INFERENTIAL E FOCUS

Software Automation

FROM MOBILE-FIRST TO AI-FIRST UPDATE: APPLICATIONS OF AI AND AUTOMATION IN MANY SECTORS

In our *Briefing* **last year** (**IF 3712**) on Artificial Intelligence, we noted that applications of AI were coming with surprising speed. Notably, in 2014, computer scientists thought it would take 10 years to develop an AI that could beat world-champion players of Go — a game exponentially more complicated than chess; yet such a program was written in just two years. Beating professional poker players was seen as another distant achievement — after all, poker requires a certain level of human intuition to understand "bluffing." And yet, earlier this year,



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an AI developed at Carnegie Mellon University was able to beat professional poker players during a 20-day tournament. In particular, the software was able to assess its previous performance and **revise itself** during the course of the tournament. AI is improving quickly, and its applications are not all fun and games, either. This *inFocus* will explore how AI is not only affecting the tech sector, but is also rapidly affecting industries such as retail, financial services, healthcare, defense and others. (*Washington Post*, 2/1/17)

TAKEAWAYS

- Applications of advanced automation and early artificial intelligence, utilizing natural-language processing, image recognition and voice recognition, are advancing quickly and moving the preferred user interface for computing and the Internet from mobile apps to AI.
- The use of AI is quickly affecting a variety of industries beyond the tech sector, including healthcare, retail, financial services and defense.

IMPLICATIONS

- Social and political discord could grow as the economy grapples with the obsolescence of many jobs and the search for new forms of employment.
- Companies that best integrate AI will experience significant cost savings and the potential for customer satisfaction.
- Companies that produce the required hardware and software for AI, including algorithms, cloud computing, processors and graphical processing units (GPUs), and lidar/lasers and cameras, all benefit.
- A competitive battle is coming among large Internet platform companies (*e.g.*, Google, Facebook, Apple, Microsoft, Amazon, and similar Chinese companies) over who offers the most favored AI platform.

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From Mobile-First to AI-First— Two Profound Tech Dynamics This Decade

In our September 2016 Briefing, we noted that Google's CEO, Sundar Pichai, had set an important and wide-ranging goal for the search company: to go from being "Mobile-First to AI-First." Pichai's goal was reflecting the lesson Google had already learned during the public's migration from computing on the desktop and laptop to increasingly computing on mobile phones. In fact, the yearly number of searches on the Google homepage peaked out in 2013, as more individuals started using apps to fulfill tasks previously conducted on a regular Web browser. Now Google must also adjust to a switch from app-based mobile computing (Pervasive Computing), to computing conducted between humans and various AI interfaces, such as Amazon's Alexa. As early as spring 2016, the Alexa voice interface was accessible only on Amazon's Echo device and could respond to only 300 specific tasks or queries. Now Alexa can handle over 5,000 different gueries and is being integrated into Amazon's app so that it is untethered from the Echo device and can go with consumers everywhere. Amazon is now competing with Google to be the consumers' interface to the Internet, as well as their access point for various goods and services. It's an existential shift not just for Google but for any company in the consumer computing and Internet industry (see IF 3712, "From Mobile-First to AI-First," 9/1/16).

What is so interesting, though, is how rapidly artificial intelligence is changing business beyond the realm of Internet and computing services. As we saw in a separate Briefing this week, the kind of "narrow" AI programs that dominate today can teach themselves and learn to perform one specialized task very well - sometimes better than a professionally-trained human can. As a result, we are seeing applications of AI affecting industries including healthcare, financial services, retail, defense and other sectors. This profundity with which even early AI applications are affecting external industries mimics a pattern that emerged from Pervasive Computing, our parlance for the reality that smartphones put a computer in billions of pockets wherever people go, at any hour of the day (see IF 3816, "Artificial Intelligence, Not Your Average Algorithm," 8/2/17).

Attached to this *inFocus* are two similar-looking charts that depict the parallel between the impact of Pervasive Computing and the emerging impact of AI. The

first chart is from 2011 with Pervasive Computing at the center. On that chart we noted the ripple that effects of the spreading impact of the smartphone was having and would have in the future, not just on infrastructure and hardware (the purple ring), or software and peripheral technology (the green ring), but on dozens of industries outside the tech sector (the blue ring), as well as on human behavior (the red ring). The same pattern is already playing out with the deployment of early AI, as depicted in our 2016 chart with Artificial Intelligence at its center. Beyond just the required hardware and software, industries are beginning to experiment with AI in ways that are likely to be as significant as the introduction of smartphones was to those industries ten years ago.

In recent months, we have observed early versions of AI being deployed in several industries. Sometimes these applications of what is marketed as "AI" are simply advanced forms of automation such as Amazon's Alexa. However, in others, the AI being used is truly selflearning, like the aforementioned Go- and poker-playing programs, suggesting that although they are in early experimental phases, such programs will begin disrupting their industries in the next several years:

Healthcare

• With a team of 100 AI researchers, Babylon Health in the UK has developed an interactive app that can "discuss" a patient's symptoms and provide a probable diagnosis. The company claims its diagnostic accuracy is already at 92 percent. (*Financial Times*, 1/15/17)

• Image-recognition software is proving to be less prone to errors than a trained human radiologist in identifying important anomalies on an X-ray or MRI film. In one Case Western Reserve University study, software was better than doctors at diagnosing brain tumors in MRI images. (*Science Daily*, 9/15/16)

• IBM's Watson diagnosed a woman with a rare form of leukemia that had been misdiagnosed by doctors previously. Watson looked at data from the woman's genetic tests and medical records and cross-referenced them with a database of 20 million cancer research papers, all in ten minutes. (*Engadget*, 8/7/16)

• Google's DeepMind has teamed up with the UK's National Health Service so that image-recognition

software can be used to diagnose various eye diseases in iris scans. (*Tech Crunch*, 7/5/16)

• A research team at Stanford has demonstrated that a machine-learning AI program can identify heart arrhythmias from an ECG better than an expert can. (*MIT Technology Review*, 7/7/17)

• Fukoku Mutual Life Insurance is replacing 34 human insurance-claim workers with IBM Watson Explorer at an annual savings of \$1.1 million per year in employee salaries. The language-processing software determines insurance payouts after reading patient records and medical bills. (*Quartz*, 1/2/17)

After cyber-security applications, healthcare is the second-largest area in which spending on AI is flowing. These examples demonstrate that AI is already replacing workers



"OK, but if sentient robots *don't* rise up and enslave humanity, what sort of careers might you be interested in?"

• JPMorgan has made the strategic choice to spend nine percent of revenues (\$9.6 billion) on tech R&D, twice the average proportion of other big banks. One application that has already emerged: an AI called COIN that replaces 360,000 hours of work done by lawyers and loan officers to interpret commercial loan agreements. (*Bloomberg*,

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 Nasdag has partnered Digital Reasoning, with а language-processing ΑI that will scan communications on Nasdaq's platforms for signs of market manipulation, insider trading or other abuse. Presently the program is "going to school" as its programmers teach it by uploading the communications that occurred in advance of past market abuses. (American Banker, 11/15/16)

• NextAngels has designed a program that uses natural language processing to read and

comprehend new financial regulations and turn them into computer-understandable rules that can be applied to transactions. (*Wall Street Journal*, 5/19/16)

Financial Services and Asset Management

in "back office" parts of the healthcare industry, and the

capability to engage in the diagnostic part of the field,

typically the reserve of doctors, is being proven.

• Nomura's Simplex Equity Futures Strategy Fund is allowing its self-learning program to invest money. The program learns from its successes and mistakes over time and adjusts its strategy, not unlike the AI program that can beat poker champions. (*Bloomberg*, 8/21/16)

• Sentient Technologies, backed by both Hong Kong financier Li Ka-shing and the Tata Group, has spent 10 years in "startup" mode, researching and training an AI that can run a fund with full autonomy. The program learns to improve itself by simulating several years' worth of trading days in a few minutes. (*Bloomberg*, 2/6/17)

• Bank of America is developing "Erica," a virtual assistant that will inhabit the bank's mobile app. The goal is for Erica to be able to handle a wide variety of customer questions and requests, including providing the customers with analysis of their spending and savings patterns. (*Engadget*, 10/25/16)

Retail

• IBM's Watson is being used as the AI engine behind a Macy's experiment to create a digital "personal shopper" that will function on shoppers' mobile phones at any of 10 locations, answer questions and guide customers through the store. (*Pymnts*, 7/22/16)

• Staples has a chatbot embedded in its "Easy Button" to handle some of its customer-service inquiries. The bot will try to interpret customers' requests to order, reorder or check the status of an order and will handle the interaction without requiring a human representative. (*Internet Retailer*, 7/22/16)

• Using lasers and image recognition, a robot in Lowe's home-improvement stores can navigate the aisles and conduct inventory, a job previously done manually by humans. (*New York Times*, 7/17/16)

• Neiman Marcus has made available to its customers an image-recognition tool—take a picture of

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a garment you like and the store's AI will identify similar items that the department store has to offer. This application—answering photo-based inquiries—used to be handled by rooms full of people in India or the Philippines. (*Financial Times*, 11/23/16)

• Baidu is partnering with KFC in China to deploy a face-recognition feature when customers enter the store that can recall their previous orders. An



"Hi, welcome to the Uncanny Valley of Pancakes."

automated language system can also listen to and place orders. (*China Daily*, 12/29/16)

• Amazon built a bricks-and-mortar grocery store called Amazon Go, being tested by its employees, that has no full-time customer-service staff. An AI-powered app uses location sensors to track which items a customer picks up, and then automatically charges their Amazon account. Amazon sees this as a potential solution for rural areas too small or remote for a Walmart or Dollar Store. (*Adweek*, 1/2/17)

Military

• In a test done by the Air Force Research Lab and startup PSIBERNETIX, a drone-operating software called ALPHA was able to repeatedly beat an experienced Air Force pilot in a combat simulation. (*Bloomberg Defense*, 8/2/16)

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• Next year, the U.S. Navy plans to activate the Long-Range Anti-Ship Missile, or LRASM, a "semiautonomous weapon" that uses AI to avoid defenses and make final targeting decisions. Meanwhile, China claims to have developed a similar missile. (*The New York Times*, 2/5/17)

Beyond some of these key industries, AI is popping up in other areas: household appliances, increasingly autonomous cars (with yetunrealized implications for

insurance, road safety and legal liability), packaging design, artistic content creation, and education. The range of applications and effects on industries has the potential to be as significant as was the adoption of smartphones and the spread of Pervasive Computing, which began nearly a decade ago with the June 2007 introduction of Apple's iPhone.

In today's increasingly distraction-filled world of fake news, political scandal, and social media, three major issues deserve our attention for their potential to have long-term and outsized impacts on global society: the rise of the new Autocratic leadership in the world, China's Silk Road strategy, and the rise of Artificial Intelligence (see **IF 3802**, "Getting Our Heads On Straight," 1/23/17).

Considering the wide array of AI applications and the numerous industries impacted, AI is an area deserving of attention and examination right now.

Ripple Effects from Pervasive Computing



Ripple Effects from Artificial Intelligence

