current skills shortages?
INTRODUCTION

Context

The evidence APPG AI has been gathering since 2017 shows education at the heart of both the opportunities and the risks in the narratives forming around AI.

AI’s impact on our education system has the potential to be revolutionary. With AI, every child across the world can have access to learning that is active, personalised, and cooperative. At the same time, the introduction of AI in our society is challenging whether our current education systems are fit for the unfolding transformations. Are our children being equipped with the skills they will need in their futures? Can passive learners survive in a world of uncertainty and agility? Do we have the proper infrastructure, data governance, and oversight to ensure our children are protected from the potential downfalls of these technologies?

In 2019, APPG AI launched the Education Pillar to tackle some of these multi-faceted questions over the next two years. We will focus on:

- how AI can be used as a tool to improve learning,
- what skills we need to prioritise as a society,
- how school curriculums need to transform,
- and what the role of ethics in education should be.

Although the primary audience for APPG AI are members from the House of Commons and the House of Lords, the group also aims to inform the general public and key stakeholders across business, academia, and civil society.

Skeleton

This Parliamentary brief is broken into three parts, highlighting the main takeaways from APPG AI’s second evidence meeting under the Education Pillar. The meeting, held 8 July 2019, was chaired by Stephen Metcalfe and Lord Clement Jones, and orchestrated by the Secretariat of APPG AI, Big Innovation Centre. It brought together key stakeholders to gather and share evidence on the skillsets our education systems and other institutions should be prioritising in an AI-filled world.

First, the brief provides an overview of how AI is transforming the global labour market, impacting both the supply and demand of skills. It also looks beyond work, unpacking the skills individuals will need to live in an AI-filled world.

The importance of transferable skills in a constantly changing world is emphasised in the second part of the brief – highlighting the need for individuals with broad skillsets and lifelong learning.

Third, based on the conversation at the fifth APPG AI evidence meeting, the next part explores what future education systems could look like in different contexts: schools and outside the classroom.

Finally, the brief ends with an appendix with the written evidence provided by Wayne Holmes (The Open University), Kiera Newmark (Department for Education), David Nash (ECITB), and Kelly Smith (The Royal Society).
TRANSFORMING LABOUR MARKET & SOCIETY

**AI Skills for Working**
The development and deployment of AI technologies is challenging the skillsets individuals will need to survive, succeed, and thrive in today’s transforming labour market – as well as the skills they will need to live in an AI-filled society.

Currently, there is a global demand for individuals who can build and manage AI. Most of these candidates come from a STEM (Science, Technology, Engineering, Maths) background and, specifically, possess skills like digital literacy, data science, coding, and machine learning.

However, more than just STEM skills, employees are increasingly demanding people with problem-solving, managerial, and interpersonal skills to ensure AI systems move from the lab to the street. Therefore, it is no longer enough to just know how to build an AI system. In the future, a successful employee will be one that also has the skills to successfully work alongside AI, commercialise it, shape policies around it, manage it, and more.

AI, like other revolutionary technologies, is also affecting the number and types of jobs that will exist in the future. Just like technological revolutions in the past, AI is likely to diminish some jobs that exist today, create others, and transform all.

In the past, such automation tended to affect more manual jobs or routine tasks (e.g. clerical work, bookkeeping, basic paralegal work and reporting). However, today’s technologies are different because they put non-routine tasks in risk of automation as well.

Technologies like AI are beginning to displace cognitive capability or even intellectual capability. Therefore, many argue that the skills which will be increasingly sought in the future will be those that humans have a comparative advantage over. These are soft skills like communication, creativity, problem-solving, etc.

Policymakers worldwide are tasked to design labour market institutions (e.g. minimum wages; employment protection) and education institutions (e.g. curriculums, pedagogy) which empower individuals with the skills to seize the opportunities offered by the AI revolution but also protect themselves from the disruption.

**AI Skills for Living**
What is important is to build resilient and adaptable education systems and labour markets that allow workers and citizens to manage the transition with the least possible disruption.

As AI technologies will ultimately impact all of us and the implications will trespass the workplace, it is important to build the digital understanding and other skills needed to live in a world of AI. At every educational level, from primary school onwards, people will need to be alerted both to its potential and to its limitations.

Like Professor Boden noted in a previous APPG AI evidence meeting, it won’t be necessary for every citizen to be a master at making AI, much as not every car-driver needs to be a mechanic. However, all individuals will need a sense of what sorts of things AI systems can do and what they cannot.

Governments must work with the wider society to ensure individuals possess the right type of skills to navigate successfully through an ever-changing, AI-environment. This will require rethinking the current education systems, identifying skill gaps, and setting up incentive structures for individuals to invest in those skills most in-demand.
TRANSFERABLE SKILLS

Broad Skillsets
As skills are closely related to economic growth and productivity, as well as individual wellbeing and self-fulfilment, policymakers must identify and prioritise the skillsets fit for the future. Increasingly so, the panel at the APPG AI Evidence Meeting agreed that the skillsets people will need in the future will be made up of a combination of ‘hard’ and ‘soft’ skills rather than one over the other.

In fact, framing the conversation as hard versus soft skills is skewed as individuals in the 21st century world should have a combination of both. It is fallacious to consider these two categories as conflicting, as Kiera Newmark stated. We can foster creativity and critical thinking through STEM. Hard skills and soft skills are complementary and should be thought of as mutually exclusive. The panel agreed that the most important category of skills will be transferable skills that people can use to adapt and apply in different contexts.

In fact, with the gradual disappearance of routine tasks, growing emphasis will be placed on these types of transferable skills as they will be much more difficult to automate and the ones which will ensure these technologies can be deployed safely and fairly across society.

Agility and Uncertainty
During the open conversation at the evidence meeting, the audience agree on one thing: what is certain is that the future is uncertain. It is, therefore, difficult (if not counter-productive) to try and plan in detail for the potential changes that might affect the world of work in the years to come.

Individuals need the tools to adapt to a future that’s going to change ever more rapidly. Young people must prepare for the jobs of the future by ensuring that they are equipped with the right type of transferable skills to successfully navigate through their lives, and older generations already in the workforce need to be given opportunities to continuously maintain their skills, upskill and/or reskill throughout their working lives.

Learning to Learn
The most helpful skill anyone can learn for this future that we’re facing is how to keep learning, how to adapt and how to continue to learn throughout life and to do that very effectively. Twenty-first century citizens must have the ability to learn and master new skills. They need to pursue knowledge and constantly climb up the learning curve.

Last year, APPG AI in partnership with KPMG, published a report called Learning to Learn, unpacking how AI is transforming the skills we will need in the 21st century as workers and, even more so, as citizens. The report concluded that learning to learn is the number one skill that needs to be prioritised and encouraged in our education institutions.

Learning to learn is about always asking questions, experimenting with new topics, and staying curious. It is about learning not because you want to pass an exam or secure a great job but because you want to learn.

This skill fits well with what the panel identified as the category of transferable skills, those that individuals will find relevant across different aspects of their lives.
RETHINKING WHAT EDUCATION LOOKS LIKE

Schools
Rethinking education in our schools is key to addressing the current disruption in the supply and demand of skills. The panellists at the APPG AI Evidence Meeting agreed that UK schools need to be reshaped to guarantee they are fit for the future. All stakeholders – including Government, business, educators, parents, and children – must work together for this to be achieved.

Many argued that the current system is similar to the factory model, preparing our youth through a one-model-fits-all approach and not adequately providing them with the skills they will need for the real world. When Lord Clement Jones asked why society focuses on narrow skills like coding rather than broader skills like creativity, Dr. Wayne Holmes noted that this approach is embedded within our system which focuses much more on knowledge acquisition to pass exams.

The introduction of new technologies like AI and innovative approaches has the potential to transform this model to more personalised learning in which all students have a chance to succeed. As Kiera Newmark shared, the Department for Education is working with schools to assess how the adoption of AI can help transform the education system but a lot more impact studies have to be conducted to guarantee we are moving towards the right direction.

The teachers play a huge role in this transformation. Teachers must be re-incentivised, trained, and consulted throughout the shift to ensure the change is holistic and successful.

Outside the Classroom
Initiatives outside the traditional classroom are also critical in helping empower younger and older generations alike with the skills they will need in the future.

The workplace is one context in which skills are increasingly being learned and developed nowadays, especially as the significance of lifelong learning and reskilling surfaces. The panel at the APPG AI evidence meeting highlighted the trend of employers seeking ‘learning workers’ with skills across the spectrum, who have the capacity to learn, relearn, and unlearn.

Furthermore, the group shed light on the importance of other initiatives trying to bridge the gap between schools and the real world. One of these examples is Elena Sinel’s Teens in AI programme aiming to bring in underprivileged children into AI. The programme partners with corporations to deliver hackathons which empower children across the UK to solve real world problems using AI.

Designing, investing in, and promoting initiatives such as these can help individuals across the UK develop the transferable skills they will need for an increasingly AI-filled world. These and a rethought education system can prepare young and old generations for an ever-changing future. Best practice should start being collected to understand what works and move towards that direction.
WRITTEN EVIDENCE APPENDIX

Kiera Newmark, Deputy Director, STEM & Digital Skills Unit, Department for Education

Biography: Kiera is responsible for STEM & Digital Skills strategy in the Department of Education, covering all ages from pre-school through to University. She is also responsible for the Department’s policy on using Education Technology in schools, colleges and Higher Education institutions. Before her current role, Kiera worked on a series of high profile policies in technology focused and non-technology focused roles.

She has previously worked in multiple Government Departments, including Cabinet Office and the Department for Business. She has also worked in the private and charitable sectors.

Written Evidence

The Government wants everyone to receive a world-class education, to ensure that they have the opportunity to reach their full potential. This supports our broader ambition to improve the productivity of our economy. 1.9 million more children are in good or outstanding schools since 2010 - and that is in part down to our reforms. We are laying the groundwork for a new technical education system, and have maintained a world-leading Higher Education (HE) sector.

The Fourth Industrial Revolution, as defined by the World Economic Forum, is the ‘digital revolution…characterised by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres’.¹ These technologies include Artificial Intelligence (AI – including its corollaries: automation and machine learning), the development of new materials, and use of novel production modes.

We cannot be certain of the exact impact of the Fourth Industrial Revolution. The Organisation for Economic Co-operation and Development (OECD) found that 14% of jobs in member countries are at a high risk of automation,² whereas a separate study suggested that 47% of American jobs are at risk.³ Although there is a lack of research focusing on the UK, these international studies indicate the challenge of predicting the impact of technological shifts – many of which are still at early stages of development.

We are preparing for the changes in the labour market that the Fourth Industrial Revolution may bring, through our new, modern Industrial Strategy (including an AI Sector Deal), supported by our Digital Strategy and a range of major Department for Education reform programmes (including the Department’s recently published EdTech Strategy).

Through these reforms, the Government is delivering a range of changes, including:

- Encouraging and supporting schools and colleges to use technology to improve student outcomes

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² OECD, Putting Faces to the Jobs at Risk of Automation (2018)
• Introducing T levels as a high-quality alternative to A levels and setting up 12 new Institutes of Technology
• Introducing a new basic Digital Skills entitlement for adults
• Designing a new National Retraining Scheme, which will empower adults to redirect their careers and move into a better job.
• Targeting policies to ensure people from all backgrounds can take advantage of the opportunities that new technologies may bring

AI technology represents an exciting opportunity. However, it remains largely untried or reliably tested within most education systems. When discussing the adoption of AI technologies in our classrooms, lecture theatres and homes, it is important that we focus not just on the possible opportunities, but also the risks. It is imperative that we approach the application and adoption of this new technology with the same high expectations around rigorous testing and trialling, as we would in any other area of public service (such as medicine).

As a result, the Department’s efforts on AI adoption are focused on developing sound, evidence based solutions that complement existing capability. For example, the Government recently announced that it would be investing £5 million to encourage technology companies to develop cutting-edge solutions, utilising the latest technology including AI to improve adults’ experience in finding and doing training.

Finally, the Government recognises that it cannot harness all the opportunities and solve all the challenges that the Fourth Industrial Revolution may bring on its own. Business and industry groups need to engage with the future challenges their workforces may be facing. The DfE is working closely with business in a number of critical areas (including T levels, Institutes of Technology and the National Retraining Scheme) to ensure that employers have the opportunity to influence these programmes directly, and reflect the changing skills needs of our economy.
David Nash, Head of Policy and Corporate Affairs, ECITB

Biography: David Nash is the Head of Policy and Corporate Affairs at the ECITB and has over 10 years of experience working in Westminster. He worked as a Senior Policy Adviser for the Federation of Small Business, where he was responsible for overseeing and managing FSB’s UK policy work across a number of key portfolios, including education and skills. Before that, David was a Research Fellow at the Institute for Public Policy Research. He has an MSc on Politics & Public Policy and is a Fellow at the RSA.

Written Evidence

About the ECITB

The Engineering Construction Industry Training Board (ECITB) is the statutory skills organisation for the Engineering Construction Industry (ECI) in Great Britain. We cover 8 critical sectors for the UK economy, such as Nuclear, Water Treatment, Oil & Gas, Renewables, Power Generation, Chemical, Pharmaceutical, and Food & Drinks. Employer-led, we fund training to enhance skills across the engineering construction industry: last year, the ECITB invested more than £21 million to support skills development within the industry.

This includes providing technical, management and professional training, and supporting apprenticeships and careers programmes. The ECITB plays a vital role, along with the education sector, government and employers, in ensuring the UK has workers with the skills to meet the needs of the engineering construction industry.

About the report: Industry 4.0: The impact of technological change on the ECI

The report examines the impact that new and emerging technologies might have on the employment environment of the ECI – from recruitment to training and development. It explores the industry’s response to the emergence of new technology, methods and processes, and the implications for skills. The report is based on findings from 829 surveyed employers from the 8 sectors we cover. It highlights the need to develop and broaden the technology skillset of future generation in anticipation of the impact of disruptive technologies. Our findings reveal that, of the employers surveyed, the greatest perceived skills challenge in adopting new technologies in the work place is that the workforce lacks the skills to be able to adopt them. The report has several major takeaways in terms of young people and skills, and we hope to discuss it with the panel and the audience.
Kelly Smith, Senior Policy Adviser on Education, Royal Society

Biography: Kelly Smith is a Senior Education Policy Adviser at The Royal Society. She currently leads the Society’s programme of work on creating the conditions for a broad, balanced and connected post-16 curriculum, which seeks to change the A level system within the next decade. Prior to The Royal Society, Kelly worked as a Policy Advisor in the Government Digital Service (GDS), where she led the GDS Parliamentary Unit, and worked as part of the EU Exit team looking at departmental digital preparedness. Kelly has also worked on assessment and qualifications policy at AQA, and was previously a Guidance Manager at a sixth form in Durham.

Written Evidence

Jobs are going to be transformed by new technologies such as artificial intelligence and machine learning. Some jobs might be lost altogether, and others will be created that don’t even exist yet. Students who are at school now will likely change jobs and industries more frequently than ever before during the course of their career.

If we want our young people to be able to succeed in this changing workplace, we need to make sure they have the right range of knowledge and skills by the time they leave school. This should include the opportunity to study a wide range of subjects to 18, to understand how they connect in real-world contexts and to develop valuable transferable skills such as communication, problem solving, and team work.

Students in the UK specialise much earlier than many of their international counterparts, who often take a much broader range of subjects throughout school. Specialising so early does not equip our young people effectively for the rapidly changing and unpredictable labour market, nor does it help students learn how to be informed citizens contributing to our democracy and society.

All young people need to develop a wide set of skills that are best acquired by learning across a range of subjects including the sciences, maths, computing, humanities, languages and the arts through to age 18.

Young people are losing out:

The UK’s existing post-16 education systems are too narrow, but within them, many young people are not even studying the broadest range of subjects that could be offered to them. These young people are at a disadvantage in the changing world of work.

Royal Society research shows that family income has a significant impact on the number of subjects a young person takes. Less than a third of students who claim for free school meals (FSM) go on to study 3 or more A levels, compared to more than half of students from better-off backgrounds.

Where a young person lives can have a significant impact on the number of subjects they take. For example, in the South East 57% of students take 3 or more A levels compared to the North East where it is only 42%.
Wayne Holmes, Lecturer, Lecturer, Institute of Education Technology, The Open University

Biography: Dr. Wayne Holmes has been involved in educational technologies and education research for more than 25 years. He is now a Lecturer in the Institute of Educational Technology (IET) at The Open University and the Author of "Artificial Intelligence in Education: Promise and Implications for Teaching and Learning." He has received his PhD (DPhil) in Education (Learning and Technology) from the University of Oxford and has degrees in Film (BA Hons), Philosophy (MA (Distinction)) and Education (MSc Oxon). He also has a fellowship of The Higher Education Academy. Before joining the IET, Wayne was a researcher and taught at the UCL Knowledge Lab, UCL Institute of Education. He was also a Senior Teaching Associate at the University of Bristol.

Written Evidence

For me as a learning scientist, to answer the session’s core question it is helpful to see it in its educational context. In fact, the impact of Artificial Intelligence (AI) on education is more complex than often portrayed. To begin with, at least three dimensions need to be considered: learning about AI, learning with AI, and learning for AI. Learning about AI involves learning what AI actually means (what it can do as well as what it cannot do), while dispelling the many myths that have grown up around it (for example, countering the popular discourse that suggests machine learning from big data is the only valid approach to AI). It also involves learning how to develop AI, training the future AI engineers, and inspiring children and young adults to explore AI programming (for example, see “Teens In AI”).

On the other hand, learning with AI, AI tools designed to support learning, is probably what most people think of when they consider the application of AI in education (AIED). There are increasing numbers of student-facing AIED tools – such as the many ‘personalised learning’ adaptive systems. Yet again, things get complicated. While personalised learning sounds an obvious win, the benefits depend on the motivations. Personalisation can mean many different things. For example, it can mean the personalisation of learning pathways, enabling students to learn efficiently the same pre-set content; but it can also mean the personalisation of learning outcomes, giving students agency over their own learning, enabling them to self-actualise, to achieve their fullest individual potential. Most AIED personalised learning tools take the first approach, they focus on efficient individualised learning, removed from the influence of human teachers or human peers, preparing the students to sit standard examinations. But rather than prioritising efficiency, and automating existing practices, surely we should be developing AIED tools that help our students to become the best version of themselves that they can be? In any case, we also need to think about both the ethics and the practical implications of these pedagogical choices. In particular, we need to move from questions of “verification” (e.g., did I build the system right?) to “validation” (did I build the right system?): instead of asking whether the adaptive tool operates ethically, we need to ask whether adaptive tools are ethically justifiable.

The final dimension of AI and education is learning for AI, learning to exist in an AI-rich world, which is the most pertinent dimension for the APPG evidence meeting on education skills. In fact, while the meeting focuses on younger people, learning how to exist with AI is critical for everyone. How this can be achieved needs to begin with what’s known as
Moravec’s paradox: while AI is strong at processes that can be challenging for humans (such as large scale mathematics, pattern discovery, and statistical reasoning), AI is weak at other processes that humans find relatively easy (such as self-directed learning, common sense, and value judgements).

This suggests that, for our increasingly AI-rich future, we need to focus on what makes us essentially human, on what we can do that computers cannot. In particular, If we are to going to live successfully in a world that is increasingly dominated by AI, we need to go beyond simplistic approaches to education that prioritise knowledge acquisition and computational skills, as is typical of exam-focused classroom practices and is replicated by most AIED tools, because these are the skills in which AI is strong. Instead, everyone needs to strengthen those human skills in which AI remains relatively weak, such as critical thinking, creativity, collaboration, communication, literacy, flexibility, social skills, and common sense. Although sometimes AI can imitate these so-called 21st century skills, it is unlikely to be able to accomplish them to human levels anytime soon. In other words, instead of humans trying to compete with AI on its terms, AI might be recast in a supporting role (as augmented rather than artificial intelligence). All of this will require alternative classroom practices, moving away from didactic instruction and standardised testing, to focus on active learning, project-based learning, collaborative problem-solving, and productive failure, all supported judiciously by appropriate guidance and occasional instruction.

In summary, the skills that all of our citizens, young and old, will need to survive and thrive in an AI-rich world are those skills that make us essentially human, the skills that computers don’t have, and won’t have in the foreseeable future. These are the so-called 21st century skills of critical thinking, creativity, collaboration, communication, literacy, flexibility, and social skills, all of which can best be fostered by guided active learning, potentially supported by AI. These are also the skills that many of the world’s leading companies increasingly demand, the skills that AI is a long way from being able to automate, and the skills that make us essentially human. Achieving this will require the involvement of many stakeholders. In particular, we need government to recognise that AI’s huge potential is being wasted if all we are doing is reinforcing, albeit making more efficient, existing classroom practices. We also need government to foster an AI for education eco-system that involves educators and learning scientists as well as computer scientists and entrepreneurs, which includes funding for research specifically at the intersection of AI and education, and in which researchers and developers can begin to explore more innovative approaches to teaching and learning.
ABOUT APPG AI

The All-Party Parliamentary Group on Artificial Intelligence (APPG AI) was set up in January 2017 with the aim to explore the impact and implications of Artificial Intelligence.

The APPG AI is co-chaired by Stephen Metcalfe MP and Lord Clement-Jones CBE.

The Group Officers are Chris Green MP, The Right Reverend Doctor Steven Croft, Baroness Kramer, Lord Janvrin, Lord Broers, Lord Holmes of Richmond, Lord Willetts, Baroness McGregor-Smith, Justin Madders MP, Mark Hendrick MP and Carol Monaghan MP.

The Group supporters – Accenture, Blue Prism, British Standards Institution, CMS Cameron McKenna Nabarro Olswang, Creative England, Deloitte, Ernst and Young, KPMG, Megger Group Limited, Microsoft, Osborne Clarke, Oracle, PwC, and Rialto – enable us to raise the ambition of what we can achieve.

Big Innovation Centre is the APPG AI Secretariat.