Leadership

Wise Leadership and AI

Chapter 4 | Making Friends with the Machines

Towards a collaborative future

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With the
AMROP EDITORIAL BOARD

Amrop
Leaders For What's Next

Making Friends With the Machines
15 keys to a healthy relationship

Only 28% of digital executives recently surveyed by Amrop agree that their boards fully understand the meaning and scope of digital — let alone AI. Yet digital leaders know that the relationships between humans and AI (automated or augmented 'learning' machines) have vast potential. Getting it right will mean better using the strengths of each and optimizing the synergies between them.

1 We can see AI as a talent management task: putting the right 'mind' on the right job.

Machine talent is best at rapidly identifying patterns in big data. Human talent, at identifying complex, causal relationships and imagining new avenues for value creation. Organizational leaders understand the need to streamline companies for human-to-human collaboration. The same applies to human-to-machine partnership. At the highest level, it's also critical to align human and organizational objectives with the abilities of self-learning machines.

2 Ecosystems are fertile territory for explorer organizations.

The gig economy with its dissolving borders is one example. Seven of the world's largest companies (and many of the most profitable), are now platform businesses, large, scalable ecosystems such as Uber or Airbnb that connect suppliers and customers through their enormous networks. These provide access to exponentially more data than legacy organizations, with a diverse pool of resources. enabling rapid experimentation and expansion.

3 The most promise lies in AI augmenting human abilities.

It makes work more accurate, productive and enjoyable. One way of seeing intelligence is 'doing the right thing to meet one (or more) objectives'. Artificially intelligent machines do this by supervised learning, applying statistical techniques to crunching (complex, big) data – finding patterns faster than humans can. It is in this way that they radically extend human ability, in voice or image recognition, for example.

4 We must remember and manage AI's darker side.

The use of (historical) data may amplify biases such as gender or racial prejudice. And this can prolong unfair or unethical situations. Privacy concerns, data manipulation and cyber-security issues are well known risks. Furthermore AI-based tech firms. Google, Facebook, Microsoft, Baidu, Alibaba and Amazon are experimenting with incursions into our lives, manipulating and modifying how we feel, think and behave. In the quest to raise the probability of guaranteed outcomes and monetize them, these giants risk undermining our fundamental freedom.

5 The effects of AI on society can swing both ways.

On the downside, and especially in the short term, AI risks employee inequality, with job security fears intensifying people's risk aversion. On the upside, it has huge potential to enhance human well-being, leisure time and livespans, and improve the health of the wider environment.

6 As in the last industrial revolution: there'll be losers, but also winners.

As Andrew Ng put it: "If a typical person can do a mental task with less than one second of thought, we can probably automate it using AI either now or in the near future." If some jobs disappear along the way, others, such as data scientist, will be created. And the movement is well underway. Profiles such as data scientist which barely existed five years ago are superceding repetitive, rote tasks such as data entry.

7 As a rule of thumb, the higher the cognitive demand, the lower the risk of job displacement.

Jobs requiring high levels of social interaction, creativity or strategic cognitive work, or high dexterity in unstructured environments, are at lower risk of short term elimination. See the full article for examples.

8 Actual job losses will likely be much smaller than the pessimistic forecasts.

Some forecasts put about 9% of jobs in the USA and Europe at risk. PWC researchers predict that 38% of jobs in the US could be at risk of automation by the early 2030s. The actual replacement is likely much lower, around 10-15%.

9 The AI/Human interplay can deliver 5 business benefits:

AI helps humans perform repetitive tasks, analyze huge data sets and handle routine cases.

1 — Flexibility (Robotics in Auto-manufacturing, Software to improve Product design, Software development estimates)
2 — Speed (Fraud detection, aggregating patient data in cancer treatment, video analytics that enhance public safety)
3 — Scale (Automated applicant screening in recruitment, customer service bots, monitoring systems)
4 — Decision-Making (diagnostic applications in equipment maintenance, real time Robo-advisors in financial services, disease prediction)
5 — Personalization (wearable AI improving the guest experience, wearable sensors in healthcare, AI analytics in fashion retail).

10 Machines may know something you don't.

As an executive making decisions in an uncertain environment, you need to focus on the consequences you want (which you know) rather than their probability (which you likely don't). AI deep learning machines may be able to help you make smarter decisions by providing clues as conditional probabilities, reducing that uncertainty. They can fill information gaps, finding or revealing patterns invisible to you. See the full article for our model.

11 Moravec's paradox explains why no robot can tie its shoes quite like you can.

According to this paradox, high level reasoning requires very little computation, whereas low-level sensorimotor skills require enormous resources. This is why robots are great at precision-welding or rapidly calculating distances in self-driving cars, but still can't can't tie their own shoes as fast and fluidly as a human.

12 AI systems are only as good as the (often poor) data they're trained on.

In AI kindergarten, the old adage: 'Garbage in, garbage out' becomes 'biases in, biases out'. Not only must algorithms be unbiased, the training data must also be free from a distorted, or unethical, perspective. And of course, the European General Data Protection Regulation (GDPR) requires firms to explain how data are used and kept private. This "right to explanation" gives consumers the right to question firms on the use of their data.

13 AI involves a trade-off between 'accuracy' versus 'explainability'.

If a deep-learning system provides high predictive accuracy, it may have serious difficulty explaining how its results were derived, turning the algorithm into a black box. In the case of healthcare and consumer-facing applications, these AI will face considerable regulatory scrutiny. So the requirement for more explainability must take into account not just technological issues but financial, legal, ethical and other key considerations.

14 Countries that currently rely on low-cost labor may well lose a competitive advantage.

In China, for example, Foxconn is leading in automating the jobs of blue collar workers. Whether factories in 'developing' nations remain a low cost and competitive link in the global supply chain will depend on their success in integrating AI. And government has a big role to play.

15 Robo-ethics remains a burning platform, which only wise leadership can solve.

How will an autonomous car share the road with pedestrians, human-driven vehicles and other autonomous cars? How should conflicts between human values and autonomous navigation systems be resolved? We'll need to think about robo-ethics, ensuring AI-driven vehicles are well coordinated and aligned with human value systems if they are to enhance, and not harm, our quality of life.

Conclusion

Human cognition has a rich host of qualities. We are flexible. We can adapt quickly to new situations. We can easily adjust the way we interpret information, solve problems, exercise judgment and act to suit our specific context. We possess imagination, intuition, creativity and empathy.

Our ability to resolve ambiguous problems and exercise judgment in difficult cases can't be matched, let alone replaced, by AI. And this doesn't look set to change any time soon.

Wise decision-making means optimizing the human/machine symbiosis.

Embracing the efficiency and effectiveness of AI/big data analytics, whilst emphasizing human creative intuition, skill and experience.

Just as in any other form of talent management it's about putting the right mind on the right job, as we welcome AI to the workforce.

Making Friends With the Machines
Towards a collaborative future

"The board has no deep understanding of digitization. It's short-term thinking and cost-cutting oriented." "Amazon is eating up our market share every day. We still protect our traditional business, instead of focused investments in digital initiatives."

A new Amrop study exploring the experiences of C-suite digital leaders on the front lines of non-tech organizations has revealed a yawning gap between digital hype (AI will take over the world!) and business reality (digitization, let alone AI, remains operationally focused). Only 28% of the executives we surveyed agree that their boards fully understand the meaning and scope of digital — let alone AI. And frustrations expressed by digital executives are all too common.

Only 28% of the digital executives surveyed by Amrop agree that their boards fully understand the meaning and scope of digital...

Yet digital leaders are fully — even painfully - aware that the relationships between humans and AI. Whether via automation by AI-driven robots, or augmenting human capabilities via deep learning' machines, getting it right will mean better using the strengths of each and optimizing the synergies between them. And yet, where do these synergies lie, exactly? With what effects on jobs, on whole professions?

It's interesting to consider this from a talent management point of view - putting the right 'mind' on the right job. Machine talent is best at rapidly identifying patterns in big data. Human talent is best at identifying complex, causal relationships and imagining new avenues for value creation.

It's a jungle out there

Commercial activities are increasingly organized within ecosystems and their borders are dissolving. Perhaps the biggest example is the collaborative, self-organizing gig economy. Seven of the world's largest companies (and many of the most profitable), are now platform businesses. Large, scalable ecosystems such as Uber, Airbnb, Netflix, Amazon, Alibaba, Gojek and Grab are connecting suppliers and customers through enormous networks. These provide access to exponentially more data than legacy organizations, enabling rapid experimentation and expansion.

Ecosystems such as these are pulsating with life. They allow forward-thinking companies to draw on the information and capabilities of a diverse pool of resources, to better explore existing markets and identify new ones. So new offers can quickly be developed.

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So, where can we see the most promise? The answer is deceptively simple: where machines augment human capabilities to make work more accurate, productive and enjoyable. Boston Consulting Group is preparing its clients for a new kind of leadership in these AI-enabled ecosystems: aligning autonomous learning machines with continuous human learning capabilities. But to benefit, organizations will need to evolve. They need to become more adaptive, agile, and improvisational. It will take courage to change, and considerable, wisely-focused investment.

In the second chapter of our AI and wisdom series 'Can We Trust AI to Tame Complexity?' we argued that we're moving from a financial capitalism to a form of data capitalism, with data as the "new oil". How can we unpack the relationship between artificial and human intelligence (and human jobs?).

One way of seeing intelligence is in terms of doing the right thing to meet one (or more) objectives. Artificially intelligent machines do this by supervised learning, applying statistical techniques to crunching (complex, big) data — finding patterns faster than humans can. This way they can radically extend human ability.

This leads to a host of advantages when data analytics are applied to our lives, in voice or image recognition, for example. But as we saw in our second article, there's a darker side. One issue is the use of (historical) data that may amplify biases such as gender or racial prejudice. And this can prolong unfair or unethical situations. Privacy concerns, data manipulation and cyber-security risks are well known bugbears.

Furthermore it's almost impossible to over-estimate the power of AI-based tech firms. Google, Facebook, Microsoft, Baidu, Alibaba and Amazon are all experimenting with incursions into our lives, manipulating and modifying how we feel, think and behave. In the quest to raise the probability of guaranteed outcomes and monetize them, these giants risk undermining our fundamental freedom.

In this chapter we'll look beyond the hype to investigate what we can expect in terms of human/machine collaboration, as repetitive and uninteresting tasks get automated, and human capabilities augmented.

Some jobs will disappear along the way, it's true. Still others will be created. And the movement is well underway. Profiles such as data scientist which barely existed five years ago are now hot property. Repetitive, rote tasks such as data entry, are fading.

The effects of AI on society can swing both ways, and probably will. On the downside, and especially in the short term, AI risks causing employee inequality, with job security fears intensifying people's risk aversion. On the upside, it has huge potential to enhance human well-being, leisure time and lifespans, and improve the health of the wider environment.

One way of seeing intelligence is in terms of doing the right thing to meet one (or more) objectives. Artificially intelligent machines do this by supervised learning, applying statistical techniques to crunching (complex, big) data — finding patterns faster than humans can. This way they can radically extend human ability.

Job automation or augmentation — preparing for the future

AI and autonomous devices, hyper-connected through the Internet of Things, provide business opportunities by automating repetitive processes. Or augmenting human abilities. Superimposing digital data and images on the physical world, smart connected products are closing the digital/physical gap, releasing untapped, unique human capabilities.

Most studies sidestep the potential of AI to actually create new tasks and whole jobs.

Organizational leaders have long understood the need to streamline over-siloed companies to facilitate human-to-human collaboration. Well, the same now applies to human-to-machine partnership. At the highest level, it's also critical to align human and organizational objectives and the abilities of self-learning machines.

When properly applied, digital tools, and AI in particular, will enable us to make better decisions. Perhaps we don't fully understand, let alone control, our destiny. But at least we have a chance to bend it in the direction of the values we feel are worth living for. The future won't just happen to us. It's likely something that we can, and hopefully, will build. That is, unless we allow tech monopolies to continue invading our lives.

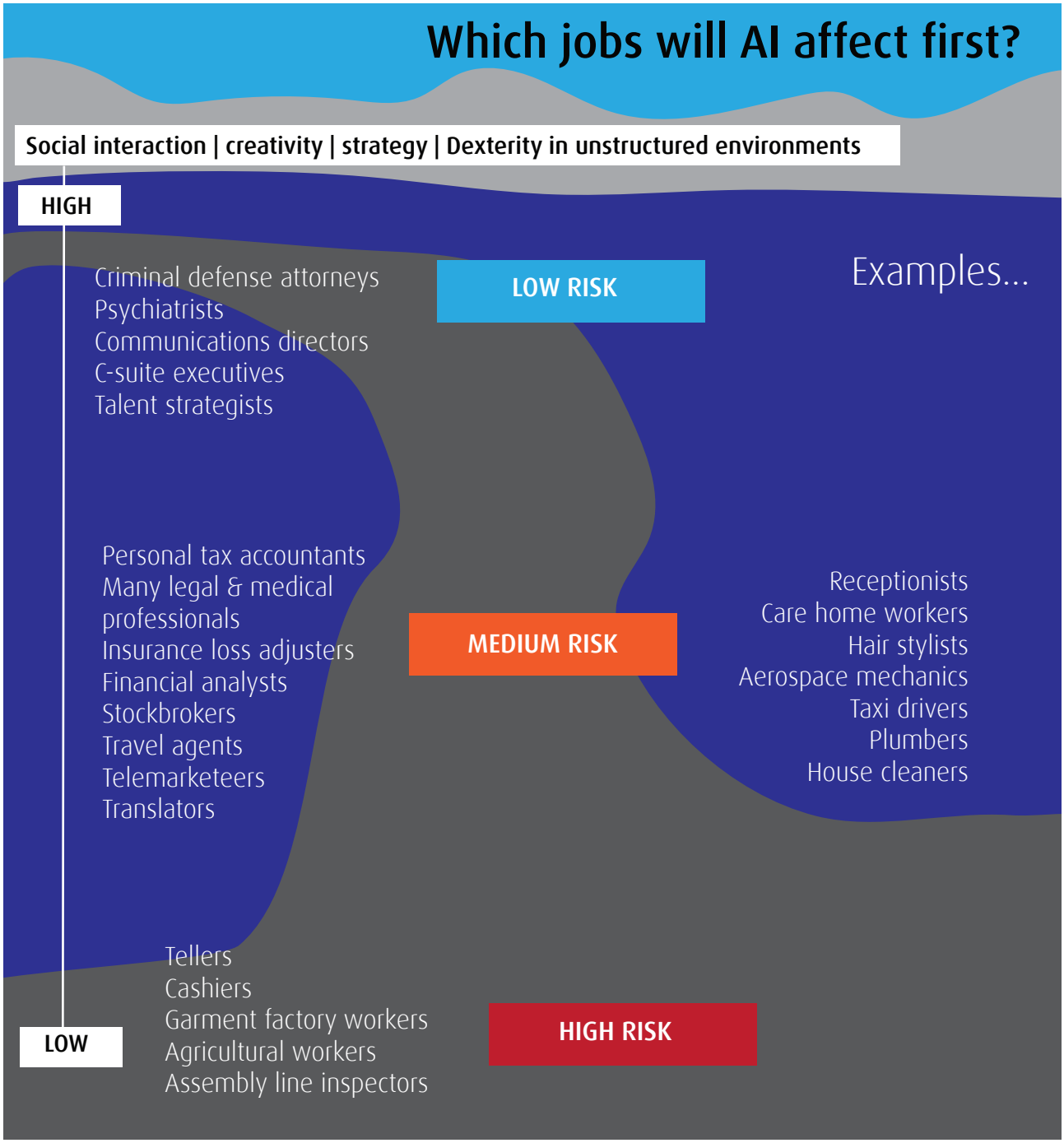
The AI revolution will be a true industrial revolution (hence the term: 'Industry 4.0'). Inevitably, there'll be winners and losers. Jobs needing social interaction won't disappear immediately. Those which are repetitive and can be optimized using data are another matter. As Andrew Ng put it: "If a typical person can do a mental task with less than one second of thought, we can probably automate it using AI either now or in the near future."

For Harvard professor Michael Porter and James Heppelmann, CEO of **PTC**, (an industrial software development company), AR can dramatically reduce errors and increase productivity. The European telecoms provider **KPN** is a case in point. Its field engineers, conducting remote or on-site repairs, use AR smart glasses to view a product's service history data, diagnostics, and location-based dashboards. This enables them to make smarter decisions about how to resolve issues, with an 11% reduction in overall costs for service teams, a 17% decrease in error rates, and higher repair quality.

Conversations around AI tend to focus on job displacement, the fear that computers will take over the world. This, as we argued in Chapter Three (Behind the Scenes of the Machines) is unlikely to materialize soon, if at all. If the fear is understandable, it assumes that humans and computers are competitors and that AI systems, with their superior speed, processing power, and accuracy (when fed big data), will phase us all out. Several economic studies have done little to calm those fears. However, these studies typically focus on broad trends. And most sidestep the potential of AI to actually create new tasks and whole jobs.

As a rule of thumb, the higher the cognitive demand, the lower the risk of job displacement by AI algorithms and AI-driven robots.

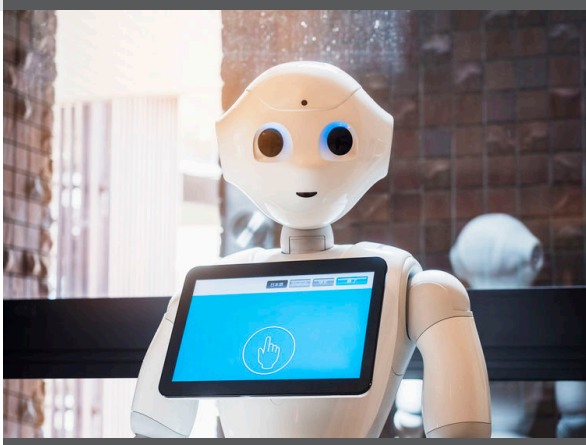
Jobs requiring high levels of social interaction, creativity or strategic cognitive work, or high dexterity in unstructured environments, are at lower risk of short term elimination.



Who is most at risk?

As we've argued, automation that eliminates a human from a task does not necessarily eliminate them from a job. Yet it's impossible to deny that digitization and robotization have caused major blue-collar job losses in the last two decades.

Actual job replacement will likely be around 10-15% in the coming years.



Tellers, cashiers, garment factory workers, some agricultural harvesters, assembly line inspectors, all face short-term risk. Receptionist, bartender and other catering jobs may survive medium term, however. So too, will jobs demanding high dexterity in unstructured environments: care home workers, hair stylists, and physical therapists, aerospace mechanics, taxi drivers, plumbers and house cleaners. But white-collar jobs are also coming under siege. Accountants, many legal and medical professionals, insurance adjusters, financial analysts and stockbrokers, travel agents, personal tax accountants, and telemarketers may all find their jobs affected in the coming years due to sophisticated machine-learning programs. Consider basic translation, already outstripped by Google.

Where are the areas of least risk? The risk to jobs requiring social interaction, creativity or strategic cognitive expertise, is still low. Criminal defense attorneys, for example, psychiatrists, communications directors and social workers. Or scientists, medical researchers and artists, C-suite executives, (and the experts responsible for executive hiring, development and retention strategies).

Despite pessimistic forecasts, actual job losses will likely be much smaller. Some forecasts put about 9% of jobs in the USA and Europe at risk. PWC researchers predict that 38% of jobs in the US could be at risk of automation by the early 2030s. The actual replacement is likely to be around 10-15%. One reason could be the current inflexibility of AI. For example, the Speedfactory technology used by adidas plants in the US and Germany was unable to handle the joining process for rubber-soled leather shoes (features of two of its leading brands). Adidas recently announced that it would discontinue production at these Speedfactories, transferring the technology to Asian plants. Meanwhile it would concentrate on modernizing other suppliers, and optimizing 4D technology.

AI algorithms will likely be to many white-collar workers what tractors were to farmhands: a productivity booster, shrinking the total number of people needed to get things done. Even if truly ambidextrous robots have yet to be invented, collaborative robots, (cobots), from companies such as Rethink Robotics (founded by robotics and AI pioneer Rodney Brooks) are already in the system. Sensors allow them to recognize a range of objects and avoid collisions. BMW uses cobots on its assembly lines to assist and augment human engineers and workers.

In the long run, automation and robots will likely be a game-changer for developing nations for whom low-cost labor still plays a big part in competitive advantage. In China, Foxconn is leading in automating blue collar jobs. Whether factories in other 'developing' nations remain a low cost and competitive link in the global supply chain will depend on their success in integrating AI. And government has a big role to play.

In Article 2 of our series we raised a deeper challenge still: robo ethics. How will an autonomous car share the road with pedestrians, human-driven vehicles and other autonomous cars? How to resolve conflicts between human values and autonomous navigation systems? We'll need to ensure AI-vehicles are well coordinated and aligned with human value systems if they are to enhance, and not harm, our quality of life.

Our human capability to resolve ambiguous information, exercise judgment in difficult cases, for example, interacting with dissatisfied customers in delicate situations, can't yet be matched, let alone replaced, by computers.

*The Verge, November 13, 2019 and www.adidas-group.com

A helping hand

AI is helping humans perform repetitive tasks, analyze huge data sets and handle routine cases, in multiple ways.

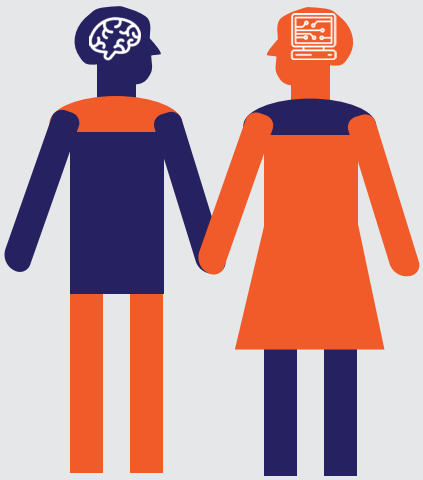
Robotic surgeries allow surgeons to reach hard-to-access organs, perform precise cuts and sutures at angles that are at the limit of human dexterity. The robotic tool becomes an extension of the skilled doctor's mind and body, allowing faster surgeries, with fewer complications.

GE is piloting a new form of AI at a wind farm in the US that 'exhibits humility'. When the AI algorithms developed to control the turbines encounter unfamiliar situations (typical in a constantly-changing weather environment), the algorithms have been trained to go into a safe, default mode that gives up control until they figure out the new scenario. GE's pilot studies are reporting a 1% hike in energy output from their AI-driven turbine controls.

Meanwhile, agricultural producers have installed a vast and diverse IoT sensor network to collect a variety of data, enabling farmers to take better decisions with respect to pest control, fertilizer usage and so on.

High 5

Humans and AI-learning machines | a match made in heaven?



Humans and AI are collaborating to improve 5 elements of business processes

1 - Flexibility (robotics in auto-manufacturing, software in product design, software development estimates)
2 - Speed (fraud detection, aggregating patient data in cancer treatment, video analytics that enhance public safety)
3 - Scale (automated applicant screening in recruitment, customer service bots, monitoring systems)
4 - Decision-making (diagnostics in equipment maintenance, disease prediction, real-time robo advisors in financial services
5 - Personalization (wearable AI improving the guest experience, wearable sensors in healthcare, AI analytics in fashion retail).

AI is enabling the era of personalized medicine based on genetic testing: powerful machines analyze and manage huge combinations of possible treatments for a given patient. These individualized treatments could solve a critical problem in clinical trials: 80% typically fail due to some mismatch between patient and drug.

There is a paradox in all of this, however, one that we've referred to in previous articles. Argued by MIT professor Erik Brynjolfsson and research scientist Andrew McAfee, it's known as 'Moravec's paradox' and goes like this: *contrary to traditional intuition, high level reasoning requires very little computation, whereas low-level sensorimotor skills require enormous resources*. This is why robots are great at precision-welding or rapidly calculating distances in self-driving cars, but still can't tie their own shoes as fast and fluidly as a human can.

Human cognition also adapts instantly to new situations. We can easily adjust the way we interpret information, solve problems, exercise judgment and act to suit our specific context. We possess a flexibility, imagination, intuition and creativity that will be out of reach for machines for some time to come.

Augmenting humans with connected smart products

Ford Motors is using virtual reality to create a virtual workshop. Here, geographically dispersed engineers collaborate in real time on holograms of vehicle prototypes, speeding up the process of building new cars, significantly reducing travel costs and time.

When a car manufacturer can re-imagine its factory floor so that people and robots (or cobots) become co-workers, AI has facilitated the creation of highly customized cars at scale, (still requiring a designer with the specialized skills to take advantage of this new cooperation). In essence, it has transformed the assembly line into a robot-human workspace.

Unilever's hiring process has been transformed by AI. The job applicant submits a video-recorded interview via computer or smartphone, answering questions designed for a specific position. The results are analyzed by HireVue, an AI application that notes words, body language and tone. The most promising candidates are invited to the Unilever offices for a final interview round, conducted by human experts who make the final hiring decision. Thanks to this human-machine collaboration, job applications have doubled compared to a year ago; the average time to hire plunged from 4 months to 4 weeks; the time spent by recruiters plummeted by 75%; and to date, a more diverse group applied and was hired.

In healthcare, powerful machine learning and simulation software can churn out hypotheses (correlations) straight from the data to find relationships in medical health records. They do this through 'Reverse Engineering' and 'Forward Simulation' (REFS). Bad drug combinations are a major therapeutic problem and have no standard solution. **GNS Healthcare**, a precision medicine company, assessed anonymized data from over 200,000 patients, and its machine-learning platform churned through approximately 45 quadrillion hypotheses. After only three months, the final result emerged: the combination of drugs most likely to interact in troublesome ways. A medical team took more than 2 years to solve the same task. This is beginning to approach the holy grail of AI — establishing a causal connection. As we discussed in Chapter 3 of this series, that would be a massive leap forward in data pattern recognition (as argued by UCLA professor Judea Pearl). In a similar vein, AI is enabling the era of personalized medicine based on genetic testing: powerful machines analyze and manage huge combinations of possible treatments for a given patient. These individualized treatments could solve a critical problem in clinical trials: 80% typically fail due to some mismatch between patient and drug[1].

[1]Daugherty, P.R. & H.J.Wilson, (2019), Human + Machine. Re-imagining Work in the Age of AI, Cambridge MA, Harvard Business Review Press, page 80

AI is enabling tasks to be performed that would have been unimaginable some years ago.

Phillips smart lighting uses AI to predict when bulbs will lose efficiency, tying into its recycling and replacement service. Today, Phillips endorses the *circular economy*; sensor data and AI allow it to sell "light as a service" instead of just light bulbs. Schiphol Airport in Amsterdam no longer buys Phillips' bulbs for its halls. It leases light from Phillips.

Companies are experimenting with AI to re-imagine ways to develop and test future generation products and services. AI is enabling researchers to mine data from past tests to uncover new insights and conduct virtual experiments to test hypotheses more quickly.

AI is enabling tasks unimaginable some years ago. **Rio Tinto** is using AI to control its fleet of mining machinery from an operations facility thousands of miles away, from autonomous drills, excavators and earth movers, to driverless trucks. Data from sensors — for example, on the breaking systems of dumper trucks - provide continuous input into a large database. AI analyzes the data for critical insights and problem prediction. Working together, this remote management is improving the fleet's operational performance. Rio Tinto has been transformed into a digital-first company.

However, we must remember that AI systems are only as good as the data they're trained on. *'Garbage in, garbage out'* becomes *'biases in, biases out'*. Training data must be free from any distorted, or unethical perspective, working with unbiased algorithms. And of course, the European General Data Protection Regulation (GDPR) requires firms to explain how data are used and kept private. This "right to explanation" gives consumers the right to question firms on the use of their data. In its pursuit of the 'Internet of You', **Sentiance**, a data science and behavioral change company, practices a sustainable and ethical approach to data use. It explicitly seeks consent from both individual data providers and clients. The result can be seen as an 'Internet of [informed] users' instead of a blindly interconnected 'Internet of Things'.

This brings us to the trade-off between '*accuracy*' versus '*explainability*'. If a deep-learning system provides high predictive accuracy, it may have serious difficulty explaining how its results were derived, turning the algorithm into a black box. In the case of healthcare and consumer-facing applications, these AI will face considerable regulatory scrutiny. It must take into account not only technological issues but financial, legal, ethical and other ones.

This all requires a shift in the human skills needed. Corporate leadership needs to be mindful of the ethical issues involved, especially when humans are the subject of the analysis.

Machines may know something you don't

As an executive making decisions in an uncertain environment you need to focus on the consequences you want (which you know) rather than their probability (which you likely don't). AI deep learning machines may be able to help you make smarter decisions by providing clues in the form of conditional probabilities, reducing that uncertainty. They can fill information gaps, finding or revealing patterns that are invisible to you. Unfortunately, whilst big data analytics may seem to wipe out uncertainty via (statistical) averaging, some randomness may still lurk below the surface. Still, even this may give enough functionality to work with.

In the case of *known unknowns*, humans make better decisions than machines. When it comes to *unknown knowns,* prediction machines appear to provide a very precise answer that could be plain wrong. But there are also *unknown unknowns* — the 'black swans'. Nassim Taleb, author of the 2007 bestseller of the same name, argues that we can't predict truly new events from past data: both humans and machines will likely fail. AI can, nonetheless, uncover unknown unknowns. We've seen how GNS Healthcare applies machine-learning AI to find overlooked relationships among data in patients' health records, undesired drug interactions to be unearthed from patient records. See the next page for our visual summary.

Whatever the case, machine learning and prediction can enhance human decision-making by providing an initial prediction that humans can then combine with their own assessments. Checking the creditworthiness of loan applicants, for example. It can provide a second opinion, or facilitate monitoring (of patients in hospitals for instance). Thanks to a reliable diagnosis from an image, patients can avoid an invasive biopsy.

Advances in AI and machine learning mean less need for "satisficing" (satisfying the minimum requirements to achieve a goal). and more *ifs* and *thens*. In other words, more complexity with less risk, transforming decision-making by expanding options.

Machine-learning techniques are also getting better at predicting missing information, including pattern recognition in medical images. This is what radiologists do to predict disease. This said, prediction machines may be able to reduce uncertainty, but won't always eliminate it.

Intelligent, AI-driven machines use their *specialized* intelligence to solve parts of a problem; humans use their *general* intelligence do the rest (more on Artificial General Intelligence can be found in Chapter 3 of our series). In that sense, smart AI machines can help engage and coordinate large groups of people to become more effective and efficient.

Intelligent, AI-driven machines use their specialized intelligence to solve parts of a problem; humans use their general intelligence do the rest. In that sense, smart AI machines can help engage and coordinate large groups of people to become more effective and efficient.

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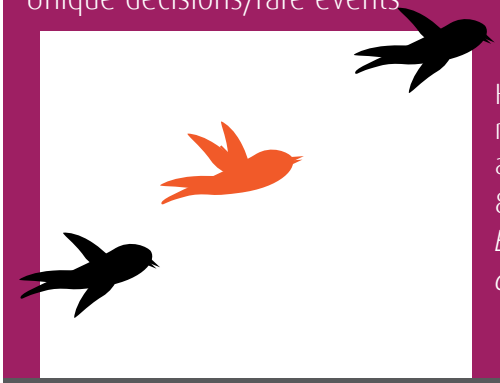
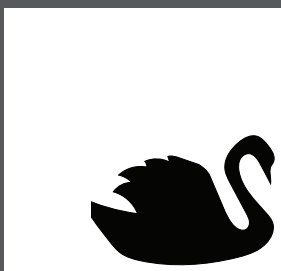
	Little data available ●	Big data available ⬤
Known Knowns Repetitive tasks 	**Humans + AI** Strong case for collaboration/ symbiosis: AI augments human capabilities/decision-making through amplification, interaction or embodiment. *E.g. AR, cobots*	**AI > Humans** AI is preferential (big data analytics, automation, prediction power through pattern-seeking, transacting, adapting where possible). *E.g. fraud detection, medical diagnosis, bail decisions, creditworthiness.*
Unknown Knowns Incomplete info = randomness 	**Humans > AI** Weaker case for collaboration. Noting that human creativity (what...if) + satisficing* may outsmart computers.	**AI ≈ Humans** Weaker case for collaboration. Computing power may augment human intelligence, but humans better understand cause & effect relationships. *E.g. using big data for a precise answer. Could still be wrong if premises are not clearly defined.*
Known Unknowns Unique decisions/rare events 	**Humans > AI** Humans should lead, using mental shortcuts (heuristics), analogies, empathy, creativity & judgment. *E.g. predicting an election outcome or major earthquake.*	**Humans + AI** Strong case for collaboration/ symbiosis: humans train, explain & sustain AI-driven applications. AI augments human decision-making. *E.g. predictive analysis of medical images.*
Unknown Unknowns Unpredictable, 'Black Swans' 	**Humans >AI?** Noting: too many unknown variables despite big data availability. It is unknown what to look for or how to guide AI algorithms = drastic uncertainty. Unclear what can be "expected".	**AI > Humans?** Noting: too many unknown variables (as box, left) Unclear what can be "predicted".

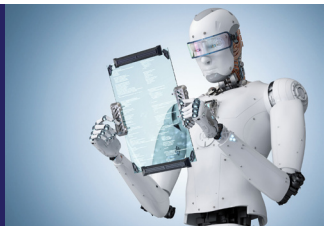
*Satisfying the minimum requirements to achieve a particular goal

Last drops

1. Most likely, AI will shift talent management away from the transactional and toward the relational
2. AI will increase the importance of human judgment (supported by AI-predictions), in making smarter and even wiser decisions. This symbiosis follows an upward spiral: as the use of prediction increases, so the value of judgment rises.
3. Our neocortex allows us to think rationally or reasonably and make links between unexpected patterns, resulting in innovative and insightful improvements of tools.
4. Thinking about a network (as our brain functions) is like thinking about entire ecosystems. How would you use your judgment to guide an ecosystem to grow in a positive direction?
5. AI "learns" from large quantities of data, recognizing patterns and deriving conclusions from these "insights". But big data is only useful if we turn it knowledge that can be applied in concrete cases.
6. Human learning and curiosity do not occur in isolation, but are embedded in traditions; the accumulated wisdom of past generations.
7. Until scientists find a way to enable machines to learn as humans do, the best AI will be unable to compete with a four or five year old.
8. The human advantage lies in the ability to ask metaphysical (why) questions and address ethical concerns. Only humans can feel empathy and mindful compassion towards other beings. These abilities constitute us as social beings (based on emotions inherent to most higher-level mammals).
9. As Jack Ma (founder of Alibaba) has said, we can't beat the computer, but we can outmaneuver it in areas where humans function best: creativity, art, craftsmanship and empathy.
10. As we explore this collaborative strength, we will need to manage the asymmetric power of the companies who "own" the data and are able to monetize this "new oil" into profits, often at the expensive of individual data privacy and individual freedom.

Companies should take steps to embrace the new world of Human + Machine, not being blinded by fears of an antagonistic relationship with human jobs. AI has enormous potential to improve products and services, our quality of life and that of the planet. This, if the darker side of AI and the potential misuse of data are carefully managed.

Recommended Reads



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