Artificial Intelligence

How it's being used

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Introduction

The founder of the World Economic Forum, Klaus Schwab, suggests that being surrounded by digital tech 'will be a transformation unlike anything humankind has experienced before[i].' People and the organisations they inhabit could change profoundly as a result. We are at the start of a new industrial revolution that will see declining costs in tandem with rising efficiency. The mental models that underpin current systems will change thanks to this technology, shifting human behaviour and the ways in which the two interact. Artificial intelligence is chief among these technologies, leading a transformation happening 10 times faster and at 300 times the scale, or roughly 3,000 times the impact, of the Industrial Revolution[ii].

Although robotics occupies a part of many a culture's imaginary future reference points, artificial intelligence is very much a contemporary issue. In fact, approximately 25 percent of a typical CEOs' time is currently spent on activities that could be done by facets of A.I., such as the analysis of reports and data to inform decisions[iii]. Given the wide range of applications A.I. could be used for, it is unsurprising that both 98 percent of corporate leaders see A.I. as essential for their businesses[iv], and that 30 percent predict A.I. to be the biggest disruptor to their industry over the next five years[v].

These predictions all tend to suggest, either explicitly or implicitly, that the skill sets and aptitudes that still confer success today are set to change in a time-frame not much beyond that of a standard higher education degree. The days of robotic automation of millions of jobs may be years if not decades away, but the reconfiguring of job skills and aptitudes is already underway. Gains and losses will be inevitable within industries as emphases shifts; much as in the way that the skills needed to be a bank teller in the 1960's differ markedly from those today.

What is set to change however, is the ways in which companies apply A.I. While some 84 percent of companies are already using A.I. in some form or another, however prosaically[vi], key areas remain relatively untouched; only 2 percent are using artificial intelligence to monitor internal legal compliance, and only 3 percent to detect procurement fraud for example. Likewise, only 8 percent of manufacturing and service companies are using A.I. to allocate budgets across the company, and just 6 percent are using A.I. in pricing[vii]. Increasingly, as pricing, budget allocation and even compliance help deliver marginal (and not so marginal) gains, the pressure to infuse appropriate forms of A.I. into the processes and systems will increase. Indeed, the primary reason across all industries for adopting A.I. is to either sustain or create a competitive advantage, as shown below in Figure 1.
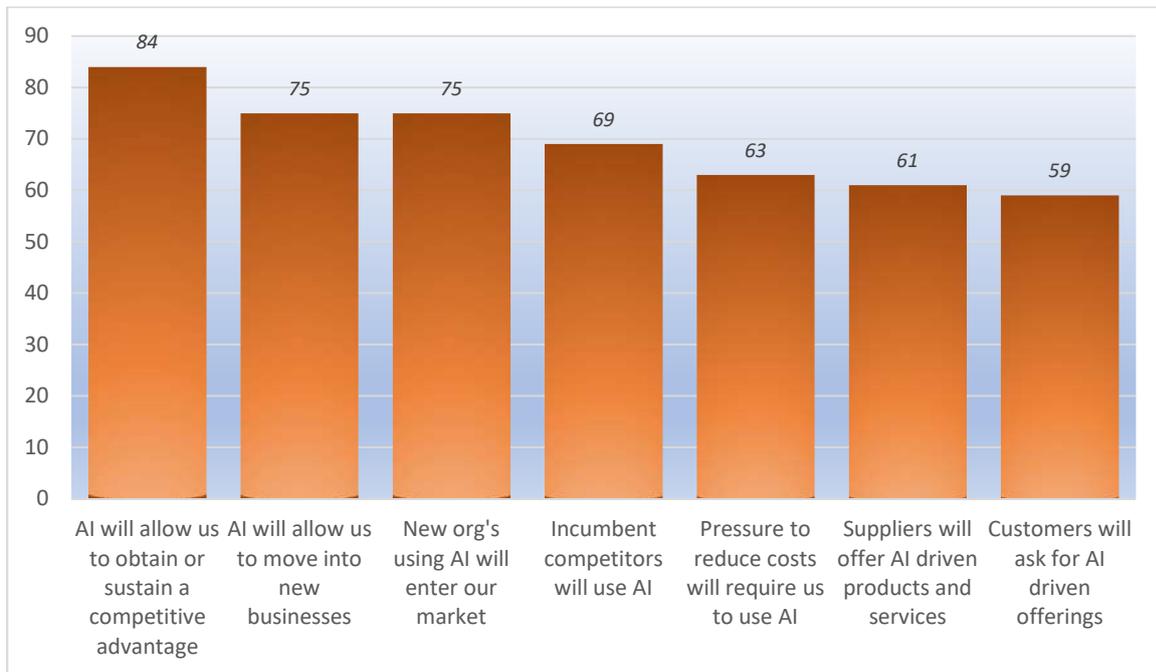
Figure 1: Reasons for adopting AI (%)[viii]

The degree to which A.I. will shift markets is clear from this Figure. With 75 percent of respondents, A.I. is foreseen as enabling companies to move into new businesses, as well as prompting new organisations to enter existing markets. Since both new vectors of competition and exploring new business involve a necessary recalibration of skills, a new approach to change management is likely to be highly sought after in the coming years. For individuals however, the degree to which jobs and their requisite skills shift is likely to widen albeit in sometimes industry or job specific ways.

Change for industries will depend on the calibration of their global size, the forecast economic impact of A.I. on the given sector and the related propensity for automation of jobs and job tasks.
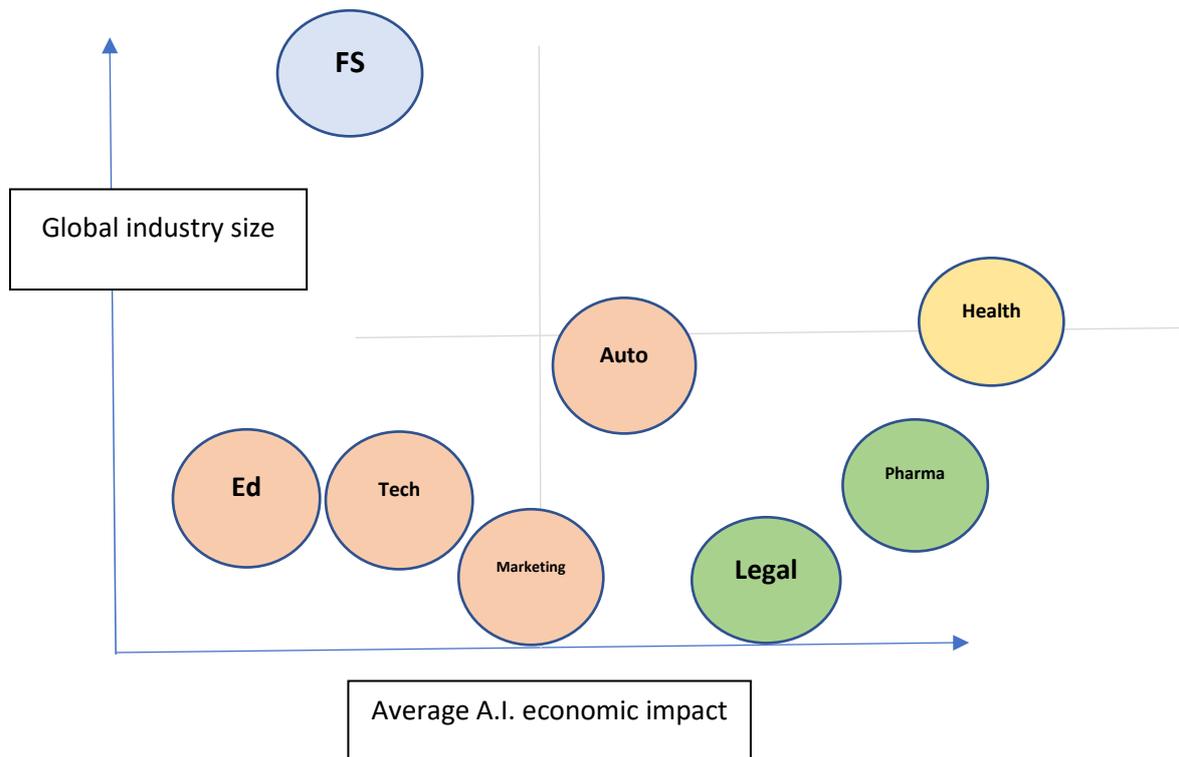
Whilst it is important not to conflate 'average A.I. economic impact,' with a direct impact on jobs since there are other factors at play, the above matrix makes clear the extent to which far reaching change is occurring. The automotive market, for example, is in many ways the public poster boy for automation – few other forms are as direct, visible and talked about in the media as self-driving cars.

Even so, it remains forecast as one of the least economically impacted industries; in fact, as a percentage, only education is forecast to be less affected. In part. this is because the skills and human empathy needed to teach effectively are hard to recreate in A.I. It is worth remembering however that even within education, A.I. has a wide range of plausible applications and some futurists even believe that the biggest company in the world of 2030 will be an education based one that either does not yet exist or is below the radar[ix]. If this prediction turns out to be correct, it is almost impossible to see how a mix of big data, micro-accreditation systems and personalised learning are not involved. It is also implausible to see how these drivers could coalesce without some form of A.I. driving or assisting the model. What then for the changes imminent in some of the more exposed industries?

Retail

Automated checkout, vending options and other formats negating the need for human labour have helped spread retail footprints, but in many cases has not eliminated the need for human workers within the store. Amazon's Go stores could change this equation significantly if, as reported, they only require six employees[x]. More granular change can be seen with the humanoid robot, Pepper. Already popular in Japan, where Pepper is used as a customer service greeter and representative in 140 SoftBank mobile stores, Nestle also announced in January 2016 that it planned to acquire Pepper robots to put in 1,000 of its Nescafé's[xi]. Early results are intriguing; pilots in California's b88ta stores yielded a 70 percent increase in foot traffic and 50 percent of sales[xii].

All told, some 23,000 robots are forecast to be deployed for customer service applications through 2022[xiii]. These are likely to both replace and augment traditional job roles, as well as help promote efficiency throughout the whole ecommerce decisioning and buying cycles. No single technology is likely to see mass job replacements, but the combination of advanced algorithms (which tend to favour online shopping), machine learning, cognitive systems, robotics and chatbots could mean up to '…2.25 million retail jobs in UK are at risk of being replaced by 2030[xiv].' That said, it is entirely plausible that many jobs will be created within warehousing and logistics should the balance between physical and online ecommerce shift decisively towards the latter.

What does it mean for skills?

Working effectively with disparate teams will become an important skill for managers whilst workers will need to develop good interpersonal skills. Automation, in total, is likely to open opportunities for innovation – and whether it be in systems, processes or management, there is likely to be a market for those who can quickly identify and propose better ways of doing things. This extends into defining new KPI's relating to automation as A.I. will almost certainly introduce new criteria for measuring company-wide success, as well as the use of A.I. derived insight to help make decisions. The case for mid-level managers and entry level workers to progress swiftly could hardly be more pressing. This will require not only strong networking skills and a drive for continuous learning but the development of a wider scanning radar able to inform on the latest industry developments and thought leadership. Familiarity with the latest forms of virtual personal assistants and cognitive systems will become increasingly important. Given the current shortage of analytical talent, leaders cannot wait to see if their individual managers are capable of working in and alongside automated systems. This compels leaders to explore and experiment with A.I., and develop training strategies.

AI used in the sector

- Robotic Process Automation (RPA): Pepper.
- Natural Language Processing (NLP): Conversica sales assistant software.
- Cognitive systems (CS): IBM's Watson used by NorthFace to help personalise shopping
- Machine Learning (ML): Sift Science is one of many companies applying machine learning to detecting user and payment fraud
- Machine Learning: Original Stitch's Bodygram custom-tailor's button-down shirts from a single photo.
- Drones & automated delivery: Amazon's drones, Domino's Robotic Units
- Payment services: Amazon's Go automated check-out
- Automated shopping: Amazon's Dash buttons

Where A.I. May be used next

- NLP: By 2020, the use of chatbots could increase by 1,000 percent[xv].
- NLP: More than 23,000 robots forecast to be deployed for customer service applications through 2022[xvi].
- In store sensing technology: Use could lead to prescriptive models, from store layout to niche and even individualised offers, including price.
- Machine Learning: Customised loyalty programs
- Deep learning (DL): Voice-based commerce is expected to jump to $40 billion in 2022 in the U.S alone, up from $2 billion today[xvii].

- RPA: 3D knitting could enable stores to create customised apparel designed online by the customers in a matter of minutes or hours[xviii].

Possible future consequences

- Shifting supply and demand chains will reconfigure where the work in 'retail' is, with 3D printing potentially redrawing the definition and links between manufacturing and retail.
- Customer service positions may both decline and number and grow in importance; comfort with an array of data and A.I. interfaces will be key for future employees.
- Retailers need to develop an A.I. based strategy that replaces myriad instances of disconnected A.I. usage.

Financial Services

'In one study, 32 percent of financial services executives were already using A.I., and that number will only increase as technologies become more sophisticated.
Accenture found that 76 percent of banking executives intend to deploy A.I. within the next three years to improve their customer interface[xix]. Virtual assistants and other forms of interaction are likely to feature prominently, reducing the number of required customer service reps but in all likelihood, requiring greater skills – both analytical and interpersonal – of those that remain.

Job losses could cover a wide spectrum of financial services jobs however, given how quantifiable many of them are. 96 percent of accountants, for example, expect their jobs to be partly or fully automated by 2022[xx]. Auditing, financial model creation and more obviously, research and analysis will also form a significant part of A.I.'s remit. It is for this reason that up to a third of existing UK jobs in financial services and insurance could be automated by 2030[xxi].

What does it mean for skills?

Machine learning is forecast to disrupt 40 percent of banking roles[xxii]. In addition, the FinTech revolution could under some scenarios lead to a 50 percent reduction in both branches and employees within 10 years or so[xxiii]. It is unlikely that all entry positions will be erased, but the content, scope and career path associated with them will likely change.

Repetitive and highly structured job roles are liable to be codified and thus automated -likely leading to a relative reduction in some data heavy arenas whilst new roles are likely to be created. Successful use of technology could see financial services providers position themselves as secured digital identity providers or as trusted advisors – for example by using the internet of things to see where clients could save money and help search better deals for them. With many banks already self-declared as software companies or else striving to be so, an increasing proportion of banking careers are likely to blur with software engineering and data science.

A.I. used in the sector
- Cognitive systems (CS): JP Morgan Chase invested in A.I.-powered technologies for compliance and reduced the time from 360,000 hours annually (manually) to mere seconds[xxiv].
- Chatbots: Cleo is a chatbot app that uses artificial intelligence to give people advice on how to optimise their finances.
- ML: UBS launched a robo advisor to offer automated investment advice based on people's financial circumstances.

- ML: ING launched a tool called Katana that uses '…predictive analytics to help traders decide what price to quote when a client wants to buy or sell a bond.'
- RPA: In May 2017 Bank of NY Mellon Corp announced that over the previous 15 months it had rolled out more than 220 bots[xxv], leading to 100 percent accuracy in account-closure validations across five systems, 88 percent improvement in processing time and a 66 percent improvement in trade entry turnaround time.
- NLP: Finie is a voice-powered A.I. platform, named Finie (for financial genie) is a way to interact with a bank account. Finie is integrated within a banks' mobile banking application, acting as '…a voice-activated intelligent personal assistant that is able to answer financial questions unique to each individual user, offer personalised spending advice, and fulfil any banking task[xxvi].'

Where A.I. May be used next
- ML: forecast to disrupt 40 percent of banking roles.
- NLP: 75 percent of bankers believe customer facing A.I. coming by 2020.
- CS: Bridgewater Associates want A.I. to make 75 percent of all management decisions by 2022.
- CS: Hybrid robo-advisors could manage 10% of all investable assets by 2025. $2.2Tn could be managed by robo-advisors by 2020
- Identity analytics: Will be able to recognize a customer more reliably

than relying on mere encryption and a password. It will know the tempo that a person types, where they hesitate or dwell, their physical appearance on video, and will be able to distinguish between a photo and a blinking, breathing person, with characteristic eye-movements.
- Virtual personal assistants (VPA): Will evolve from chatbots to provide a personalised banking interface.

Possible future consequence
- Applications of A.I. and machine learning to data could result in new and unexpected forms of interconnectedness between financial markets and institutions.
- Network effects and scalability of new technologies may give rise to third-party dependencies and strategically important players and platforms.
- A.I. could revolutionise banking, making it almost omnipresent/invisible.

Legal Services

Whilst jobs losses due to technological change are nothing new, neither is the fact that historically, each wave of technology has led to a net gain in jobs. A range of technologies, including many artificial intelligence based ones have already contributed to the loss of more than 31,000 legal services jobs. They have, however, also created 80,000[xxvii] in the same period. What may be different this time is the condensed time frame in which technologies mature. As it stands, it is estimated that 22 percent of a lawyer's job and 35 percent of a law clerk's job can be automated[xxviii].

London firm Hodge Jones & Allen is already pioneering a 'predictive model of case outcomes' to assess the viability of its personal injury caseload[xxix]. Other examples also highlight the ability of artificial intelligence to augment knowledge work; with one such system - Lex Machina - predicting the outcome of patent disputes 'more accurately than the best patent lawyers[xxx].' It achieves this through the rapid interrogation of a database replete with 800,000 past cases – from which it offers its predictions[xxxi].

ROSS, a digital legal advisor to the world's law firms, has also been launched. Using natural language technology, the system can be asked questions in the same manner as another human being. Importantly, ROSS provides an evidence based response rather than merely sorting

cases based on keywords[xxxii]. Whilst both ROSS and Lex Machina could reduce overall headcount, the greater potential lies in maximising lawyers time by reducing background tasks and allowing lawyers to orient towards more value adding tasks.

What does it mean for skills?

Current entry-level positions could be eliminated, perhaps requiring greater use of university-work placement schemes or greater use of work experience in alternate mediums such as virtual reality. Alternatively, the use of cognitive technologies could reduce the skills needed to do routine work – enabling a much wider range of people to undertake it and pressuring wage costs downwards. As with lower positions, the possibility of enhanced cognitive systems reducing the skills barrier to entry could see many currently highly skilled positions devolve into lower paying positions.

In the face of competition from large and consolidating firms at the top end and the apps and automation solutions increasingly provided by small companies, specialisation within the industry could increase quite significantly. Lawyers will probably need to become increasingly entrepreneurial, whether as a firm or an individual, to compete in the emerging field.

Alternative career paths are likely to emerge concurrent with specialisation.

For example, '…Orrick, Herrington & Sutcliffe LLP created a different talent model where not every associate is on partner track. The company now hires non-partner track "career associates" who receive lower salaries in return for a reduced demand on their time. Associates are promoted based on performance, and the firm can pass through lower costs into client fees[xxxiii].'

A.I. used in the sector
- RPA: A December 2016 Accenture noted that 5 percent of its workforce (20,000 jobs) is no longer human[xxxiv].
- NLP: ROSS
- CS: Lex Machina
- CS: A 2018 study pitted the LawGeex A.I. solution and 20 US-trained top corporate lawyers found the A.I. had 94 percent accuracy vs. 85 percent for the humans[xxxv].
- ML: 'Kira' is not tilted towards job replacement but rather enabling lawyers to do different things[xxxvi].
- Chatbots: DoNotPay is a free service that helped appeal over $4m in parking fines in just 21 months by successfully contesting 160,000 of 250,000 parking tickets (64% success) in London & New York[xxxvii].

Where A.I. May be used next
- RPA: 85 percent think tech replacing HR within legal services in general is permanent. 86 percent believe law firms using fewer support staff is permanent[xxxviii].
- RPA: 39 percent of jobs (114,000) in the legal sector stand to be automated[xxxix].

- RPA: McKinsey estimates that 22 percent of a lawyer's job and 35 percent of a law clerk's job can be automated[xl].
- DL: Given the fast pace at which the field is advancing, tools may soon appear capable of understanding a variety of legal documents.
- Smart contracts: Algorithms could one day '…replace judges in some cases, with documents written in machine-readable code. The lawyer will move from litigating the dispute to programming smart contracts[xli].'
- CS: By 2026, futurist Thomas Frey suggests we will see legal documents written by A.I.[xlii].

Possible future consequence
- New techs will enable lawyers to reorient energies – i.e. the estimated 80 percent of legal cases that go unmet due to a lack of resources[xliii]
- Entry level jobs and paralegals may be heavily reduced, requiring prospective lawyers to develop expertise in adjacent fields such as cybersecurity as a way into the profession.
- The rise on A.I., broadly, presents a swathe of issues for the legal system. The rise of some applications of A.I., such as robot doctors and A.I. medical diagnoses or even autonomous cars, may call into question some longstanding legal principles, such as liability.

Health and Pharma

'In the Next Economy, companies (will) use technology to augment workers, not just to replace them, so that they can do things that were previously impossible,' says Tim O'Reilly[xliv]. Nowhere will this be more visible than in healthcare, where on many levels, improvements in efficiency and medical efficacy, will lead to better outcomes and ultimately, the promise of better lives lived.

A.I. can already predict Alzheimer's a decade before symptoms show that human doctors can read. Progress is likely to accelerate by 2020, when chronic conditions, such as cancer and diabetes, are expected to be diagnosed in minutes using cognitive systems[xlv]. Just five years later, in 2025, A.I. systems are expected to be implemented in 90 percent of the U.S. and 60 percent of global hospitals and insurance companies[xlvi]. The role in drug discovery through the interrogation of big data is also increasingly likely; healthcare may contribute up to $3.3 Tn of the overall IoT market by the middle of the next decade[xlvii].

It is difficult to talk about specifics though given the diverse nature of jobs folded into the health and pharma sectors, their large combined size in dollar terms and the large economic impact on both A.I. is set to have.

What does it mean for skills?

The combination of wearables and other consumer tech, analytics and cognitive process automation could reduce the number of jobs by enabling a wider range of services that currently require direct human interaction to become online/automated/DIY – boosting the number of patients per doctor. Both health and education services are expected to demand an increasing supply of workers in the short-to-medium term.

Conversely, new entry type positions could be generated. The confluence of predictive analytics, advancing communication technologies and an increasing tendency towards 'self-service,' could create whole new classes of consultant-like jobs in the contact centre space. Future contact centres could cater to non-traditional services such as medical examinations using biometrics and similar smart technologies.

Mental health counsellors, life consultants and an array of services based around the provision of care are likely to emerge, especially given developments in neuroscience. It is possibly that such positions could become standardised within companies given the overwhelming human and economic cost of mental health.

A.I. used in the sector
- Cognitive systems: From research done in India, IBM Watson's treatment recommendations agreed with those of physicians' 96 percent of the time for lung cancer and 93 percent of the time for rectal cancer. Watson for Oncology can also generate a personalized treatment plan[xlviii].
- ML: Disease diagnosis/identification is the goal of biopharma company Berg. It is using A.I. to research and develop diagnostics and therapeutic treatments in multiple areas.
- ML: Can increase clinical trial efficiency.
- ML techs are also being applied to monitoring and predicting epidemic outbreaks around the world.
- ML: ML techs are helping advance the collection and digitization of electronic health information.
- NLP: Chatbots

Where A.I. May be used next
- ML: McKinsey estimates that '…big data and machine learning in pharma and medicine could generate a value of up to $100bn annually, partially from new tool creation for physicians, consumers, insurers, and regulators[xlix].'
- ML: Drug discovery could be revolutionised by applying ML techniques to swathes of data. Atomwise uses supercomputers that search out potential therapies from a database of molecular structures

- ML: The UK's Royal Society also notes that ML in bio-manufacturing for pharma is ripe for optimisation.
- CS: IBM's algorithm, Medical Sieve, 'is an ambitious long-term exploratory project to build the next generation 'cognitive assistant' with analytical, reasoning capabilities and a wide range of clinical knowledge[l].'
- RPA: Robo surgeons have bested humans in the sewing of pig intestine. Although outright replacement is not on the horizon
- Cognitive/RPA: Babylon launched an app in 2017 which offers '…medical A.I. consultation based on personal medical history and common medical knowledge. Users report the symptoms of their illness to the app, which checks them against a database of diseases using speech recognition. After considering the patient's history and circumstances, Babylon offers an appropriate course of action[li].'

Possible future consequence
- Data governance will become the most pressing issue to address for healthcare companies, both at an individual consumer level and a wider perspective.
- Recruiting data science talent in the pharmaceutical industry and building a robust skills pipeline is a major necessity.
- A.I. will both encourage and demand a 'data-centric view' in helping shift the industry's mind-set toward embracing and seeing value in incremental changes over the long-term.

Marketing

There can be little doubt that A.I. will alter existing marketing structures. Deloitte believes that the function, being, '…highly quantitative, targeted and tied to business outcomes, will likely become highly automated by 2025.' Using data and even tech such as facial recognition, A.I. is already able to create highly-personalised experiences at scale in real-time. It will also allow us to do different things: 80 percent of marketing leaders say A.I. will revolutionise marketing by 2020[lii].

Marketers are accruing ever more data concurrent with the emergence of ever more insight-related tools. True data-driven decision making is increasingly plausible – and perhaps necessary - for an environment that will shortly be characterized by more tools, more datasets and more platforms[liii]. Integration for marketers will be key.

A.I. will also help drive an era of personalisation. Getting personalisation right and scaling it across the organisation can reduce acquisition costs by 50 percent, lift revenues by 5 to 15 percent and increase marketing spend efficiency by 10 to 30 percent[liv]. Perhaps more pertinently, deep personalisation could also compel marketers to increasingly think about long term customer relationships and needs. Automated consumer lives will necessitate a more on-demand level of engagement, something that only A.I. can provide.

By 2025, an average connected person anywhere in the world could interact with connected devices nearly 4800 times per day. IoT devices will trump current data centre traffic by 49 times and by 269 times the transmission from end-user devices. It is likely that A.I. will start to automate certain consumer decisions; it is also probable that much customer engagement will depend on A.I. on one way or another.

What does it mean for skills?

Bernd Schmitt, the Robert D. Calkins Professor of International Business at Columbia Business School, thinks '…it's entirely possible that marketing, branding and creative tasks may be done by supercomputers[lv],' in the not-so-distant future. Predictive and personalised services cannot be done at scale without significant data investment and some sort of automation – whether in the analysis of such data or just in the organisation of campaigns.

There is also the prospect, concurrent with the field undergoing changes itself, that psychologists will increasingly be sought by companies and organisations operating in the consumer realm. The rise of neuroscience, allied to psychology could make for an interesting addendum to many a marketers' mix, for example.

A.I. used in the sector
- Algorithms: Search tech like Elasticsearch are now relatively mainstream.
- Data-as-a-Service companies (e.g. Indix) make it easier than ever to draw from search data from other larger sources
- Algorithms: 'Companies like PredictiveBid and Israel-based Albert have decided to put a significant amount of their focus on programmatic advertising, which bring a tremendous amount of efficiency to bear on the "inventory" of website and app viewers[lvi].'
- A.I. enhanced BI: 'Companies like Rapidminer, Birst, Sisense, and others are aiming to become industry standards for B.I and predictions[lvii].'
- ML/ RPA: Tailor Brands' A.I. logo design software is adaptable and capable of learning, considering it is used on a frequent basis. It could '…design logos, promotional products, and even social campaigns[lviii].'
- NPL: Amazon Echo has become a key enabler for consumers to order anything from an Uber to a pizza. Baidu's Duer chatbot assistant is capable of ordering products within its' interface.

Where A.I. May be used next
- Image recognition: It may soon be possible for consumers to search for products. Companies like CamFind and their competitors and experimenting in this space already.

- ML: Allows advanced customer segmentation by continually learning from user behaviour.
- ML: Content generation could be revolutionised. The AP already uses A.I. for the writing of some articles, as do both Automated Insights and Narrative Science.
- Neuroscience: Scientists have developed a system that can read complex thoughts based on brain scans. Using the smart algorithms they developed, the team was able to discern a person's thoughts with 87 percent accuracy[lix].
- ML: A.I. will enable hyper personalized engagement
- CS: A.I. will be making the offers (on the sellers' end) and whether the offer matches what individuals have specified they want (on the buyers' end)

Possible future consequence
- ML will provide better solutions that multi-platform offerings. The average business deploys at least 16 separate platforms to keep up with their sales and marketing efforts[lx].
- A.I. will start to automate certain consumer decisions. Successful marketers will need to envision how A.I. impacts both consumers and the marketing paradigm.
- Marketing skills and competencies are clearly changing but may not become completely technical or data focussed. A.I. infusion will likely augment decision making and free up executives' time

Education

Under contemporary education systems, futurist Bryan Alexander suggests '... the broad masses of people are being prepared for the wrong economy[lxi].' Despite this, or maybe because of it, Thomas Frey believes the biggest company in the world by 2030 could be an education based one. Whilst the interpersonal skills requisite of good teachers will remain beyond the reach of A.I. for the foreseeable future, it is hard to envisage such a large company rising without using A.I. in its systems and processes.

There is more than enough evidence to suggest that the nature, format, content and even goals of the current education model are set for disruption. The commoditization of knowledge is a key factor here; '…charging people lots of money to provide them with skills they could learn from an Internet video is probably not gonna be a viable long-term financial model,' notes Richard Miller, president of Olin College of Engineering in the United States.

In addition, there is an apparent need to shift the university model from being informational in nature to something approaching developmental. Indeed, by 2022, 35 percent of skills considered important in today's workforce will have changed[lxii]. How we remediate such issues could also change. Micro-learning could be one key result of the IoT. By analysing more metrics than is possible in contemporary education, it could become possible for individuals to accurately identify areas of educational weakness and to have courses of remedial action recommended. As the world of work becomes ever more complex and marked by soft skills, developing tactics to deal with any highlighted deficiencies will not necessarily include a standard-length bachelor or masters course. That said, with A.I. potentially delivering educational content at around 4-10 the current speed, some have suggested that future undergrad courses could be completed in as little as half a year[lxiii].

What does it mean for skills?

Labour-intensive industries tend to suggest significant savings from the introduction of artificial intelligence yet a lot of tasks teachers perform are hard to automate – especially when the educational content, medium and audience are themselves dynamic. Nevertheless, blended learning using cognitive technologies could see a relative reduction in the demand for teaching assistants and a need for those remaining to develop specialised skills able to benefit from a cognitive assistant.

Advances could see new specialised positions open for facilitating even greater learning around a given subject, necessitating greater in-depth knowledge.

Social education specialists for example, could help streamline the data/information flowing from our networks and help construct value out of it[lxiv]. This flow of information will enhance the notion of the 'quantified self.' If the education system as a whole is slow to respond to such possibilities, greater opportunities arise for personalised one-on-one tutors/consultants able to give you the content you need, via the medium best suited to you, at the time of day best suited to your bio-rhythm, for example.

A.I. used in the sector
- CS: Netex Learning '…provides a personalised learning cloud platform designed for the modern workplace, in which employers can design customizable learning systems with apps; gamification and simulations; virtual courses; self-assessments; video conferencing; and other tools[lxv].'
- CS: Carnegie Learning's Mika uses cognitive science to provide personalised tutoring and real-time feedback for post-secondary education students[lxvi].
- ML: Brainly, a social network that helps millions of students collaborate, uses ML to automate the filtering of spam and low-quality content. It also using A.I. to personalise its platform's networking features[lxvii].
- RPA: It's now possible for teachers to automate grading for nearly all kinds of multiple choice and fill-in-the-blank testing and automated grading of student writing may not be far behind.

- RPA: A joint project between Stanford University and University of Washington is also working on an AI-powered tutoring system[lxviii].
- RPA: TechAssist is a robot in some UAE schools - students will also be able to ask for assistance with any course-related query and the robot will immediately fetch relevant answers. It will also be able to track the progress of individual students and customise the answers to guide them accordingly[lxix].

Where A.I. May be used next
- Virtual worlds: The University of Southern California (USC) Institute for Creative Technologies is a pioneer in creating smart virtual environments and applications that draw on A.I. USC researchers have several ongoing projects in the space that hint at applications to come over the next two decades[lxx].
- ML: Third Space has launched a A.I. project that aims to find positive teaching and learning patterns. The company's goal is to create a platform that gives real-time feedback and helps online tutors become better at teaching[lxxi].
- VPA: 'In Intelligence Unleashed, a paper published by learning company Pearson, the authors suggest the concept of "lifelong learning companions." These software agents that can exist in the cloud and be accessible from multiple devices, gathering data about children and assisting them as they grow and develop their knowledge[lxxii].'

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- ML: With enough data, potential and promising teachers could be recognized at an earlier stage – perhaps leading to multiple pathways into the profession.
- CS: An A.I. powered system could feasibly form the basis of a new form of micro accreditation system that can document, analyse and suggest learning pathways and courses of remedial action.

Possible future consequence
- It is likely that both intelligent systems and humans will manage different aspects of students' academic and social competencies.
- A.I. will enhance teachers' effectiveness but in turn require a more 'connected' teaching commitment.
- A.I. will change where people learn, who teaches them, how people acquire skills, and how they 'demonstrate' these skills (i.e. micro-accreditation)

Automotive

McKinsey notes that, '…for A.I. in mobility, machine learning will not be optional; it will be the technological foundation and the source of significant competitive advantage for decades to come. For example, machine learning is required for autonomous driving (AD), at the very least in image recognition, where human programming cannot possibly keep up[lxxiii].' The infusion of A.I. would appear to be a key driver of the forecast that the demand for automotive A.I. hardware, software, and services will explode from $404 million in 2016 to $14 billion by 2025[lxxiv].

Whilst an expanding and evolving range of A.I. applications ensure that future development will not mirror past and current trends, there are reasons to believe that artificial intelligence will not decimate industry jobs (although whether we need as many cars in the future is debateable). Indeed, between 2010 – 2015, the US automotive industry added 135,000 new robots while concurrently creating 230,000 human jobs[lxxv]. It is of course, a question of extent and tipping points. It is likely that robots, algorithms and other forms of A.I., will increasingly saturate both the production line and the end service. At times, this will undoubtedly replace existing jobs, but is equally likely to create new business models and hence new value-adding jobs.

The emergence of new business models poses both opportunities and

challenge for traditional OEMs. Broadly speaking, many of these models could shift focus towards B2B spheres (i.e. fleet sales or mobility services to municipalities). This alone though, could put additional pressure on margins yet will also enable more software-related services and upgrades.

What does it mean for skills?

With the onset of automation in the automotive industry, the demand for engineers will keep on increasing, albeit increasingly associated with artificial intelligence, robotics, cognitive solutions and machine learning. Autonomous driving engineers will prosper for example, tasked with the development of new standards, algorithms and infrastructure.

The evolution of cars into the ultimate mobile device (especially so when autonomous) will necessitate customer care experts. Given ageing populations and the expanding range of services potentially carried out by, or in, autonomous cars, explaining, demonstrating and even fixing new technologies will climb in importance.

As value chains in the greater automotive ecosystem collide and merge, opportunities for interaction designers will emerge. In some ways, this could be beyond what we associate with current interaction since the prospect of screen-less

communications presents new design and interaction issues. New approaches, skill sets and mindsets will be needed to compliment the requisite analytics experts that will underpin the future automotive market.

A.I. used in the sector
- Autonomous vehicles (AVs): Companies such as Tesla and Google are already using A.I. technologies in their autonomous vehicles.
- AVs: In 2017 Ford announced a $1bn investment into a start-up named Argo AI[lxxvi].
- Algorithms: For shared-mobility services or as-a-service, A.I. can help to optimise pricing by predicting and matching demand and supply[lxxvii].
- Predictive analytics (PA): Companies like KONUX feed the sensor data into an A.I. system that crunches it to improve system performance, optimize maintenance planning, and extend asset life cycles. McKinsey cites a potential impact of 10 percent lower total annual maintenance costs[lxxviii].
- PA: Vendors like Blue Yonder offer A.I. techniques capable of optimising forecasting and replenishment while simultaneously adjusting pricing. Such uses, when optimised, could A.I. reduce overall inventories by 20 to 50 percent[lxxix].
- ML: 'QuantumBlack, a firm specializing in advanced analytics, has successfully employed A.I. to streamline the R&D process and identify the most promising R&D projects early on. In part, it does

this by pulling data from a wide variety of integrated sources and then using A.I. and machine learning to forecast factors that might detract from performance[lxxx].'

Where A.I. May be used next
- ML: A.I. could learn to identify patterns in performance data that reveal potentially dangerous situations or require preventative service (cognitive predictive maintenance)[lxxxi].
- RPA: A.I. has high potential to automate business support tasks such as IT or finance. Automation rates of approximately 30 percent are expected within business support functions[lxxxii].
- ML: Process optimisation and increased productivity, already achieved via advanced analytics, will be further boosted by A.I.
- ML: A.I. will eventually enable a fully automated self-adjusting system to make supply-chain management decisions autonomously.
- CS: Allowing A.I. to crunch data will propel entirely new (vertical) businesses[lxxxiii]. For example, 75 percent of consumers say they would be interested in having an AI-driven robot do housework[lxxxiv].

Possible future consequences
- McKinsey notes the scale of the impact. 'In the short to medium term, there is a substantial, industry-wide, artificial intelligence– enabled opportunity that by 2025 could reach an annual value of

about $215 billion for automotive OEMs worldwide[lxxxv].'

- A.I. transformation cannot happen as a singular process; it also necessitates data harmonisation, ecosystem creation and a build-up of A.I. capabilities, processes and skills within the workforce.

- A.I. could transform much of the manufacturing process, from research and design to project management and business support functions[lxxxvi].

ICT

The tsunami of data and the creation of new algorithms to interrogate it have helped create a booming market for a range of A.I.[lxxxvii]. However, the market largely remains dominated by large tech companies, since they generally control the talent pool. Given the mismatch in supply and demand, Gartner forecasts that 40 percent plus of data science tasks will be automated by 2020[lxxxviii]. This could both relieve and exacerbate the current supply and demand issue. Relief could be offered by automating aspects of the current data science remit; but to the extent that talent will still be needed, it will become ever more specialised, and hence rare and expensive to access.

The issue goes beyond tech organisations however. Across all industries, by 2021, demand for data science and analytics will further outstrip supply of talent. Some 69 percent of employees foresee them needing these skills for roles, yet only 23 percent of educators see their students as prepared to meet employee demand[lxxxix]. If anything, this mismatch could benefit tech companies able to package or sub contract out solutions, if tech companies can recruit strongly. This isn't a given. On February 7th, 2018, a report was published that concluded that'… about 22,000 Ph.D.-level computer scientists around the world are capable of building AI systems. Of those, only about 3,000 are currently looking for a job. In contrast, at least

10,000 related positions are open in the U.S. alone[xc].'

The divergence in supply and demand – whilst broadly favouring the big tech firms, will create both winners and losers within this field. The winners will also be well positioned to create new revenue streams and new job typologies. Several large players are cognizant of this, with Intel, Facebook, and Google all creating their own internal A.I. training programs. 'Google is also one of the companies experimenting with automatic machine learning, or AutoML, meaning A.I. that can create its own A.I. The search giant recently began offering the service to cloud customers[xci].'

What does it mean for skills?

Software itself will increasingly play a more dominant role relative to humans in the creation of software. Entry positions at established companies may steadily reduce relative to current levels but at least in the short term, growth is numbers is still possible and perhaps likely.

The critical thinking and technical skills that characterise many engineers will continue to persist and in the case of skills, evolve. Perhaps the key marketing point will lie in the ability of software engineers to bring harmony to chaotic systems and to do this in a way understood by business. Software engineers' skills could easily be adapted to other emerging ICT fields,

from cognitive process automation, robotics and emerging scientific fields such as biotech. Augmented reality architects could come to the fore, as could avatar designers and smart dust developers (the idea of hooking everything and anything to the internet via nanobots).

A.I. used in the sector

- Many of the examples throughout this paper derive from tech companies – IBM's Watson, Google's driving cars, Amazon's recommendation engine for example.
- A.I. offerings from this sector will almost certainly define future winners; both within the sector and amongst client industries. That said, there are a few examples specifically *within* the tech sector.
- RPA: Ubisoft is leveraging a new A.I. tool called Commit Assistant, which flags mistakes in a game's code before programmers even make them[xcii].
- RPA: Google's A.I. was used to build its own A.I., and it outperformed those made by humans[xciii].
- Google's Cloud Machine Learning Group changes how the company organizes and operates its business. Amazon built a similar group cloud computing group for A.I. Facebook and Twitter have created internal groups akin to Google Brain, the team responsible for infusing the search giant's own tech with AI.[xciv]
- Machine Learning: Without machine learning, Facebook would

never have achieved its current scale.

Where A.I. May be used next

- A.I. as a service for most verticals and become the main revenue stream for tech companies.
- A.I. developments will allow tech companies to move into a range of new industries, especially allied to inherent data capabilities many tech companies possess.
- Cybersecurity and IoT networks will emerge as key areas for A.I. implementation.

Possible future consequence

- A.I. will drive up demand for data quality. Organizations are increasingly taking humans out-of-the-loop and empowering AIs to make decisions.
- NLP and ML will be increasingly accessible to even small and medium organisations.
- A.I. run companies are likely to appear, whether as small component parts of ecosystems or even larger entities.

Conclusion

Our current thinking, embedded in models from the 19th and 20th century, is ill-prepared for the fundamental changes that automation heralds for tasks, jobs and even industries

Although artificial intelligence remains a useful umbrella concept, it is vague and does not immediately differentiate between technologies such as natural language processing and either robotic processing automation or pattern recognition. Given the plethora of technologies bundled under A.I., businesses would be well advised to map out the key technologies within the suite that could most complement existing strategies, provide bridges into new areas and improve the customer experience. Such strategy should also recognise the role and interplay of supportive industries such as the Internet of Things (IoT) that could both propel and compel the use of A.I.

The range of A.I. technologies is too diverse and impactful to ignore yet an overt focus on what is nevertheless an interesting and hugely impactful tech trend is short-sighted. In its analysis of successful companies, MIT Sloan correctly notes that '…history warns us that mastering digital technology won't determine which companies become corporate winners. Instead, making the necessary organizational and leadership changes will[xcv].' These areas – new jobs, reorganization of current jobs, change management and how A.I. is grafted into overall structures and strategies – will define tomorrow's winners. At first A.I. and automation will demand we do things differently, but in time it will allow us to do different things.

About David Smith

David is recognised as a leading strategic futurist who combines the experience gained from a 35 year IT, marketing and business career with strategic visioning to help organisations better prepare for the future. His career has spanned European and US corporations. He is a much sought after keynote speaker and is the author of many works on embracing change and the drivers of change. Before establishing Global Futures and Foresight, an independent futures research firm, he created and ran the Unisys internal Think Tank, The Global Future Forum. Prior to this he was head of strategic marketing for their $2bn global financial services business.

David and his organisation has been engaged by some of the largest and most prestigious firms from around the world including: The European Commission, NATO, BBC and financial services firms including HSBC, Lloyds/TSB, Atom Bank, RBS, Lloyds, More Than, e-sure, Travelers, Allianz, QBE and Lloyds syndicates along with many other prestigious firms including CSC, Unisys, Cisco, Microsoft, Siemens, Deloitte, Ernst & Young, PWC, Bausch & Lomb, Linpac, Kraft, Heinz, John Lewis, Roche, Philips, Ogilvy etc. He is also a regular lecturer at business schools across Europe.

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About Global Futures and Foresight

Global Futures and Foresight is a research and consulting organisation that helps organisations be better prepared to embrace change, innovate and develop new strategies and solutions and helps clients to avoid the risk of being blindsided by external disruptive change.

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About Marcela Lopez, Artist

Front cover by Marcela.

Marcela Lopez, Colombian artist with European influences based in UK. Commissions and artwork for sale. My subject matter is landscape. Using my hands I choose plaster to capture the movement of water and trees on wooden boards. Through my artwork I intend to invite viewers to a peaceful moment of reflection. I see my artworks gently brightening up any space and being a source point of serenity and comfort.

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