10 July 2017 – 5:30pm GMT
House of Commons, Committee Room 9

BIG INNOVATION CENTRE

Markets and AI-Enabled Business Models

A theme report based on the 4th meeting of the **All-Party Parliamentary Group on Artificial Intelligence [APPG AI].**

Markets and AI-Enabled Business Models is a theme report based on the fourth meeting of the **All-Party Parliamentary Group on Artificial Intelligence (APPG AI) -** held on 10 July 2017 at the House of Commons.

This meeting was chaired by Stephen Metcalfe MP.

The evidence presented in the report is not exhaustive but reflects what was discussed at the meeting, and the views and experiences put forward by the people giving evidence. Written submissions by individual expert advisors in relation to this meeting are also included.

The APPG AI was established in January 2017 and its officers include:

- **Stephen Metcalfe MP**- Co-Chair
- **Lord Tim Clement-Jones-** Co-Chair
- Chris Green MP- Secretary
- The Rt Rev Dr Steven Croft-Bishop of Oxford- Treasurer
- Baroness Susan Kramer- Vice Chair
- Lord Robin Janvrin- Vice Chair
- Lord Alec Broers- Vice Chair
- Mark Hendrick MP- Vice Chair
- Carol Monaghan MP- Vice Chair

Markets and AI-Enabled Business Models

A theme report based on the fourth **All-Party Parliamentary Group on Artificial Intelligence [APPG AI]** Evidence Giving meeting**.**

10 July 2017 – House of Commons, Committee Room 9

All Party Parliamentary Group on Artificial Intelligence

Overview

> **The aim of the fourth APPG AI Evidence Giving meeting centred on understanding AI's impact on markets and business models.**

The meeting was chaired by Stephen Metcalfe MP (former Chair of the House of Commons Science and Technology Select Committee). Six experts were invited to provide evidence reflecting their **views on changing markets and AI-enabled business models.**

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105 TOTAL PARTICIPANTS

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6 Pieces of Oral Evidence

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7 Pieces of Written Evidence

The panel included: **Mike Lynch** (Founder of Invoke Capital), **Martin de Heaver** (Director at Orbit), **Husayn Kassai** (Co-Founder and CEO at Onfido), **David Kelnar** (Investment Director and Head of Research at MMC Ventures), **Abhijit Akerkar** (Head of Delivery – Bank of the Future Pilot at Lloyd Banking group), and **Michael Aikenhead** (Head of Strategic Artificial Intelligence Advisory at Cognitive Finance Group).

All six members of the Panel discussed how **AI is transforming value creation, introducing completely new forms of value generation and, also, restructuring existing models.**

Five key trends were extracted from the meeting:

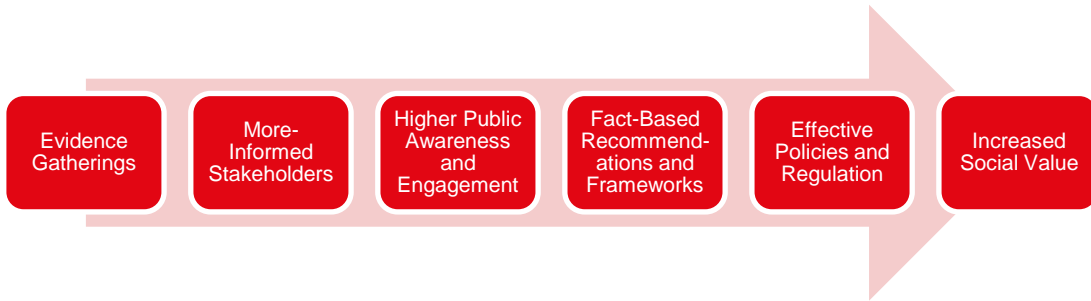| Theme	Description
1. AI is creating new products and services.	The opportunities to adapt AI quickly and create new products or services means high potential for new market entries, new leaders, and an overall reconstructing of current industry landscapes. Companies that will benefit most are those that manage to take advantage of the interplay of technologies.
2. AI is increasing efficiency.	AI is transforming how products and services are generated, delivered and used or consumed. AI has the power to replicate labour at a much greater scale and speed, with the same or better quality. As it can totally disrupt business processes it is not merely about replicating human tasks but about creating radically new organisation of production. Cost and time are reduced while quality and variety are all enhanced.

3. AI is forming new business models.	Companies are changing their business models to reap the full benefits of the Fourth Industrial Revolution with AI. Two common systems are the vertical model and the horizontal model. (A vertical model has a defined and specific target market while horizontal models are broader and seek opportunities to market to a general audience.). With AI there is also the formation of a third model made up of a horizontal system with vertical openings.
4. AI is providing broader access to more personalised products and services.	The products and services enabled by AI-technologies all share two key characteristics: • They are accessible to a broader group of individuals, spanning previous geographic and social borders. • They can be tailored to the personalised needs and/or preferences of each customer (also called mass customisation).
5. AI is redefining success.	Changing the factors of competitive advantage and the criteria investors looks for. Data access, platform control, and AI capabilities become more important in the competitive spheres than the products and services themselves.

This theme report is not research-oriented but aims to summarize these key themes, using the evidence gathered at the fourth APPG AI evidence meeting (details above). It is not exhaustive but reflects what was discussed at the meeting, as well as the views and experiences put forward by the people giving evidence. Written excerpts by individual expert advisors in relation to the meeting are also included.

The All-Party Parliamentary Group on Artificial Intelligence [APPG AI] was created in January 2017 to explore the impact and implications of Artificial Intelligence, including Machine Learning. We aim to**: 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.** Government, business leaders, academic thought leaders and AI entrepreneurs have come together in an effort to share evidence and beliefs, and assist in setting an agenda for how the UK should address AI moving forward.

Figure 1 illustrates the process of how APPG AI aims to contribute to increasing social value, through fact-based recommendations and well-informed stakeholders.

Figure 1. The Purpose of APPG AI

Evidence Gatherings	More-Informed Stakeholders	Higher Public Awareness and Engagement	Fact-Based Recommend-ations and Frameworks	Effective Policies and Regulation	Increased Social Value

The first APPG AI Evidence Giving meeting approached Artificial Intelligence through a general lens, identifying the key issues within the umbrella term that stakeholders should focus on. The second and third APPG AI Evidence Giving meeting deep dived into ethical and legal issues in AI, regarding decision-making and the data-driven economy.

Event Summary

Co-Chair Stephen Metcalfe MP welcomed the group of 105 attendees (made up of 6 Parliamentarians and 99 experts from government departments, academia, and business) to the 4th APPG AI Evidence Meeting. He asked the panel and other key stakeholders to present their views on how AI has transformed and will transform the economy, precisely in regards to changing market structures and business models.

Before the evidence giving, **Birgitte Andersen**, CEO and Co-Founder of Big Innovation Centre (BIC), took a moment to introduce the Future of Trade Think-Piece – which was also provided to each audience member in hard copy. The think-piece was created by the Big Innovation Centre for Innovate UK to highlight the move from e-commerce to AI-commerce and, overall, the shift in value generation.

Mike Lynch, tech pioneer who has been working with technology since 1990, and is now the creator of investment fund Invoke Capital, was first to speak. Given his experience in the space - supporting several large AI companies such as Luminance, DarkTrace, and Neurence – he shared that there is a lot of activity/interest in investing in AI companies in the UK. However, Lynch noted that 90% of companies do not possess 'real' AI capability, 5% have basic AI capability, and 5% have 'real' or advanced capability. This lack of capacity is a challenge that must be addressed. He ended his remarks acknowledging the considerable effects AI will have across markets as well as in traditional business. Currently, he argued there is relatively low competition, which means the companies using/applying strategic data first will benefit most due to a high first mover advantage.

Second to present his views was **Martin de Heaver**, Director of Orbit – an observatory for Responsible Research and Innovation (RRI). Martin noted that a distinct characteristic of the 4th Industrial Revolution is its remarkable speed. For decision-makers to address this issue of speed, they should put pivotal focus on the early stages of research (when an AI application is just an idea). He called stakeholders to apply the AREA (Anticipate, Reflect, Engage, Act) framework. He argued that the RRI model can provide a macro-analysis lens to understand the interdependence of developing technologies and, also, can help ensure social purpose behind new emerging technologies. In other words, the model can help assure transformations consider potential social impact from the very beginning.

The third speaker was **Husayn Kassai**, the co-founder and CEO of Onfido – a company that uses Machine Learning to help businesses digitally verify people's identities. Husayn argued that AI has changed markets across industries and, ultimately, helped businesses reduce costs. Onfido, for instance, has helped the finance sector because it makes financial services accessible to all while at the same time maintaining the security of the transaction. He pushed for government to take action regarding two policy areas: (1) the disruption automation will make in the job market and (2) the need to provide financial and non-financial support for start-ups to compete.

David Kelnar, Investment Director and Head of Research at MMC Ventures, took the floor and discussed two projects MMC is working on to understand the AI landscape in the UK better. First, after analysing 300 software start-ups in the UK, they have identified four main trends: (1) AI activity has increased sharply in the recent years. For example, 60% of all start-ups in the analysis were founded in the past 36 months; (2) AI start-ups tend to have

a B2B focus; (3) the entrepreneur focus is highly uneven; and (4) UK sectors are at an early stage compared to the US. The second project refers to an investment framework MMC has built with 17 key factors for start-up success in the sphere. Some of the factors identified include power of data network effect, distance from monoliths, proprietary algorithms, and ability to obtain and retain talent.

Abhijit Akerkar was the fifth speaker, who focused his provocation on five key trends unravelling. First, the big 'Tech Giants' have made huge investments in order to get AI ready for business. In 2016 alone, more than $20 to $30 billion was invested in AI. Second, easy access to AI has provided instant ignition to innovation. Third, adaption of AI is uneven across sectors. Digital leaders are on the frontier of the AI bandwagon. High tech/telecom, automotive, and financial services are considered high in AI adoption. Retail, media, and CPG are medium in AI adoption. Education, health care, and travel are low in AI adoption. Fourth, AI will disrupt business models, specifically through radical personalization, incisive predictability, and efficient production. Fifth, the UK market is the reservoir of potential waiting to be unleashed. According to PwC, UK GDP could be up to 10.3% higher in 2030 – the equivalent of an additional £232 billion.

Lastly, the Head of Advisory at Cognitive Finance Group, **Michael Aikenhead**, provided his oral evidence on AI's impact in the financial sector. 'We are currently in the 2nd wave of AI', he said, 'in which we are seeing a lot of transformation in business models across industries'. He noted that innovation is so fast-paced that we cannot possibly predict what the landscape will look like in the next five years. We can speculate, however. Some pressures we see rising involve radical personalization, growing activity by MNCs (Apple entered the financial industry through products such as ApplePay), and open banking or digital banks being created. Banks across the world are responding to these pressures at different speeds, and US banks tend to be the most advanced thus far. He called for the UK to focus on building the right skills in society to successfully compete in this dynamic environment.

Table of Contents

1. AI is creating new products and services

Markets and business models across industries, sectors, and geographical boundaries are transforming dramatically because of Artificial Intelligence (AI). Recent reports have repetitively highlighted AI's potential to overcome the physical limitations of capital and labour, and, consequently, open-up completely new sources of value and growth. Accenture estimates that **AI could add an addition £630 billion to the UK economy by 2035**, increasing the annual growth rate of GVA from 2.5% to 3.8%.[1] 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 equivalent of £232 billion.[2] Policy makers, industry leaders, and academic experts are thus working together to (1) prepare for the changes AI will bring and (2) ensure that the UK reaps the full benefits.

As part of this mission, the APPG AI focused the fourth Evidence Giving meeting on further understanding the specific ways AI has transformed the economy and will continue to transform it moving forward. The session had two main objectives. First, the group aimed to get a better grasp of recent trends in the AI Revolution, unpacking industry patterns and tendencies on a wider scale. Second, it aimed to pinpoint specific policy implications and brainstorm recommendations for the UK government to adapt to ensure its economy will seize the opportunities.

The first trend vocalized by the panellists was the emergence of a large number of new products and services powered by AI-enabled technology.

Figure 2. New Products and Services Produced by AI
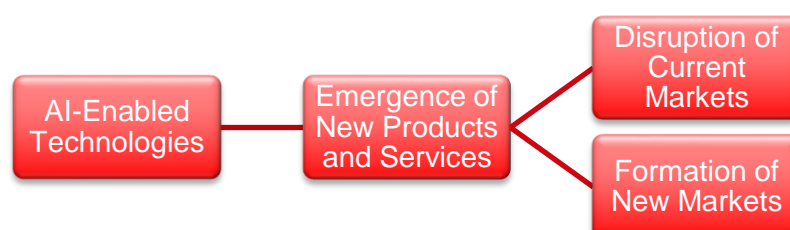
One of the most cited AI-enabled new products is the autonomous vehicle. Until recently, driverless cars were only envisioned in science-fiction movies; however, companies such as Tesla, Google, Volvo, and BMW are now making them reality in streets around the globe. In California, it is expected that manufacturers will start testing the vehicles in June 2018.[3] This year, in August, Germany developed a set of ethical guidelines for self-driving cars which, amongst other things, prioritises the value and equality of human life.[4] Products such as these will completely transform the transport industry, pushing traditional car manufacturers to

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[1] Purdy, M., Daughtery, P., (2016), 'Why Artificial Intelligence is the Future of Growth,' Accenture.
[2] Cameron, E., Andres, J., Gillham, J., (2017), 'The Economic Impact of Artificial Intelligence on the UK Economy, PwC.
[3] Mitchell, D., (2017), 'Totally driverless cars could be allowed on California roads by June 2018,' Los Angeles Times.
[4] Gershgorn, D., (2017), 'Germany has developed a set of ethical guidelines for self-driving cars,' World Economic Forum.

rethink the nature of their products, causing policy makers to adapt regulations accordingly, and changing how normal citizens live their daily lives.

There are many more examples of AI-enabled technologies impacting industries and sectors worldwide. For instance, chatbots have revolutionized the customer service sector, robot-assisted surgery has transformed healthcare, and algorithmic trading has amended finance. Given the exponential growth of technological advance, we can expect that these disruptions continue to increase moving forward.

As Abhijit Akerkar, Head of Delivery for the Bank of the Future Pilot at Lloyds Banking Group, noted, not all industries are adapting AI at the same speed however. Highest AI adoption is seen in telecommunications, automotive/assembly, and financial services. Medium AI adoption is characteristic of the retail, media/entertainment, and consumer packaged goods industries. While low AI adoption is seen in education and travel/tourism.

Abhijit identified three factors that will affect growth across sectors:

- **Technical**: access to structured data; employees with technical skills
- **Commercia**l: higher benefit for complex businesses whose performance is driven by forecasting, fast and accurate decision making, and personalised customer interactions
- **Regulatory**: product liability (especially for automakers), privacy considerations restrict access to data, ethical issues (e.g. algorithmic transparency and job security concerns)

The opportunities to adapt AI quickly and create new products or services means high potential for new market entries, new leaders, and an overall reconstructing of current industry landscapes. Ultimately, the digital leaders in each industry will be the ones that unleash most value in the future.

Mike Lynch, often regarded as Britain's most successful technology entrepreneur and investor, was first to provide evidence. He highlighted the different ways AI adds value to a company, an industry, and the ecosystem as a whole. Furthermore, he shed light on the importance of being the first to offer a new product to a market.

Mike Lynch
Founder of Invoke Capital

The adoption of AI will have a profound impact on markets and business models, both new and traditional.

There is a **first mover advantage**: early pioneers will receive more data, thus the more their systems will learn, in turn cementing their position in the market. For example, the more people talk to Siri, the more it will learn and the more capable it becomes.

Strategic data: We must think strategically about where we have large and deep data sets that allow AI to learn. For , the NHS owns one of the most powerful data sets – we must avoid allowing medical AI companies access to this data but then the NHS gets charged excessively for the resulting systems.

We are already seeing the rapid adoption and success of AI in cyber security and the legal markets, both areas where humans alone are incapable of keeping up with the vast and complex data flows. **Billions of dollars of value are already being created in the UK**.

We must be wary that AI is becoming a buzzword - much ostensible AI software is really snake oil, often little more than simplistic automation that isn't robust enough to handle complex real-world situations. Many investors cannot separate out the real from the fake, and so there is much scope for disappointment as well as success.

Key enablers of AI will be training and retaining a talent pool of those skilled in AI. Changes to the insurance market will be also be critical – for example, how will we insure driverless cars and so on.

Finally regulation, for example financial markets, will need to change too – as AI is increasingly used in algorithmic trading, regulation of the machines by the machines seems the only way keep pace with the speed and complexity of transactions.

Other issues include expandability of conclusions.

The panel agreed that there will soon be new markets that the world has not seen so far. Opportunity lies in companies that manage to take advantage of the interplay of technologies.

2. AI is increasing efficiency

More than just creating new products and services, AI is also helping make existing products, services, and tasks much more efficient.

Husayn Kassai, the Co-Founder and CEO of a Machine Learning (ML) software company, spoke to the APPG AI community about how his business has changed the finance industry. Onfido helps businesses digitally verify people's identities by validating a user's identity document and comparing it with their facial biometrics. The identity can then be cross-referenced against international credit and watch list databases.

Traditionally, the finance industry has always suffered from a trade-off between access and security but through the use of machine-learning, Onfido has been able to shrink this gap. Meanwhile, it has helped its clients reduce costs and increase profits.
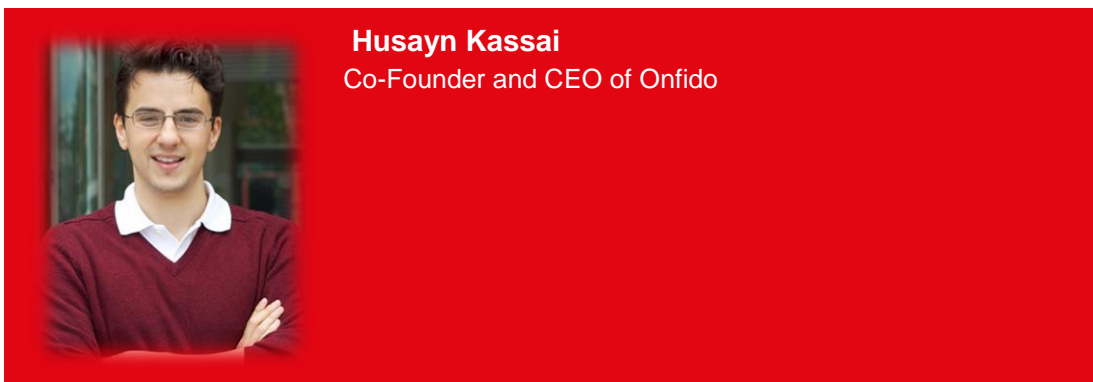
Husayn Kassai
Co-Founder and CEO of Onfido

Onfido builds trust in an online world by helping businesses digitally verify people's identities. Using Machine Learning technology (a subset of AI), Onfido validates a user's identity document and compares it with their facial identifiers. An innovator in the Computer Vision space, Onfido's Machine Learning technology learns to identity fraud as it evolves over time, enabling clients to rapidly onboard more users while protecting themselves against fraudulent activity.

Impact on society

One significant benefit being driven by the implementation of AI is the banking of the 2.5bn unbanked people worldwide.

Historically, there has existed a trade-off between access and security. On the one hand, 2.5 billion people in the world are under or unbanked and therefore cannot access financial services. On the other, identity fraudsters are using financial services to launder money used in human trafficking, drug trafficking, terrorist financing etc. This amounts to around 2-5% of world GDP, approximately equal to $2 trillion.

By using Machine Learning, Onfido is one of the companies beginning to bridge the gap and reduce the access-security trade-off. Onfido is able to reduce risk such that FinTechs and banks are able to bring thin or no- credit file individuals onto their platforms. This grants access to the under- and unbanked online, whilst at the same time, minimises the chances of identity fraudsters laundering money. This has helped online banks provide debit accounts to any of the 4 million unbanked in the UK.

There are also those that stand to be negatively impacted by the development of AI however, and the potential for job losses is a particular concern. In the case of Onfido's technology, Machine Learning is not intended to replace so much as augment human compliance roles. By automating up to 95% of typical Identity Verification cases, expert human resources are able to give more focus to the remaining 5% that require human intervention.

Industry

Financial services is one area that is already seeing considerable benefit from the use of AI.

Incorporating AI into financial services can lead to reduced fraud, lower operational costs and the automation of compliance processes. This can range from AI-enabled data collection, to analysis and risk-modelling that helps businesses take advantage of that data.

At Onfido, we use prediction and automation techniques to help automatically classify, extract data from and verify identity documents that are provided to us as part of KYC and AML checks.

There is still considerable resistance to the implementation of AI in some areas of financial services, however. While AI solutions are already being used by more agile online banks, it's seeing slow adoption from more risk-averse, highly regulated, traditional financial institutions.

With competitive pressure increasing, financial services are starting to actively seek out solutions to their pain points – but without the infrastructure in place at a high level to support this, it is difficult for incumbent financial services to embrace innovation without exposing themselves to risk. Initiatives like industry sandboxes (of which Onfido is a part) can be really helpful in encouraging collaborative innovation in a safe space and will hopefully see further uptake and development of AI solutions.

Government

The Government could have the greatest impact on AI innovation in the short term by opening up access to EU and global talent pools. Unfortunately, the UK does not have enough home grown talent to drive the development of AI, and will struggle to keep up without greater access to overseas specialists. Longer term, more focus on science and technology education would ensure that the necessary skills are being developed to build the workforce of the future.

The development of AI, particularly Machine Learning, commonly requires the use of a significant amount of data, including regulated personal data. We encourage the Government to address the tension between data protection, and the development and use of AI in the forthcoming Data Protection Bill[5]. We would like the Government to make clear that processing personal data for the purpose of training data sets is in the legitimate interest of the controller, and does not amount to profiling that might produce legal effects or significantly affect the individual.

Identity verification has been a task that has existed for centuries, but AI has been able to make it easier, cheaper, and faster. Other examples of how AI has transformed task completion can be found in legal document processing, mortgage profiling, recruiting new employees, organizing emails, and many more.

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[5] The Data Protection Bill is being currently discussed in the UK Parliament. For further details and updates, visit https://services.parliament.uk/bills/2017-19/dataprotection.html

In all these examples, **AI has the power to replicate labour at a much greater scale and speed, with the same or better quality**. Or, in other words, AI-enabled technology allows companies to offer products and services that are cost-friendly, time-saving, and high-quality. The reduced cost has opportunity to reduce price significantly, democratising access to previously costly, bespoke or more personal services. Basically, AI can increase variety of products and services via mass customisation where everyone gets bespoke treatment – '*à la carte*,' while reducing price and increasing quality.

Figure 3. AI increasing efficiency
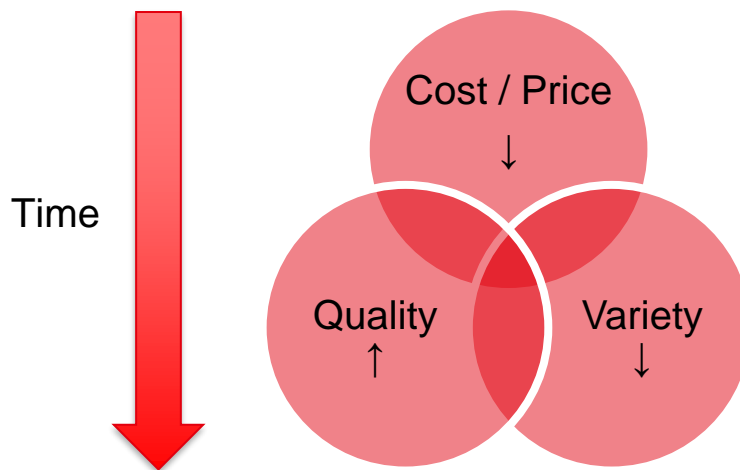
This transformation accelerates the overall cycle of innovation and has dramatically changed the current notion of time.

Taking the first example of legal document processing, one can see how AI can do the same job of reviewing legal documents in much less of the time. JPMorgan's learning machine software can interpret commercial-loan agreements in seconds, while it previously took 360,000 hours of lawyers' time annually.[6]

Cases like this show how the same outcome can be completed in only a margin of the time and, consequently, lead to completely different customer expectations and production cycles. Customers expect to receive the same quality of a product or service in a much quicker timespan. Therefore**, providers have started engaging in end-to-end processes to make sure their products and services are delivered to their target audience in the quickest time possible**.

Birgitte Andersen, CEO and Co-founder of the Big Innovation Centre (BIC), announced to the APPG AI the launching of a new report: The Future of Trade.[7] The think piece was prepared by BIC for Innovate UK, to explore how automation and AI are disrupting the marketplace. Mirroring what was discussed in the fourth Evidence Giving meeting, the piece identified some of the key drivers of trade in a world of AI and other emerging technologies. The drivers identified included: increasingly automated processes, less time-consuming product cycles,

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[6] Son, H., (2017), 'JPMorgan software does in seconds what took lawyers 360,000 hours,' Independent.
[7] Andersen, B., Farrel, S., Iliadis, N., Ponce, M., (2017), 'The Future of Trade: Who, what, where & how' automation and Artificial Intelligence are disrupting the marketplace,' Big Innovation Centre. Accessed: http://www.appg-ai.org/evidence/think-piece/think-piece-future-trade-ai/

smarter capabilities, cost reductions, and customer-centric products and services.

Figure 4. AI drivers of trade
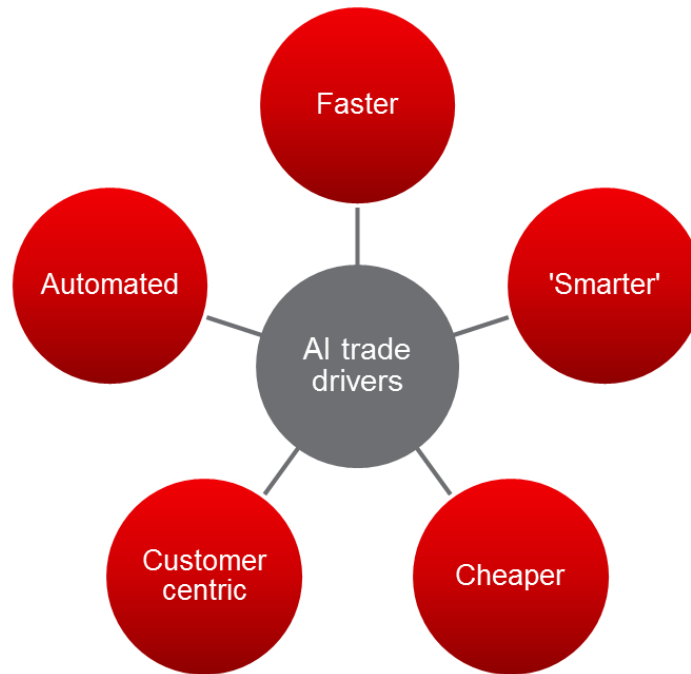
These drivers are transforming market landscapes across industries and regions. Together, they are bringing the rise of the Fourth Industrial Revolution.

3. AI is forming new business models

Current business models are also being affected by AI. Most companies, trying to reap the benefits of the Fourth Industrial Revolution, are adapting innovative visions to embrace AI and implementing the necessary changes within their organisation models and processes.

The APPG AI panel discussed the differences between horizontal and vertical models, shedding light on both the advantages and disadvantages of each in terms of AI. A vertical model has a defined and specific target market while horizontal models are broader and seek opportunities to market to a general audience.

Mike Lynch argued that **AI is a still a specialist art and that vertical models are easier to build business cases around**. David Kelnar, Investment Director and Head of Research, agreed with Mike, and suggested it was important for start-ups to distinguish between vertical and horizontal models. A company should have a clear vision with a clearly defined model that will make them distinct from competitors.

Abhijit Akerkar spoke about **a new trend that is rising, in which companies are organizing in a horizontal way with vertical openings**. He said this business model allows companies to reap the advantages of both structures.

Michael Aikenhead, Head of Strategic AI Advisory at Cognitive Finance Group, summed up the transformation in one simple sentence: **'Business models for the upcoming years will be to take business model X and add AI.'**
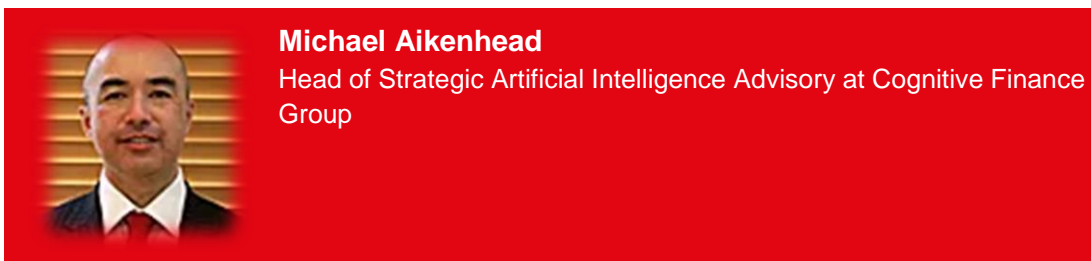
Michael Aikenhead
Head of Strategic Artificial Intelligence Advisory at Cognitive Finance Group

Cognitive Finance Group

- CFG is a consultancy specialised in applied Artificial Intelligence in financial services.
- We are the trusted adviser to Boards and senior management on scoping, selecting and implementing Artificial Intelligence for business growth and increasing competitive advantage.
- We have a dedicated team of strategists in Financial Services as well as data scientists and Machine Learning experts.

Business model impacts are 'easy'

- Within a few years everything will have intelligence embedded in it to some degree
- Business plans of the next 10,000 start-ups are easy to forecast: Take X and add AI!

Detailed prediction is more difficult!

- Not one impact on all business models
- Business models will be affected differently in different industries and for different types of tasks / work
- Need to look at concrete problems

Consensus that there will be widespread changes in work and in the workforce

- Disruption to jobs from AI
  - Disagreement how much (47% of total US employment is vulnerable to automation: Frey and Osborne 2013 and then Bowles 2014 in a European context) (9% in OECD countries: Arntz, Gregory and Zierahn 2016).
  - Difference is in looking at occupation or task level (Chui, Manyika and Miremadi 2015: estimate that 45% of work activities could be automated using already demonstrated technology).
- Similar uncertainty on employment replacement or displacement (Petropolous 2017)
- It is easier to see fields in which automation might do away with the need for human labour than where technology might create new jobs – it has always been like that.
- Potential for AI to not only automate and make efficient what is done now, but to generate new ways of doing things.
- Clear that there will be change and potentially large-scale change.

Pressures on established Financial Services business models

- Potential for large scale change means existing organisations cannot afford to ignore AI
- Established companies need to take on AI
  - because they have to keep up with existing competitors
  - new digital entrants are emerging
  - consumer expectations are changing
- Several trends putting pressure on existing business models
  - disaggregation of services
  - AIBanking As A Service
  - Regulatory: Revised Payments Services Directive (PSD2) drives data sharing
  - Consumer expectations for on-demand, multi-channel and Mass Personalisation
    - Creation of expectation and ability to deliver expectation creates requirement to deliver against expectation
- Have already seen big changes in financial services business models from fintech and AI
  - Large US bank gone from 600 traders (cash equity) in one area of the business to 2, supported by 200 computer engineers,
  - Bank has already begun to automate currency trading, and has found consistently that four traders can be replaced by one computer engineer,
  - Automated trading systems now account for half the volume in many commodity futures (CFTC analysis 2017).
- New entrants in to markets
  - Big tech companies making incremental moves
    - Amazon cash (method to add cash funds to Amazon account, avoiding bank cards)
    - Amazon Pay (method for customers to use their Amazon balance at non-Amazon retailers)
    - Google wallet (method for customers to send funds via the wallet service)
    - Apple pay (method for customers to send funds via the wallet service)
    - Facebook Payments International (entity for Facebook to apply for licences to be a payments provider)

- Ant Financial / Alipay:
  - 450 million users v Apple's 50 million Apple Pay users.
  - signed deal with BBVA
- Smaller players emerging and surviving because of AI – Digital Challengers
  - potential for new companies opened by availability of AI (e.g. Atom Bank, Fidor Bank, N26)
- Aggregating a range of behavioural and financial information providers will be in a unique position with their vast user bases and ability to utilize user data, as well as account information for e.g. assessment of risk and creditworthiness.
- Why bother to log into your bank app when everything is already available from other providers?
- Existing FS organisations moving at very different speeds.
- Remains to be seen what will happen from all this activity.

Observations in Financial Services

- Lots of activity just focused on keeping the lights on.
- All organisations need strategy at a senior level addressing how they are going to deal with business model pressures.
- We are seeing
  - Lack of senior awareness of potential AI transformations
  - Skills gaps
  - Skills shortages
  - Availability of accessible clean data as a difficulty
- Until there is a General AI we see financial services organisations transforming but not fully automating like some industries.

Governmental responses

- Decision makers should recognize that AI isn't a matter of any single technology or application and there is constant evolution of AI and related technologies, consultation is excellent, but
  - Limited ability to predict effects - Ongoing consultation is need.
  - What horizon is being looked at? What happens in 5 years will be different to what happens in 10 years, to what happens in 25 years.
- Making rules too early without a clear view and knowledge of how technology will be implemented and its impacts would be counterproductive.
- What can we say about business models – AI will form part of them and that understanding, awareness and monitoring is needed to take advantage.
- The industry needs access to the skilled staff necessary to thrive
  - Some large tech companies (e.g. SalesForce: Marc Benioff) discuss ability and responsibility of Cos to turn themselves into universities so that they can educate in-company as people get displaced.
  - Senior staff have to have a data and 'intelligence augmentation' mindset.
- It is an international marketplace (both for talent and for provision of services) so UK must be internationally focused.

Although predicting what the landscape will look like in five years might be impossible, the APPG AI group agreed that it was important to distinguish between speculation and impact.

David Kelnar also discussed how business models are transforming. He provided the example of the automotive and car insurance sector. Pointing out that car ownership will severely drop in the next years, he discussed how car manufacturers will likely adapt models to follow a pay-

as-you-go model in which transportation is treated as a service rather than a product. At the moment, he approximated that 87% of car insurance is personal and not commercial. Nevertheless, this is likely to change as manufacturers or service providers will end up being the actors buying insurance for a car moving forward.

Rachel Free, Counsel at CMS Cameron McKenna Nabarro Olswang, provided a second example, illustrating the complexity of transforming business models, especially when considering data and API ownership.

Rachel Free
Counsel (Patent Attorney) at CMS Cameron McKenna Nabarro Olswang LLP
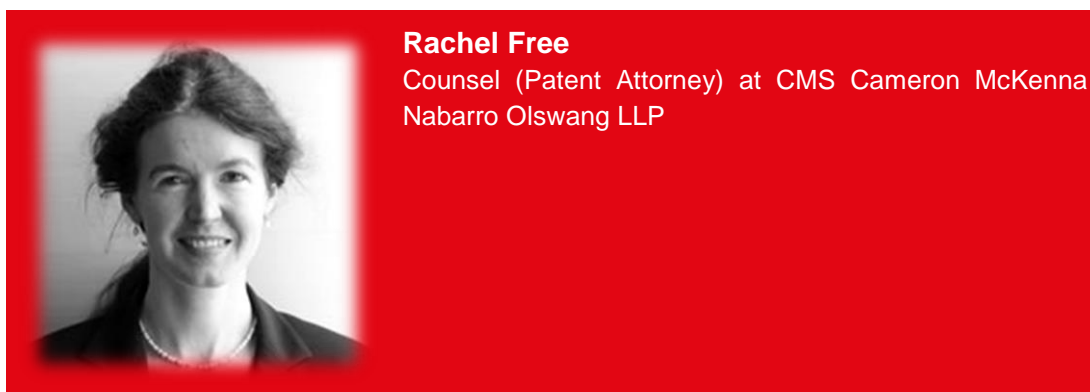
AI Business Model Example

I have an example about a business model where the product is a trained Machine Learning system.

Suppose I am a small UK start-up company. I have spent money, time and effort to create my new product which is a Machine Learning system for predicting flight arrival times. To do this I have collected flight data, by going to airports and manually recording flight arrival and departure data. I have cleaned the data and used my skills in selecting a particular type of model to use. Suppose the model is created using 'off the shelf' software that is already known to the public. I have trained the model and adjusted its parameters to obtain accurate predictions.

I start to sell my new product. Using my preferred business model I sell a service. Customers pay me on a 'pay per query' basis to use my model as a cloud service. To do this I make an application programming interface (API) to my model available to the public. The customers can create their own products which use the API. For example, a customer might have a taxi business, or a travel insurance business which uses the flight predictions.

My business becomes successful until a competitor steals my Machine Learning model using a model extraction attack. The competitor does this by exploiting the prediction API of my cloud service. This is possible as set out in research papers such as Tramer at al. 'stealing Machine Learning models via prediction APIs.'[8]

The competitor goes still further and makes a model inversion attack to obtain some of the flight data that I manually collected. The competitor already has the model parameters and the competitor uses confidence information output by the model to enable the model inversion attack. Fredrikson et al. 'Model inversion attacks that exploit confidence information and basic countermeasures.'[9]

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[8] Tramer, F., Zhang, F., Juels, A., Reiter, M., Ristenpart, M., (2016), 'Stealing Machine Learning Models via Prediction APIs.' Accessed: https://arxiv.org/pdf/1609.02943v2.pdf
[9] Fredrikson, M. et al, (2015) 'Use Privacy in Data-Driven Systems: Theory and Experiments with Machine Learnt Programs,' CCS 2015 https://www.cs.cmu.edu/~mfredrik/papers/fjr2015ccs.pdf

To avoid these attacks by my competitor in future I use a different business model which does not make the API available publicly. This restricts the business models available to me and reduces the ability for interoperability. In addition, the transparency of my Artificial Intelligence (AI) product is reduced because the public does not have the API and so has less understanding about how it works. In addition, the public is unable to check for any biases in the AI product because the public no longer has access to the API. In my view, it is important for AI to be transparent so that the public has an idea how it works and is able to check it doesn't have unintentional biases against particular groups of people.

It is harder for the customer with the travel insurance business to use my service. I can still give that customer an API on a one to one basis but I need to police its use and I need to keep use of the API restricted to that customer only. The 'red tape' involved increases.

If I decide to use copyright law to seek redress from the competitor, I need to obtain evidence of copying and I am faced with an expensive legal process.

The example is also applicable to other scenarios where the data is confidential such as medical data or DNA data.

4. AI is providing broader access to more personalised products and services

The products and services enabled by AI technologies all share two key characteristics:

- They are **accessible to a broader group of individuals**, spanning previous geographic and social borders.
- They are **tailored to the personalised needs and/or preferences of each customer**.

Citing McKinsey, Abhijit Akerkar informed the group that **Tech Giants invested $20 to $30 billion in Artificial Intelligence in 2016**. From this total, 90% of it was spent on R&D while 10% of it was spent on AI acquisitions. As a result of these investments, AI is now mainstream and ready for commercial use. These products and services have already penetrated a variety of markets and have dramatically changed the customer experience.

First, the technology itself and its cost-saving consequences make it that many products and services are now available to a larger portion of individuals. Barriers to access are falling and people worldwide are reaping the benefits.

One example that was discussed in the meeting is the supply and demand for primary care for the elderly. Recently, the supply side of primary care has severely decreased while the demand side is constantly increasing as the Baby Boomers generation ages. AI offers solutions to this market discrepancy through technologies such as robot companions, talking digital assistants, or strategically-placed sensors.

As AI has the potential to assist the elderly, it also has huge potential to help the poor. Healthcare and agriculture are two sectors in which AI is being used to improve the lives of the less-advantaged. More people now have broader access to better and less expensive healthcare through technologies like smartphone applications that help provide medical diagnoses. Hunger is addressed through drones that have the ability to pick previously inaccessible crops and to increase the yield of farmland under tillage in developing countries.

In relation to this, Husayn Kassai discussed how the finance industry is also making services accessible for a growing number of people worldwide, even in the less developed parts of the world. Banking until now was a service utilized mainly by citizens of high income and middle income. Through the use of digital and AI technology, individuals in developing countries can also start seeking its benefits.

Second, AI is largely built on open innovation platforms in which databases, APIs, and other forms of Intellectual Property are shared amongst stakeholders. As discussed in the third Evidence Giving meeting[10], AI feeds off the quantity and quality of data available. Therefore, it is vital for companies to have access to the big data in order to build effective algorithms. Many of the Tech Giants offer their tools and data online for free and, therefore, give access

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[10] http://www.appg-ai.org/evidence/evidence-meeting-3-ethics-legal-data-capitalism-overview/

to researchers and start-ups to also innovate.

Martin de Heaver, Director of Orbit, advised the group on the importance of open innovation, collaboration, and a 'responsible' research field - in which individuals develop products that have social purpose. He proposed the AREA framework for researchers to apply a macro-analysis perspective and understand the interdependence of emerging technologies.

Martin de Heaver
Director at Orbit
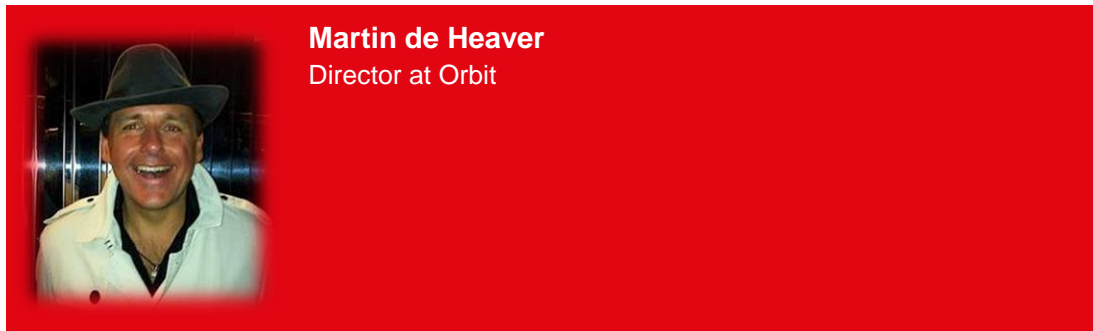
ORBIT is a new organisation funded by the Engineering and Physical Sciences Research Council and operated by De Montfort and Oxford Universities.

ORBIT aims to embed Responsible Research and Innovation practices into ICT research, and thus acts a resource for Society, Government and Industry to get a glimpse at the potential future of ICT technologies long before they reach commercial maturity.

This early view of what might be coming well over the horizon may give valuable additional time to innovate solutions to make the most of opportunities presented by ICT technologies, and to mitigate the risks to society of such fundamental and rapid innovation.

Responsible Innovation is a process that seeks to promote creativity and to identify opportunities for science and innovation that are socially desirable and undertaken in the public interest. The RRI process draws upon a framework known as AREA which helps ICT researchers to: Anticipate, Reflect, Engage and then ACT.

By undertaking this assessment across all publicly funded ICT research this opens the potential for a meta-analysis of the potential impact of the development of many complementary and potentially interdependent technologies at specific points in the future.

So as technologies evolve along their time lines, points can be identified where, for example a potentially transformational, yet theoretical automation application actually becomes viable due to the commercial availability of powerful enabling technologies such a practical neuromorphic or quantum computing. We have seen this with deep neural networks in recent years.

The ORBIT resources are available to both the Academic and Industrial Research Communities, and if you think that they could be valuable in your work please do get in touch via the www.orbit-rri.org web site.

Speed is a key component of the Fourth Industrial Revolution and, hence, the framework proposed by Martin aims to empower early-stage researchers to advocate their work and commercialize their products in a fast-paced environment.

Third, the panel agreed that personalisation is a key feature of today's products and services. **AI empowers companies to create products and services that are tailored to the**

needs and likings of each customer. Traditionally, organisations have used descriptive analytics and diagnostic analytics to understand what has happened and provide insight for why. Nonetheless, AI allows organisations to make well-informed predictive analysis, prescriptive analysis, and cognitive analysis. Through predictive analysis, they can gather foresight about what is likely to happen ahead, when, and why. Through prescriptive analysis, they can accelerate the decision-making with well-curated data. And, ultimately, through cognitive analysis, they can self-learn to understand human thought stimulation and actions. This process is what creates a personalised experience for the client.

Figure 4. The Road Towards Personalisation, from Descriptive Analysis to Cognitive Analysis
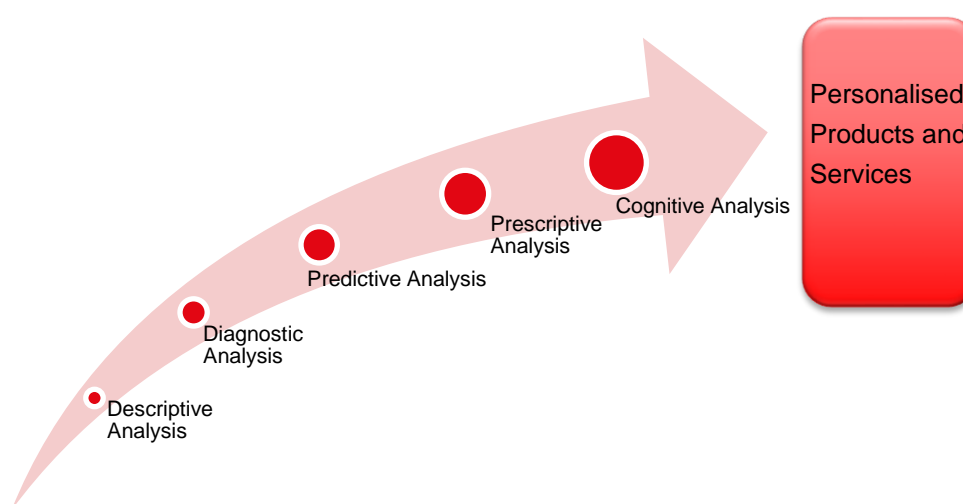
Advertisers, for centuries, have been working to identify a target audience and to deliver messages that speak directly to its lifestyle preferences. Machine Learning and other AI-tools give advertisers this power, enabling them to predict consumer behaviour and, thus, provide personalized recommendations.

Through the use of chatbots and other voice applications, customers can have a personal experience with an organisation in which their specific questions can be answered. These technologies have been integrated with existing platforms like the iPhone, Facebook Messenger, Slack, and WeChat. In consequence, this reduces the distance between a customer and a company because customers can interact via applications they are already accustomed to using in their daily routines.

Personalisation has been impacting every industry, including healthcare. Abhijit Akerkar informed the group of a study revealing that personalised medical treatments could save $2 trillion to $10 trillion of healthcare costs globally. Many health-related problems individuals face today - such as limited resources, long waiting times, short appointments, and lack of access to quality care – can be resolved by AI and personalised healthcare. The personalisation of medicine policy aims to challenge today's system by placing the individual citizen at the centre of healthcare decision-making.[11]

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[11] Scyfer, (2017), 'The Personalisation of Healthcare,' Scyfer. Accessed: http://scyfer.nl/2017/07/25/ai-in-healthcare/

Overall, personalisation and broader access are transforming market dynamics and customer-client relationships dramatically. The ability to produce and offer services cheaper, faster, better, and more customer-centric is revolutionizing the global economy.

5. AI is redefining success

Ultimately, these new trends linked to the emergence of AI technologies are redefining the factors for success. There has been a complete shift in mind set for what is needed to compete in today's market landscape.

Investors are assessing investment opportunities in very different ways. First, they are putting emphasis on the AI capabilities of a company and whether the AI is assisting them to innovate and drive up efficiency. Second, they are looking for companies with business models that are adaptive and flexible to the new supply and demand patterns in society. Third, they want to invest in companies that will have the competitive advantage to succeed in a future filled with AI technologies.

David Kelnar, speaking from the perspective of an investor, highlighted some key factors start-ups and scale-ups should adapt if they want to succeed. Grouping the factors in three main categories (value creation, value realisation, and defensibility), he highlighted the power of the data network effect, the distance from Tech Giants, the capability of proprietary algorithms, and the ability to obtain and retain talent.

Figure 5. Success Factors for applied Machine Learning companies (Source: MMC Ventures)
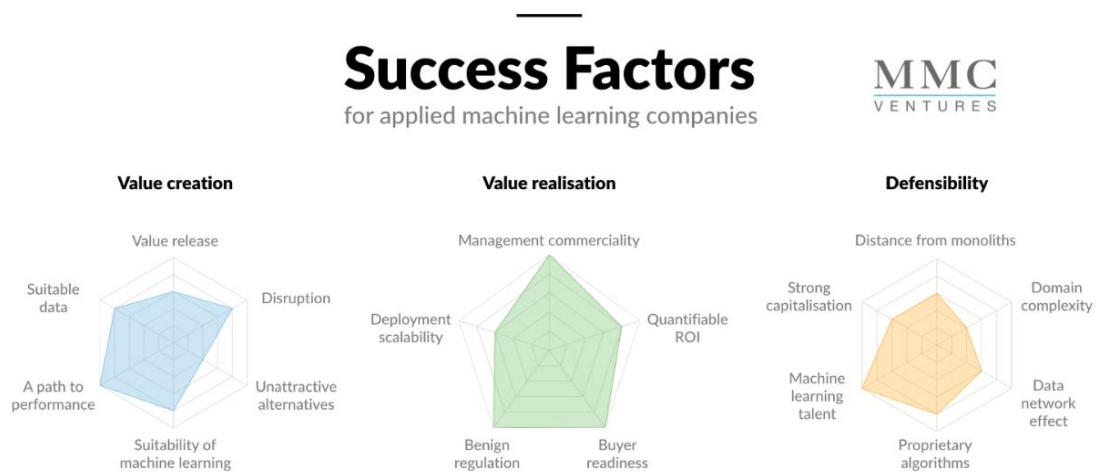
Discussing the vibrant and dynamic landscape in the UK, David Kelnar advised companies to consider these factors in order to compete in the increasingly changing arena. He also noted that **future generations will be shaped tremendously by these new trends and emerging technologies.**

David Kelnar
Investment Director and Head of Reserch at MMC Ventures
(excerpt taken from the MMC Venture AI Investment Framework[12])

To what extent does a Machine Learning (ML) company have the potential to create significant value? We consider six drivers of value creation. Three (value release, scope for disruption, and feasibility of alternatives) relate to business system impact. Three (suitability of ML, a path to better-than-human performance, and suitable data sets) are questions of technical feasibility.

I. Value release

How effectively, through predictive success or process automation, can a company unlock value in a business system by creating revenue, or cost savings, for customers? We assess a provider's ability to create revenue for customers by:

- increasing uplift in conversion, yield, throughput, price or similar direct drivers of revenue;
- reducing churn by improving customer experience—through greater personalisation, better customer service, lower customer friction or enhanced brand loyalty; or
- creating new revenue opportunities—by identifying new customers, increasing up-sell or cross-sell opportunities, or enabling new market opportunities.

We also consider a provider's potential to decrease costs for buyers by:

- reducing surplus spend, excess resourcing or core resource requirements through improved predictive efficiency, process efficiency or process automation; or
- reducing economic leakage through, for example, improved compliance.

II. Scope for disruption

Beyond its immediate impact, we consider whether an ML-led company has scope to disrupt (enable new categories of users to utilise a service) as well as optimise (streamline a process for existing users).

Consider AI-driven personal assistants. While AI assistants can undertake only a small range of tasks relative to their human counterparts, they can automate the scheduling of meetings for business users. With the salary of a human personal assistant averaging £25,000 per year, according to PayScale, personal assistants are unaffordable for many small and medium-sized businesses. AI assistants will make capabilities accessible to businesses of all sizes, creating value by expanding the addressable market.

Few businesses disrupt, and a business need not disrupt to be attractive. But businesses that disrupt may create outsized outcomes through scale.

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[12] Kelnar, D., (2017), 'The MMC Ventures AI Investment Framework: 17 success factors for the age of AI,' MMC Ventures.

III. Unattractive alternatives

Scope for value creation can be greater when the cost or availability of alternatives are prohibitive. In some attractive cases, there are no practical alternatives because Machine Learning makes possible the previously impossible. In most cases, alternatives can be found—with sufficient investment in human or other resources. Where alternatives to a company's solution are particularly costly, scarce, inaccessible or non-scalable, scope for value creation is especially significant.

Human labour is frequently the direct, and most expensive, alternative to digitisation. It's striking that three of the top four sectors on which most UK Machine Learning start-ups are focused—finance, IT and utilities—are those with the highest annual salaries. We see additional opportunities in Professional Services.

IV. Suitability of Machine Learning

To what extent is Machine Learning well suited to the business challenge at hand? ML is well suited to problems that are arduous, complex or inscrutable:
- arduous problems are those in which people are competent, and could codify a solution into a program, but it would be impractical to do so.
- for complex problems, people are competent but codifying that capability into a program is prohibitively difficult. Object recognition is a complex problem. People are very good at recognising pictures of cars, but we can't codify an effective set of rules to do so.
- inscrutable problems are those in which people do not have competence. In these fields, we cannot label or organise data to underpin a predictive engine. Deep learning approaches to ML, with utilise neural networks, excel at inscrutable problems because neural networks can determine the parameters to optimise.

Machine Learning is poorly suited to unbounded problems and questions of causal inference.
- ML algorithms cannot draw on knowledge beyond the data provided to them. Anastassia Fedyk has highlighted the difficulty vividly with an example from the 1990s, when researchers at the University of Pittsburg evaluated ML algorithms for predicting mortality rates from pneumonia. 'The algorithms recommended that hospitals send home pneumonia patients who were also asthma sufferers, estimating their risk of death from pneumonia to be lower. It turned out that the dataset that fed into the algorithms did not account for the fact that asthma sufferers had been immediately sent to intensive care, and had fared better only due to the additional attention.' For ML to be effective, problems need to be sufficiently self-contained.
- Second, ML is poorly suited to problems where causal inference is of primary interest. ML describes how elements of data relate to one another other, not the causal mechanisms of their relationship. ML is poorly suited to prediction problems when the future is not expected to be similar to the past, and where prior patterns are unlikely to reflect a new reality.

V. A path to performance

ML does not need to be 100% effective to be valuable. From a practical perspective, ML-led solutions need only offer near-human, or ideally better-than-human, levels of performance to enable automation and process scaling. When assessing the performance of ML-powered technologies, therefore, we look beyond the immediate term to assess whether there is a path to a level of performance—ideally better-than-human performance—to unlock value.

Human levels of performance can be lower than assumed. 94% of car accidents in the US are due to human error, according to data from the National Highway Traffic Safety Administration. Autonomous vehicles do not need to be 100% safe to be valuable; they need only offer a safety rate similar to, or better than, the 1.25 deaths per 100 million vehicle miles that human drivers in the US achieve. (In practice, of course, buyers' trust in a technology is a further condition for its adoption—and the bar for

acceptance will be higher in certain areas, including autonomous travel. We discuss this below).

VI: Suitable data

For ML to create value, it needs suitable data sets on which to be trained and deployed. We evaluate the extent to which a company can access suitable data. We gauge data suitability in the context of two stages of data manipulation required for ML:

- selection: data availability; the existence of gaps and duplication in data; quality of data labelling, existence of bias in data;
- processing: data fragmentation; data cleaning requirements; a need for data sampling; the need for data transformation, decomposition and aggregation.

We also gauge whether data sets will retain value. Data sets retain value if numerous new iterations of an algorithm can be tested, and improved, using historic data. This isn't always the case. If a chatbot company improves its algorithm, the prompt it offers a user will differ from the prompt it will have offered in the past. If the chatbot's prompt would differ, the response that follows from the user probably would too. With a vast set of user replies now decoupled, and potentially irrelevant, to the algorithm in question, the company's historic data is of limited use. We can contrast this with a fraud prevention company. An algorithm can usefully be tested against historic customer activity data sets to see if the accuracy of the algorithm is improved.

New commercial success factors are causing a demand for different competencies and skills. Many of the panellists discussed the **current lack of skills in the AI ecosystem**.
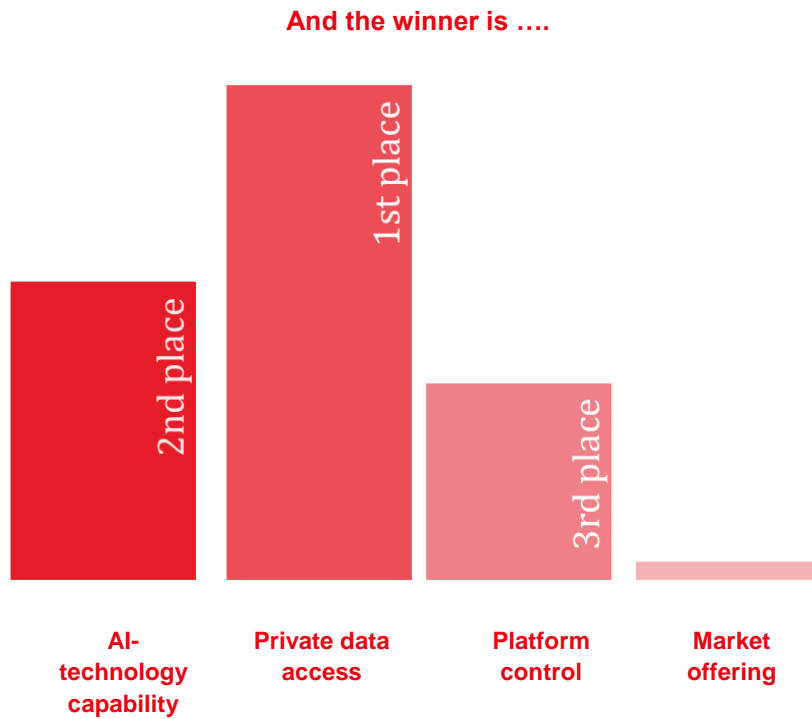
The UK needs to engage in a massive upskilling to make sure individuals themselves remain competitive and, also, companies can compete on a global arena. After the presentation of the panellists, the Q&A part of the session of the fourth Evidence Giving meeting focused on the disruption in the job market and the need for new skills. Many in the audience voiced their concern about what will happen once machines get smarter and companies choose to replace human labour with more cost-efficient technologies. The Parliamentarians agreed this was a top concern for the Government and asked for more evidence regarding the relationship between labour and technological advancement.

Educational restructuring is a potential solution to the issue, **allowing younger generations to get trained in the skills that will help them compete in the labour market**. Older generations must also be retrained through life-long education initiatives. Furthermore, companies need to be able to attract and retain the best talent across the globe.

The 'Future of Trade' Report created by the Big Innovation Centre also discusses the changes in competitive success factors.[13] Companies that will continue to excel will not be those that will have the best market offerings but those that have platform control, AI-technology capacity, and access to large datasets.

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[13] Andersen, B., Farrel, S., Iliadis, N., Ponce, M., (2017), 'The Future of Trade: Who, what, where & how' automation and Artificial Intelligence are disrupting the marketplace,' Big Innovation Centre. Accessed: http://www.appg-ai.org/evidence/think-piece/think-piece-future-trade-ai/

Figure 6. Competition factors in AI markets

And the winner is ….

| AI-technology capability | Private data access | Platform control | Market offering |

As data is the main source of the emergence of these AI technologies, it makes logical sense that companies who own data will be the ones with the most valuable ingredient to succeed. Therefore, the panel called for the UK government to act quickly in deciding how data is government, **setting clear standards for how data is collected, used, managed, and owned**.

In sum, the fourth APPG AI Evidence Giving meeting allowed key stakeholders from academia, industry, and government to understand the AI-influenced market trends currently unravelling. Abhijit Akerkar pinpointed five key patterns that will have the most impact for society.

Abhijit Akerkar
Head of Delivery (Bank of the Future Pilot) at Lloyds Banking Group

AI is ready for business. The ingredients for a breakthrough are in place. Powerful computer hardware, sophisticated algorithms, and training data sets are accessible on demand on the cloud. Digital giants have made staggering investments with almost $20-30 billion in 2016 alone.

This **easy access to AI. has provided instant ignition to innovation**. Over 550 AI start-ups have got $5 billion in funding in 2016. B2B companies, offering sector or function specific solutions, have the lion's share.

Industries on the digital frontier are leading the AI. curve. They include High Tech, Telecom, Financial Services, and Automotive. Growth will be robust but uneven across sectors. Technical readiness, the size of the prize, and ethical and regulatory issues will drive the adoption rate.

AI. underpins several disruptions. The big 3 are:

- **Radical personalisation:** Personalised medical treatments could save $2 trillion to $10 trillion of healthcare costs globally.
- **Incisive predictability:** National Grid could cut national energy usage by 10% through better predictions.
- **Efficient production:** Amazon reduced operational cost by 20% by using Kiva robots.

For now, corporates are reimagining their business models. **Disruption is emanating from the full stack start-ups.** They are building end-to-end solutions that bypass incumbents.

The **UK market has enormous potential and is waiting to be unleashed**. The AI could potentially add up to 10% to the GDP – an additional £232 billion - in 2030 (PwC estimate). The problem to solve is: **How do we ensure that the boundless benefits of AI. are developed by and available to all society?**

AI is reshaping the economy as a result of completely new products and services introduced into markets, increase in efficiency, shifts in business models, broader access and personalisation, and changing factors for success. The change is happening quickly and to ensure the transition period is smooth and society adjusts accordingly, policy makers must react strategically.

The participants of the fourth Evidence Giving meeting (including the APPG AI officers, the panel, and the wider audience), once having discussed the transformations in markets and business models, established a set of **action points** the group should focus on.

Theme	Action Points
1. AI is creating new products and services.	Monitor the technological advancement across industries and sectors and invest (publicly and privately) in research, science and innovations that develops the interplay of emerging technologies.
2. AI is increasing efficiency.	Lots of qualitative and anecdotic evidence on labour market transformations. Now it is time to invest in quantitative research unpacking how the labour market and overall productivity will be affected by AI cost-saving technologies. Work with industry and the wider public on the transition period in which workers will need to be upskilled. (More on this in Evidence Meeting 6).
3. AI is forming new business models.	Gather use cases of different business models and create 'Best Practices' for companies to adapt. Ensure that the regulatory and policy frameworks are in place to unlock the new business models. The data aspects of the new business models are among the most critical at the current time, as policies are shaped around data protection, as opposed to user rights which are so important for the new business models to thrive and grow in the UK.
4. AI is providing broader access to more personalised products and services.	Ensure all members of society have access to the benefits of new products and services. Educate the public on the data transaction required for access to most of these personalised products.
5. AI is redefining success.	We must ensure that investors are AI friendly, in the sense they understand the intangible nature of the businesses in the start-up and scale-up ecosystem. Individuals and companies must also be upskilled in showing how to present their intangible assets. The new factors of competitive success beyond products and services themselves (i.e. platform control, data access), must be understood by all stakeholder in the AI revolution, if UK is going to move ahead.

Acknowledgements

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, including Machine Learning.

Our supporters - Barclays, BP plc, Deloitte, EDF Energy, KPMG, CMS, Oxford University Computer Science, PwC - enable us to raise the ambition of what we can achieve.

The APPG AI Secretariat is Big Innovation Centre.

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