# ARTIFICIAL INTELLIGENCE AND THE INTERNET OF THINGS

UK Policy Opportunities and Challenges

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CAMRI *Policy Briefs* **2**

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# ARTIFICIAL INTELLIGENCE AND THE INTERNET OF THINGS

## UK POLICY OPPORTUNITIES AND CHALLENGES

Mercedes Bunz and Laima Janciute

**A CAMRI POLICY BRIEF**

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# ARTIFICIAL INTELLIGENCE AND THE INTERNET OF THINGS

## 🔒 Key Messages

**Through the use of algorithms or artificial intelligence (AI), objects and services can perform skills, which they did not have before. By seeing, tracking and processing gathered information, objects and services now have the ability to process language and images and to make autonomous decisions.**

**This policy brief will deliver an overview of international policies. It will also take into account the approach of UK's government advancing AI mainly from a business perspective and formulate an ethical approach considering the role of AI from a democratic perspective – that of the public interest. It proposes the following recommendations:**

> The usage of AI in public services should ensure that the digital knowledge within these public institutions is strengthened instead of being transferred and privatised.

> The creation of large public databases to foster the development of AI. The monopolisation of data by big technology companies must be avoided.

> The obligation to apply only 'explainable AI' in sensitive areas such as health, welfare, criminal justice and education and ensure algorithmic transparency.

> Ensuring algorithmic liability. This should be complemented by the creation of a standing body to audit artificial intelligence.

> Campaigning to spread the knowledge about AI and automated decision-making; this could be done with the help of public services such as the BBC among others.

# 💬 WHAT'S THE ISSUE?

Based on large amounts of data, computer systems have gained new abilities to perform tasks that so far required human intelligence, from image and speech recognition to decision-making or to automatic translation between languages. Today, artificial intelligence (AI) has already become widely used with wide-reaching economic, social and ethical implications. For that reason, inquiries into the ethical and social implications of current advances in AI are as urgent and essential as economic approaches.[1] The report of the House of Lords Select Committee on Artificial Intelligence (AI), for which one of this brief's authors (Dr Mercedes Bunz) gave oral evidence, is an important step in this regard. Published in April 2018, it calls for the UK to lead the way on ethical AI. The UK government has understood the importance of AI but is focussing on it mainly from a business perspective.

> **'The UK government has understood the importance of AI but is focussing on it mainly from a business perspective'**

Its policy paper 'Industrial Strategy: Artificial Intelligence Sector Deal' published shortly after the Lord's report states: 'AI has the

potential to solve complex problems fast, and in so doing, free up time and raise productivity'[2]. By introducing new automation, the potential of AI will indeed change businesses and more: successful automation of skills that so far needed human intelligence will have a fundamental impact on ever more aspects of everyday life, raising profound social, ethical and legal questions. These questions stem from the potential of bias accidentally built into AI systems, a lack of transparency in algorithmic decision-making, and insufficient testing of the predictability of AI technology. Further questions are raised by the tendency that an automation of knowledge also means a privatisation with public knowledge becoming corporate. And last but not least, the automation of knowledge work also leaves a question about the potential impact of AI on the labour market. Besides a rise in productivity caused by AI assisting with the accomplishment of tasks in a more efficient way, researchers from the University of Oxford[3] have warned that there will be a rise in unemployment due to substitution of human-performed work by AI technology. Here, the government's Industrial Strategy states the hope for the emergence of new types of jobs to compensate for those that might be lost.[4]

From Alan Turing to Sir Tim Berners-Lee, Britain's contribution to digital innovation has been instrumental in the past and should also be so in the future. Today, AI is deemed to be one of UK's strongest sectors which could possibly 'add an additional £654 billion to the UK economy'[5]. The UK government currently aims to boost the UK's position in AI technology through working closely with AI businesses as described its 'Sector Deal' presented in April 2018.[6] It suggests to 'work with industry to explore frameworks and mechanisms' that allow managing data in 'Data Trusts'.

With the aim to add an ethical and democratic perspective to this approach, we present and convey the findings from a research study into the effect of algorithms and AI applied to things resulting in the so-called internet of things. The following section will present research evidence on the challenges and opportunities arising from such transformation of objects and analyse the agency that things acquire through being informed by algorithmic processes. The subsequent review of policy options elaborates on international debates and also illustrates how non-regulation is an undesirable scenario if one wants to follow the overarching principle of the promotion of human flourishing laid out in the joint report by the British Academy and the Royal Society.[7] Following their recommendation and this principle, the final section of this report will present a range of policy recommendations to strengthen this human flourishing regarding the development and usage of AI technologies.

# 🔍 RESEARCH EVIDENCE

## Algorithms in the Age of the Internet of Things and AI

The background of this policy brief is a study by Dr Mercedes Bunz and Professor Graham Meikle, in which they evaluated the ongoing developments in the overlapping fields of the internet of things and AI through an in-depth analysis of 30 cases and expert interviews.[8] For the study, we defined the internet of things as uses and processes that result from giving a network address to a thing and fitting it with sensors. AI was defined as the mimicking of cognitive functions associated so far with human minds such as learning tasks and problem solving or – as in the case of self-driving cars – decision-making. Looking at both areas, the aim of the study was to systematically map new social potential and challenges which demand new policies. The thirty cases studied ranged from a smartphone and an activity tracker (Fitbit) to an intelligent personal assistant (Alexa, Siri), a chatbot (Microsoft's Tay), a self-driving car (Tesla, Google-Waymo) to a self-service checkout. Alongside this, supplementary interviews were carried out with experts and executives working on the development of those digital technologies.

## Research Findings

The case studies showed that things informed by algorithms and/ or AI gain new skills they have not had before. With this, they acquire a new form of agency, new ways to act and to make decisions. This new agency is particularly effective regarding the following skills:

**The skill to read and speak:** New developments in the field of AI have led to advances in speech recognition and natural language processing providing things with the ability to read, listen, and process what has been read or heard in order to answer. These technologies have in recent years allowed for the development of intelligent personal agents with conversational interfaces such as Alexa, Siri or Google Home to enter the mass market but also fostered applications processing medical information such as Babylon.

> Potential: Voice dialogue is an intuitive alternative to the graphic user interface; language processing allows new forms of dialogues.

> Challenge: Concerns about privacy/ubiquitous surveillance – for example, to be able to listen the conversational agent needs to be 'always on'.

**The skill to see:** Advances in image recognition driven by neural networks are currently being beta-tested in the UK in a vast range of uses from self-driving vehicles to medical applications. For the Moorfields Eye Hospital London, AI analyses highly complex eye scans in partnership with DeepMind Health. And on some of UK's streets cars already park themselves or take over driving either in part or fully.

> Potential: Specific to the areas where this is applied. In transport, more effective and safer transport will likely bring positive outcomes for citizens and/or the environment. The detection of illnesses can assist and ease the delivery of healthcare for the NHS.

> Challenge: There are cases that show that visual identifications by algorithms can easily be fooled. The reliability of image recognition has not been sufficiently tested.

**The skill to track and process:** Digital chips have become smaller and affordable and a wide range of sensors can now be applied to all things. Most smartphones currently hold a receptive microphone, an ambient light sensor to adjust screen light, a barometer to sense elevation and air pressure, an accelerometer to measure velocity, a gyrometer to sense gravity and which way is down and a fingerprint sensor. Inserted into objects, these sensors can be used to assist or replace human activity by being pre-programmed or by making their own decisions (AI). Information that was before researched and presented by lawyers, journalists, doctors can now also in parts be searched and processed by automated data/document review.

> Potential: Comfort and convenience in everyday life. Providing medical and care assistance (assistive technology). Higher effectivity through faster interaction.

> Challenge: Concerns for privacy/ubiquitous surveillance - the internet of things is tracking not just the movements of citizens but also their habits. Trust and consent – users should have control over their data

and the right to question decisions based on their data. Biased decisions – AI systems often have the tendency to amplify biases they find in the data they are trained with[9] and they need large, expensive databases to be trained on.

**Summary of research findings:**

1. Powered by data processed by an algorithmic framework, things and applications acquire new skills and now speak, see, and track.

2. The new skills enable things and applications to learn, which can even even enable them to make automatic decisions.

3. The making of those decisions transforms things and applications to a new status. They have now reached a new kind of self-sufficiency i.e. they themselves have new ways, space and opportunities to act and react thereby gaining agency.

## Impact

From smartphones and activity trackers to connected lights, home assistants and self-driving vehicles, our study (Bunz and Meikle, 2018) has made clear that the internet of things and the application of AI is already a mass phenomenon. While so-called 'general AI' successfully performing any intellectual task like a human being is still far off, immediate impact from so-called 'narrow AI' can be expected as described under three headings:

1. **Data**: Large, high-quality datasets are highly valuable as a source for training AI. This leads to tasks being done more effectively and/or the creation of new knowledge. The data trusts that are the source of this new knowledge should not be exclusively guided by a business perspective. Furthermore, privacy and security concerns should be respected and combined with the needs for generating, collecting and processing data that are necessary to feed an AI applied for the goal of human flourishing.

2. **Responsibility and liability**: Through the development of new assisting technology that can offer new skills and even make decisions, society is for some becoming more inclusive, for others more convenient. On the other hand, questions of algorithmic bias and media recognition arise which concern the issue of whose reality is being technically assisted and who is left out – or even who is being discriminated against by automated decisions. For businesses, the liability for the application of this technology – making a wrong or biased decision – is currently a difficult grey area.

3. **Work and the job market:** AI is already assisting with intellectual tasks changing the role of lawyers, doctors, journalists and stockbrokers easing their work. When AI is applied to services and robots, these tasks could lead to a new wave of automation of high-skilled as well as low-skilled jobs. The risk of profound job losses needs to be considered.

# ▤ REVIEW OF POLICY OPTIONS

Internationally, the impact of AI on society and the required regulatory approaches to respond to it have been intensely debated. Public investment in AI is a widely adopted policy strategy and several nations' government spending on AI is exceeding the UK government's plans[10]: The Canadian federal government[11] has pledged US $100 million in the 2017 research budget to launch the Pan-Canadian Artificial Intelligence Strategy, delivered through the Canadian Institute for Advanced Research (CIFAR). To ensure keeping up with the sector, it invested a further US$150 million into the launch of the Vector Institute for AI at the University of Toronto, compared to £42m covering the first five-years of the also newly installed Turing Institute located at the British Library. In the US, the National Science Foundation spends $175 million on intelligent systems. China, while not disclosing their public investment, has by now overtaken the EU in the publication of AI papers and in having the biggest AI-ecosystem after that of the US.[12] Following those efforts, the EU's Digital Single Market Strategy has declared Artificial Intelligence 'an area of strategic importance and a key driver of economic development'[13].

Alongside economic objectives, a broad range of stakeholders have articulated a necessity to adopt in the near future common ethical frameworks and codified rules, including international guidelines – among them the Alan Turing Institute (London), the Leverhulme Centre for the Future of Intelligence (Cambridge), or the AI Now Institute and Data Society (both in New York). Here, the aim is to shape the development of AI in a human-centric way that respects the rules of societies.

> ‘The role of governments and international organisations is key to delivering the needed frameworks of governance’

The role of governments and international organisations is key to delivering the needed frameworks of governance.[14] Clarification of responsibility and liability is a salient question for business stakeholders who need legal certainty. There have been calls for proactive regulation by some industry leaders, including Elon Musk.[15] The policy strategy of the Obama administration initiated the discussion of a potential impact of AI and robots on the workforce; their policy recommended such solutions as retraining and (in case of significant AI-job displacement) the strengthening of the unemployment insurance system and the creation of new job opportunities. Furthermore, AI-related policy discussions are particularly prominent in the EU, where EU-wide policy options are being considered.[16] EU states have declared their plans for cooperation regarding AI. An expert AI group has been asked to produce a set of draft guidelines for the ethical development and use of AI, based on fundamental EU rights. This will be influenced by the following two resolutions passed in 2017:

> The resolution on 'Civil Law Rules on Robotics'[17] is setting a global precedent as proposing a comprehensive and tailored legislative approach in this field. It emphasises the need to define the legal status for Cyber-Physical Systems and to address the issues surrounding liability in cases of accidents caused by robot- and AI-driven technology, also highlighting other problems such as privacy and data protection, ethics, safety, standardisation as well as the restructuring of the workplace. It proposed the creation of a dedicated EU Agency that would oversee and coordinate responses to opportunities and challenges arising from robotics and AI. The EP has also held a subsequent public consultation.[18]

> The EP's resolution on 'Fundamental rights implications of Big Data'[19] pays particular attention to the role of algorithms and of other analytical tools, and raises concerns regarding the opacity of automated decision-making and its impact on privacy, data protection, media freedom and pluralism, non-discrimination, and justice. The EP supports the proposal to establish a Digital Clearing House to enact a coordinated holistic regulatory approach between data protection, competition and consumer protection bodies.[20] The EU has enshrined an explicit right for individuals to challenge decisions made based solely on automated processing of personal data in the EU General Data Protection Regulation in force since May 2018.[21]

## Non-Regulation

AI's development and its use have already created new businesses and new services thereby transforming existing ones. As some job tasks are taken over by algorithms, organisations can operate more effectively. By evaluating an abundance of data created by the internet of things, among others, AI is also certain to create new knowledge. Arguments against regulation stress that it is too soon to set down sector-wide regulations for such a nascent field. Regulating AI might hinder further developments and inbuilt security certainly comes at a cost. However, many industry voices from Accenture to Elon Musk are asking for oversight and/or regulation.[22]

# ☑ POLICY RECOMMENDATIONS

To balance the government's important but one-sided 'AI Sector Deal', that is only pushing the development of AI from a business perspective, the following policies are recommended:

1. **The exploration of the usage of AI applications within public services:** The application of AI in public services should be supported. This should not mean that knowledge, which has been part of a public institution and/or its responsibility, should become privatised.

2. **The restriction to use explainable AI for public services and in sensitive sectors:** Core public and private stakeholders operating in sensitive sectors such as healthcare, education, welfare, criminal justice and others should be required to use explainable AI instead of black box systems.

3. **The creation of high-quality public databases:** Public data created in the NHS, by National Rail, or by the London Underground is a rich source of data for AI. This data should be gathered and cleaned to allow and attract AI developments in public areas. The data should

thereby legally remain in the public domain for which Data Trusts run by private businesses are not an adequate solution.

4. **The development of democratic AI:** To ensure a non-biased and democratic AI, standard tests for data training sets used in AI should be developed.

5. **The support of anonymity/consent:** To ensure the availability of data to train AI while safeguarding the anonymity of citizens, guidelines for consent and the depersonalisation of data should be developed; this includes further research investments into the anonymisation of data.

6. **The institution of algorithmic liability:** Existing laws should be revisited to ensure that liability rules regarding the failure of AI are in place for citizens and businesses/organisations alike. This supports AI development as much as its acceptance.

7. **The spreading of public knowledge about AI:** Citizens need to be informed about the potential and the pitfalls of data and automated decision-making. For this, the government can rely on BBC services' obligation to inform and educate. It should also invest in a campaign to reach out to the general public.

# 📄 NOTES

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# ARTIFICIAL INTELLIGENCE AND THE INTERNET OF THINGS

## UK Policy Opportunties and Challenges

Through algorithms and artificial intelligence (AI), objects and digital services now demonstrate new skills they did not have before, right up to replacing human activity through pre-programming or by making their own decisions. As part of the internet of things, AI applications are already widely used today, for example in language processing, image recognition and the tracking and processing of data.

This policy brief illustrates the potential negative and positive impacts of AI and reviews related policy strategies adopted by the UK, US, EU, as well as Canada and China. Based on an ethical approach that considers the role of AI from a democratic perspective and considering the public interest, the authors make policy recommendations that help to strengthen the positive impact of AI and to mitigate its negative consequences.

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