FUTURUM. TECHNOLOGY INSIGHTS FOR BUSINESS LEADERS

OPPORTUNITIES IN COGNITIVE COMPUTING AND AI (ARTIFICIAL INTELLIGENCE)

2016-2020

DANIEL NEWMAN
Principal Analyst

SHELLY KRAMER
Principal Analyst

OLIVIER BLANCHARD
Senior Analyst

Published: 10/17/2016

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Futurum Research provides research, insights and analysis to the market that help tie leading and emerging technology solutions to strategic business needs. The purpose behind each of our reports is to help business executives and decision-makers gain a better understanding of the technologies driving digital transformation, connect the dots between the practical business requirements of digital transformation and the forces that impact employees, customers, markets and experiences, and take appropriate action regarding critical digital transformation opportunities.

Executive Summary

This report is an overview of the state of cognitive computing and artificial intelligence (AI) in 2016 and focuses on opportunities and challenges relating to human-AI partnerships, natural language processing, Big Data analysis, and AI-based automation leading into 2020 and beyond.

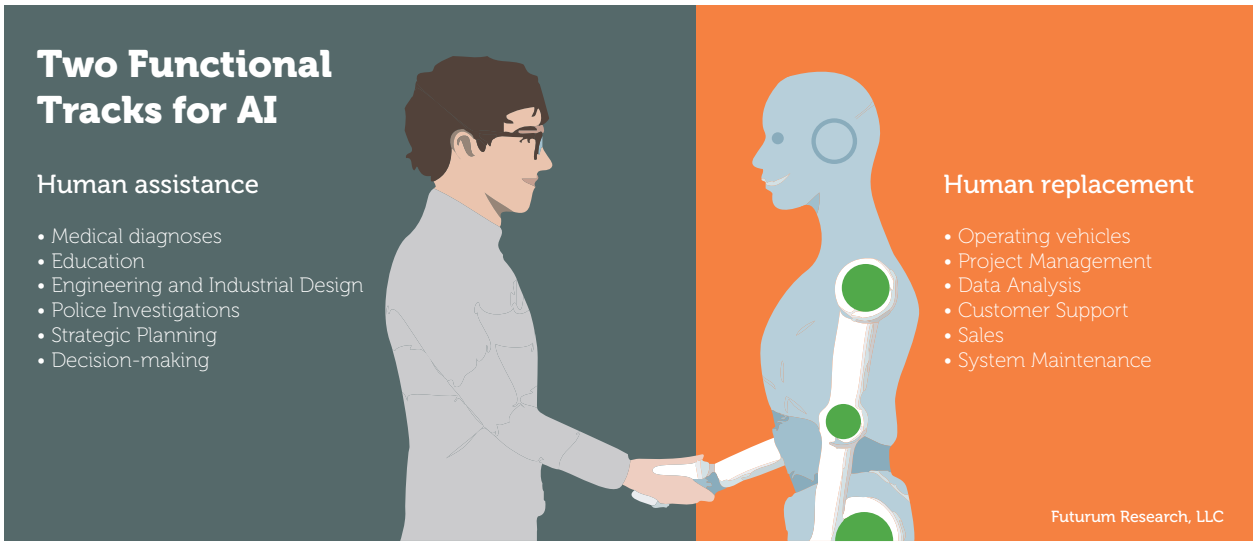
INTRODUCTION

Cognitive computing, often also referred to as artificial intelligence (AI) is any computerized or virtualized simulation of human thought processes that relies on adaptive self-learning systems that combine natural language, real-time data analysis, and pattern recognition to emulate or mimic human thought. The idea behind AI isn't simply to program supercomputers to sort through massive amounts of data; rather, it is to apply humanlike thinking, logic, and learning to the process of Big Data computing through a simple, intuitive, and natural language interface.

In short: if the massive computing capacity of the cloud cannot yet be connected to a human brain, humanlike thinking can instead be built into the cloud.

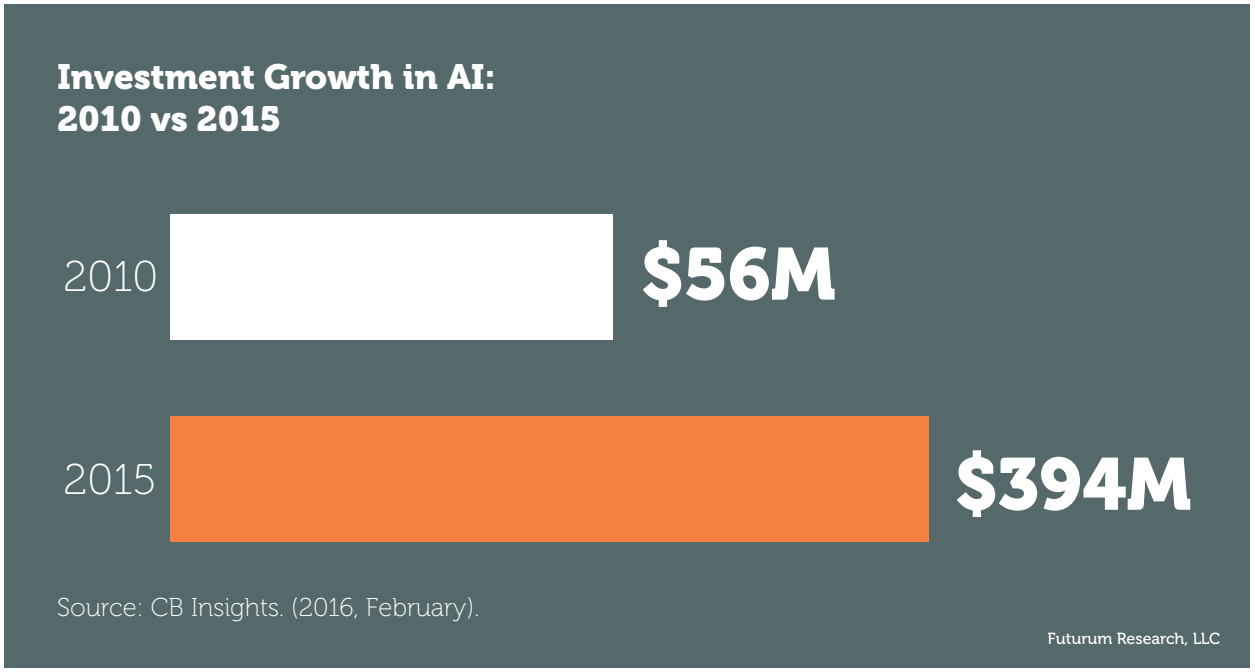
Artificial intelligence was once the realm of science fiction, but we squarely entered into the age of AI in recent years, with significant advances now finding their way into common technologies, from data analysis to task automation. Among the current leaders in the AI space are IBM, whose Watson AI continues to test the boundaries of AI applications in a variety of industries, from healthcare and medical research to marketing and fighting crime; Google, with its vast ecosystem of libraries and languages; and Microsoft, with its flag firmly planted in the center of the cloud API world.

The current state of cognitive computing offers two distinct but non-mutuallyexclusive trajectories of opportunity for the technology. The first involves AI-aided human tasks, in which intelligent computers assist humans in making decisions and performing tasks. The second involves intelligent automation, which eliminates the need for human involvement altogether. These two categories of opportunity will be the focus of this report.



The State of Cognitive Computing and AI

Commercial AI applications are still in their infancy, with AI moving steadily out of its proof of concept and case studies phase. According to CB Insights, however, the acceleration of investments in AI technologies, particularly with startups, is notable between 2010 and 2016. The relatively weak investment volume of $56 million in 2010 grew to a far more optimistic $394 million in 2014. [*] This acceleration appears to be continuing well into 2016, with healthcare, logistics, retail, utilities, and process manufacturing driving demand for AI solutions.



This trend, along with the tremendous potential for AI, helps put IBM's own massive investment in its AI solution (Watson) in perspective. Although growth has remained relatively slow as the technology works towards realizing its potential, it is worth noting that IBM's Watson division has set a $10 billion revenue target to be reached by the end of 2023.

As mentioned above, technology solutions giants Microsoft and Google are also actively developing their own AI solutions, specifically Microsoft Azure and Google DeepMind. Google's DeepMind AlphaGo project recently made headlines for defeating the world's best Go player, Lee Sedol, in a 4-to-1 match, in a demonstration reminiscent of Watson'svictory against human "Jeopardy"contestants just five years ago.

However, beating humans at complex games is not the ultimate goal of cognitive computing. These are merely demonstrations of AI capabilities. At its core, cognitive computing's purpose is to bring sense to the chaos of data, especially massive sets of data, and to do so in real time, in the most appropriate context, and in a way that mimics human thinking; that is, whatever a human mind could accomplish if it had the computing power of the cloud.

Source: CB Insights. (2016, February). Deep Interest In AI: New High In Deals To Artificial Intelligence Startups In Q4'15. Retrieved May 20, 2016 from cbinsights.com

Cognitive Computing and Human Partnerships

Cognitive computing is designed, first and foremost, to help users do their jobs better and/or improve outcomes. Since one of the principal features of AI is a natural language interface that allows users to converse with intelligent computers in much the same way that they would interact with human beings, AI can easily be integrated into virtually any vertical, role, or environment. Natural language interfaces promise to eliminate most technical barriers of entry for every profession, regardless of cultural, socioeconomic, or generational concerns.

Here are a few examples to illustrate what human-AI partnerships look like in the professional world:

HealthCare – Assisted by super-intelligent computers, doctors can, for instance, both improve and accelerate patient diagnoses, then prescribe customized treatments based on each patient's medical profile.Depending on the degree to which diagnostic systems are aware of a patient's medical history, genetic information, environmental factors, and lifestyle, the margin of error for both diagnoses and treatments can benarrowed down to virtually zero.

Finance – Economists and financial analysts can use a combination of Big Data and cognitive computing to better understand, model, and predict market behaviors. These models can, for instance, be used to anticipate market swings, as well as replicate their ripple effects, recovery trajectories, and recovery velocity. This type of AI-aided predictive modeling can also be used to anticipate stock and fund performance, visualize complex causality nexuses, and determine the viability of various investments.

Marketing - Marketers can leverage cognitive computing to maximize the ROI of their campaigns and programs by better understanding customer behaviors. Social, demographic, transactional,and personal data can be layered and analyzed to create behavioral profiles for individual consumers. Common denominators among consumers can also be identified and used to segment consumers into an infinite set of batches that marketers can then target or engage based on the AI's recommendations. This degree of specificity has the potential to turn what was once essentially a scattershot model with low ROI into intuitive, personalized precision-marketing with high ROI.

Environmental Design and Management - By combining cognitive computing, the Internet of Things (IoT), cloud solutions, and Big Data, urban designers, city managers, engineers, and architects can design smarter andmore efficient cities, buildings, and utilities. The result will be to mitigate many of the common challenges associated with complex urban environments, such as traffic congestion, environmental pollution, power distribution, utilities management, crime prevention, and emergency response.

Business – Business leaders can leverage cognitive computing to turn their decision-making from a traditional "gut feeling and instinct" guesstimate mode to a broad data-driven mode based on deep learning and analysis, which bears a statistically far better chance of achieving the organization's desired outcomes. After all, why leave complex decisions to chance when you can have a super-intelligent computer make them for you?

This list can easily be expanded to other fields, from engineering, applied sciences, and automotive research to law enforcement, education, and public policy.

User-Focused Applications for Cognitive Computing and AI

There are other ways in which cognitive computing and AI can be useful:

Virtual Assistants - One of the most promising categories of AI products is the virtual assistant. If you aren't familiar with virtual assistant AI, think Apple's Siri, Google's Google Assistant, Amazon's Alexa, and Microsoft's Cortana. Although limited in their capabilities, these four early-generation virtual assistants have given us a glimpse into the role that AI can play in our daily lives, from helping us organize our schedules and prioritize our workdays to helping us shop, book flights, and solve simple everyday problems.

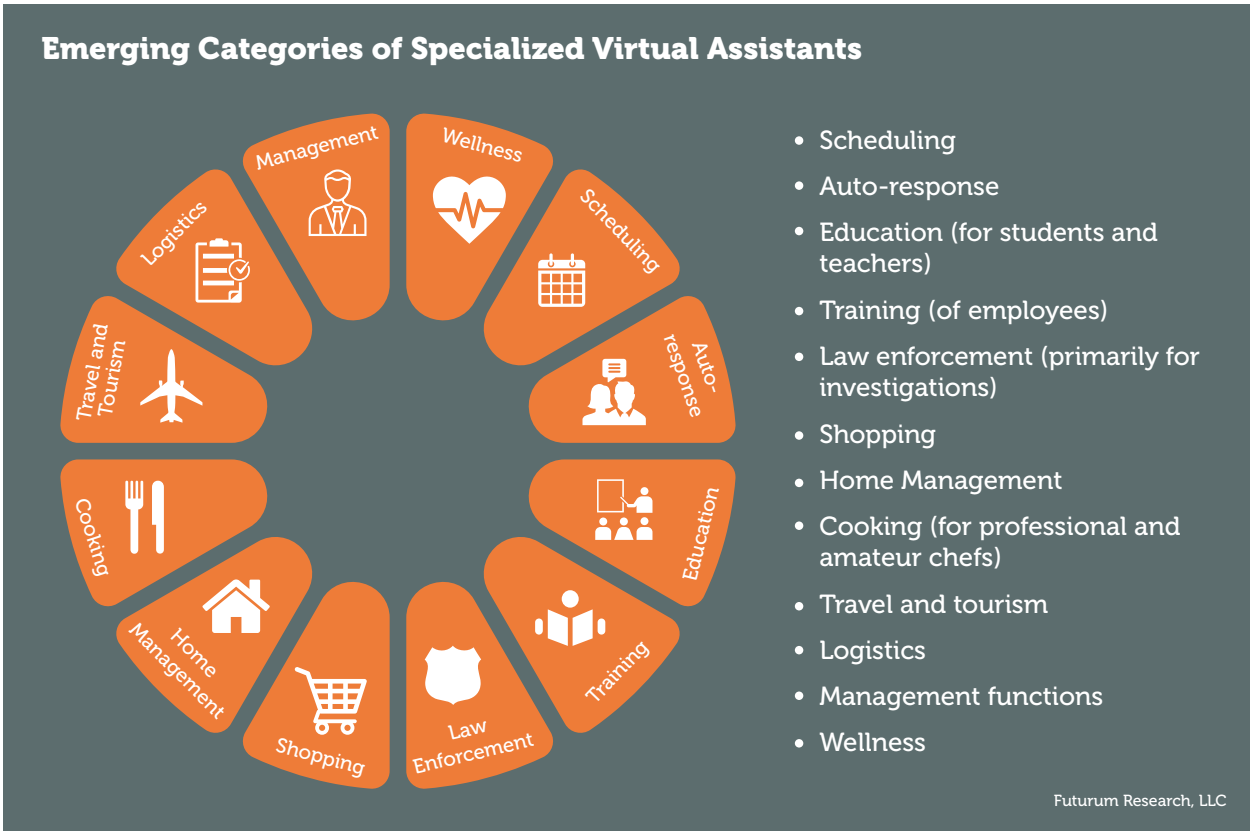
One of the most frustrating limitations for users until now has been the performance of the natural language interface, which either makes interactions with the AI unreliable or limits the virtual assistant's operational flexibility to a small number of tasks. These early-generation wrinkles are quickly being ironed out, and we expect virtual assistant language interfaces and their range of capabilities to feel far more humanlike by 2020.

Specialized Virtual Assistant AI - We are seeing a shift towards specialization in virtual assistant AI, which could signal the genesis of a subset of purpose-driven AI niches. Unlike Siri and Cortana, which focus on whatever needs their users may have at any given time, specialized AI tend to concentrate on narrow fields of specialization. For instance, Personal Health 360's Shae is a virtual assistant that mostly works with users to manage their health. Lifebeam's Vi is a personal trainer AI that captures and analyzes data from a variety of IoT devices like heart rate monitors, cadence sensors, and GPS, and integrates with popular fitness apps like Strava, Apple HealthKit, and Google Fit. The humanlike Vi provides users with real-time feedback on their workouts, including encouragement and expert advice.

From a bird's eye view of the market for specialized AI, we see tremendous potential for AI-based health management outpatient care applications, particularly in relation to post-surgery recovery, chronic illness management, and senior care. A specialized AI can help patients manage and even accelerate their recovery after a medical procedure. With the assistance of specialized AI, patients living with chronic conditions can better manage their

symptoms and their day. Elderly patients can also use specialized AI to regain some degree of autonomy, especially when combined with IoT and smart home solutions. Although specialized virtual assistants cannot perform all of the duties of a medical professional, they can perform important daily management and assistance functions around the clock.

See the graphic below for specialized virtual assistant AI products we expect to emerge in the next three to four years:



The Shift to IoT Virtual Assistant Interfaces

Although smartphones and computers have traditionally been the hardware platforms of choice for virtual assistants, we are noticing a push towards dedicated devices and IoT integration. An early example of this is Amazon's Echo, which was followed by Google Home and Samsung's experimental Otto project. Echo, Google Home, and Otto are essentially Internet-connected microphones and speakers that apply users' natural spoken language to search the web, answer questions, control other devices, shop, and play media.

One of the interesting design directions taken by Samsung with Otto is the decision to make it more than just a nondescript object. Its subtle robot-inspired styling gives it the hint of a human head, face, and eyes,which evokes a sense of a physical presence and even a personality, much like a home-based tabletop robot. Psychologically, this may encourage users to interact with it more often and therefore extend the range of users into younger and older demographics. Otto isn't meant to serve as a companion robot, but we can see how some future incarnation of Otto could easily transition into that role. In terms of capabilities, Otto is also equipped with built-in cameras that can stream video directly to a user's phone, and perhaps more interestingly, uses facial recognition to identify users. As we expect facial recognition to become a staple of home automation and AI-based devices

in the future, it is a good sign that this technology has turned up in Samsung's Otto project.

As smart technology continues to evolve in homes, offices, retail establishments, and vehicles continue, we expect that virtual assistant AIs will further embed themselves into the fabric of these environments. This isn't to say that virtual assistants will completely migrate away from our mobile devices—they won't, but users will be able to access their virtual assistants from multiple interfaces and interface points, namely vehicles, appliances, wearables, and connected objects.

As the IoT further embeds itself into everyday objects and surfaces, so,too grows the range of AI interface possibilities. It is entirely conceivable that an AI interface will soon be connected in homes to every piece of furniture and surface, from pantry shelves and bathroom mirrors to kitchen counters and window panes.

Virtual Assistant AIs and Users with Special Needs

Earlier in this report, we mentioned the role that AI can play in eldercare and patients managing chronic illnesses. The point at which a virtual assistant AI becomes effectively integrated into smart environments is also the point at which this potential can be fully realized. An AI-connected home can, for instance, ensure that patients are prompted to take their medication at the required intervals.

Beacon and sensor-equipped medicine dispensers, combined with smart surfaces, can also assist in ensuring that the patient is about to take the correct medication in the correct dosage. If an error occurs, the AI can immediately notify medical professionals or emergency services. The ability to autonomously notify emergency responders whenever a medical emergency occurs shouldn't be taken lightly. Falls are the leading cause of home injury deaths; each year, roughly 6,000 Americans die from falls that occur in their own homes, and one in three Americans over the age of 65 suffers a fall that may lead to lasting injuries.

Virtual assistant AIs embedded in smart environments can also provide friendly, nonjudgmental supervision and assistance, ranging from preparing meals and doing laundry to controlling the water temperature of a bath and automatically turning off the stove when no longer in use.

Earlier in this report, we mentioned companion robots. Although we don't want to segue completely into the world of robotics, it makes sense to at least mention that particular subset of AI-based solutions. Companion and assistance robots will soon be part of the intelligent ambient technology ecosystems discussed here. Early incarnations of these intelligent machines include Softbank Robotics' Nao and Pepper, Blue Frog Robotics' Buddy, and less anthropomorphic social robots like Jibo.

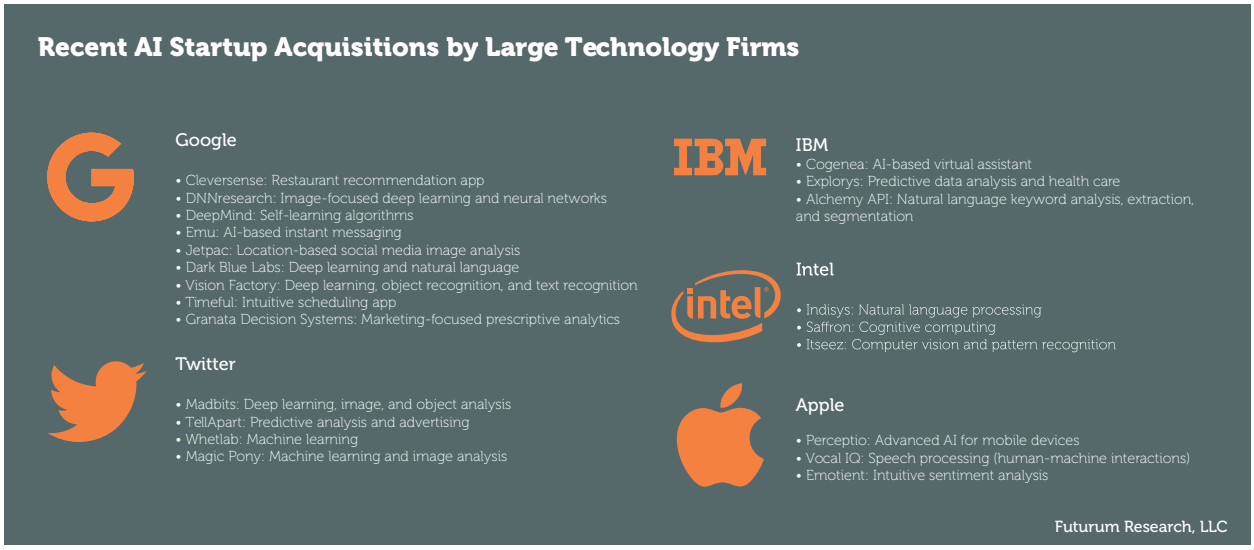
As consumer/home robots also grow more specialized, we anticipate growth in key demographics, including children, singles, seniors, and patients requiring some degree of home care.

AI's Impact on Business Processes and Big Data

We are seeing a recent and definitive trend towards AI integration in Big Data analytics, signaling that AI and Big Data will find themselves thoroughly intertwined by 2020. As AI promises to help analyze massive amounts of data and derive increasingly more accurate insights, both real time and predictive, this inevitable synergy has been a long time coming.

Salesforce's acquisition of the machine learning startup PredictionIO in February 2016, the AI startup Metamind in April, the predictive analysis platform Implisit, and the intuitive scheduling app Tempo AI in May, as well as the subsequent announcement of a new AI initiative called Einstein in late August, all illustrate the sort of acquisition and development roadmap that should become fairly standard among large tech and solutions companies over the next three to five years. As AI becomes increasingly prevalent in day-to-day applications, it is only natural that it should also find its way into common business software. Natural language interfaces, deep learning, intuitive automation, and scalable Big Data analysis will grow to become standard features of all major business solutions.

A breakdown of AI startup acquisitions over the last few years reveals that major tech companies are serious about not only where the technology is going, but also (and more importantly) what their primary uses for AI seem to be. Below are a few examples (see graphic):



The above graphic shows just a short list of acquisitions. It doesn't include other large stand-alone projects like Google Assistant, Open AI, IBM's Watson, or Facebook's DeepText (not to mention its FAIR and AML labs).

While much of the cognitive computing and AI work being done involves text, image, object, pattern, and language recognition, the cognitive computing capability that always rises to the top of our list is the ability to quickly convert massive amounts of data into patterns, intelligence, and insights. Bringing natural language processing into the mix not only improves the ability of learning machines to think, learn, and analyze data on a user's terms, but it also erodes both intent and language barriers between machines and humans.

As we see it, the ultimate outcome of cognitive computing as it relates to data analysis and business management is software is the ability to not only answer questions but also to anticipate them, as well as suggest courses of action and model entire campaigns, programs, and program lifecycles. Intelligent computers will remove a lot of the guesswork and risk from decision-making, and that capability alone should figure at the top of every executive's list when thinking about investments in cognitive computing and AI-based technologies.

The Rise of AI-Based Automation

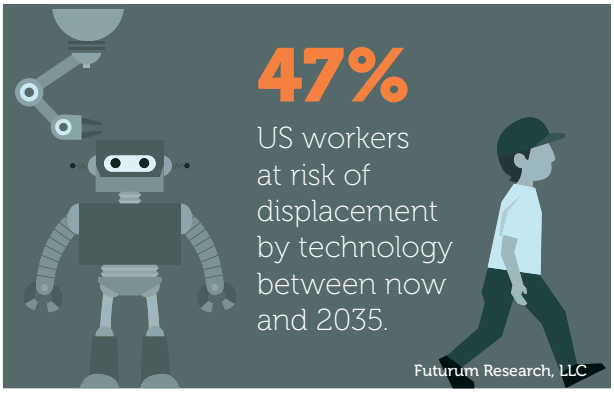
One of the biggest concerns about cognitive computing is the impact it will ultimately have on the job market. It is one thing to enhance the capabilities of healthcare professionals, CEOs, engineers and data scientists with AI solutions, but it is another thing entirely to replace humans with AI-based software. One of the looming societal and organizational challenges of AI integration is that as AI opens the doors to humanlike automation, millions of jobs may soon become obsolete.

- Self-driving vehicles, for instance, could eliminate the need for commercial truck drivers, bus drivers, airline pilots, ship crews, and cab drivers.
- AI-powered virtual "bots" could soon eliminate the need for human customer service representatives and salespeople.
- Business strategists, accountants, law clerks, personal assistants, cashiers, media planners, CEOs, and even technology analysts could someday be replaced by lifelike AI designed to sound, think, and behave like humans—only smarter and more productive.

Regardless of the moral, cultural, and macroeconomic aspects of this discussion, the move towards business automation is already underway, and the fast-growing robotics and AI markets are likely to deliver productivity boosts as high as 30 percent by 2020 in certain industries. If this actually happens, it is sure to catch the attention of more than a few COOs and CFOs.

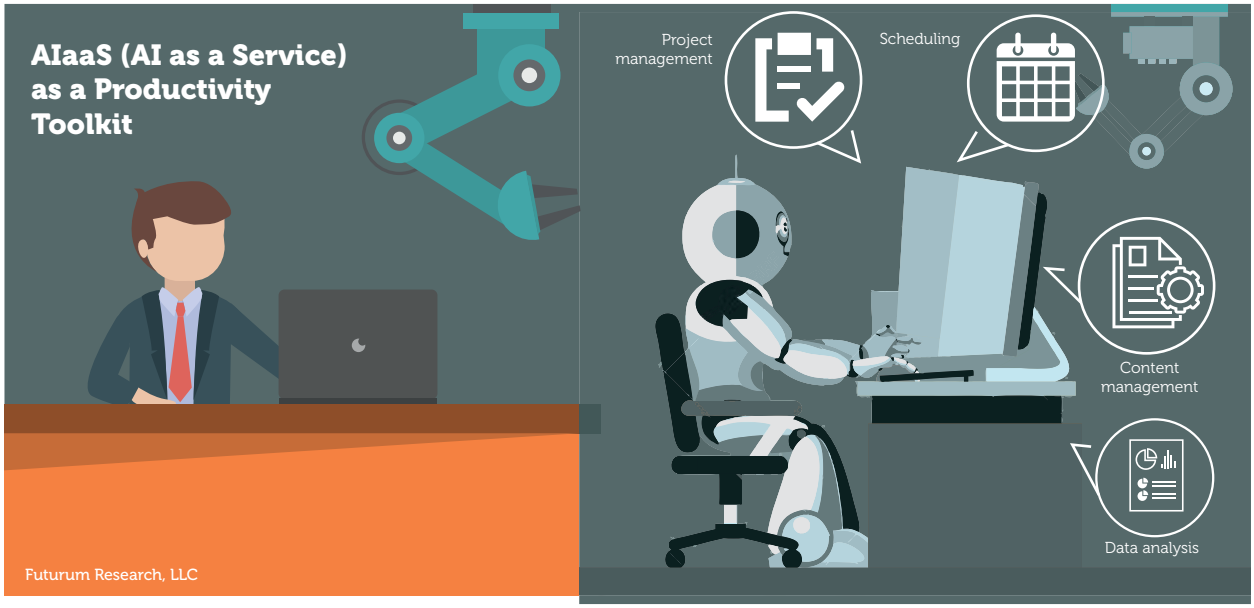
The simplest way to look at this impending shift is to take a step back and note that where automation and robotics once threatened mostly manual labor roles, AI now presents a similar threat

to knowledge workers, whose jobs could not, at least until now, be performed by machines. Many data entry workers are now at risk of becoming obsolete in the same way that assembly line workers were 20 years ago. Many call center workers are looking at the same end of the line because of AI as field technicians are because of IoT solutions. The bottom line is that as many as 47 percent of workers in the US could be displaced by technology between now and 2035[+]. This knowledge will give most workers in at-risk roles time to transition to other careers, but the question remains whether new technologies and the coming industry shifts will create as many jobs as they eliminate.



The challenge businesses will face in the coming decade will relate to striking the right balance between automating tasks that no longer require human intervention or management and enhancing human-driven roles with AI solutions. Equipping decision makers, project managers, attorneys, retail clerks, and analysts with AI capabilities may ultimately be a more efficient model than replacing them with machines. Looking beyond the horizon of the next 10-year window, the backlash against automation, especially if it is perceived as a major source of economic and social unrest, could shift the balance between human-assisting AI and AI-based automation toward the former rather than the latter.

Note that AI may also give rise to an industry of independent contractors capable of leveraging virtual teams of AI-driven workers to boost their own productivity and thus gain a competitive advantage over their competitors. AI as a service (AIaaS) could potentially bolster a new era of millennial "gig economy" micropreneurs in the next decade.



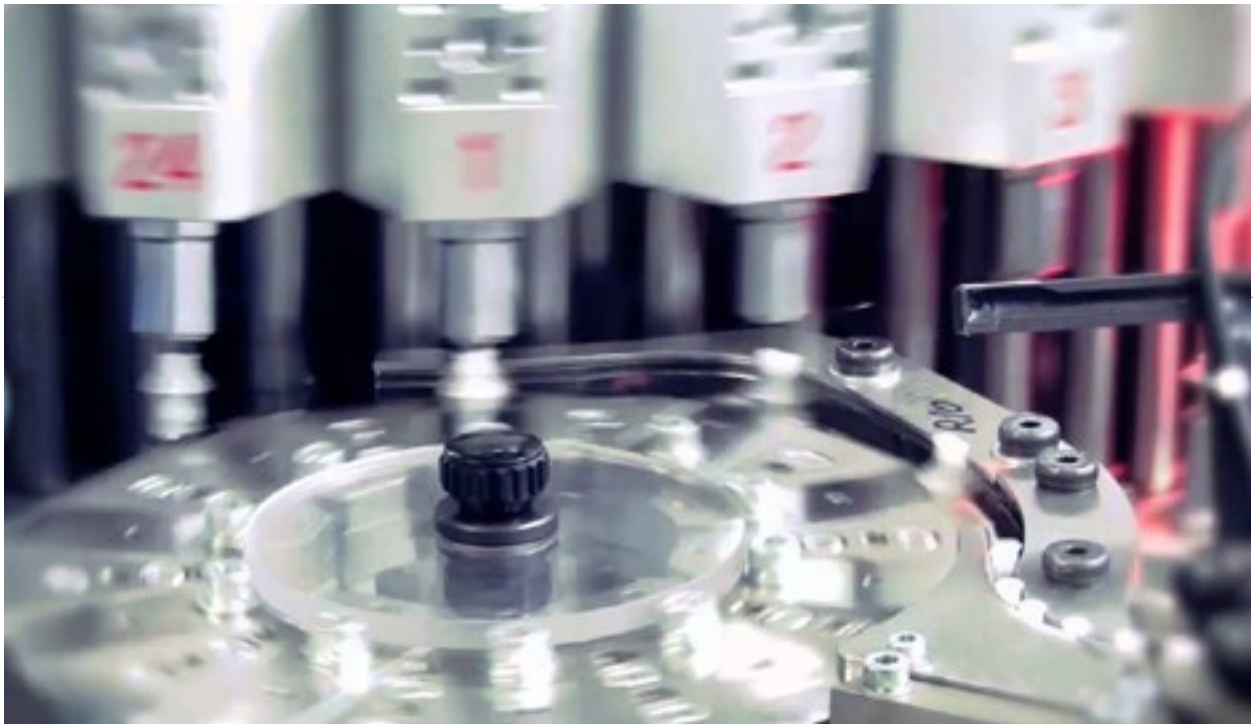
+ Source: Bank of America Merrill Lynch. (2016, December). Robot Revolution – Global Robot & AI Primer. Retrieved May 11, 2016 from bofaml.com

Key Takeaways

As purpose drives function, it also drives demand. Although companies like IBM, Microsoft, Google, Facebook, Apple, and Salesforce continue to invest in cognitive computing and AI research, demand for solutions that impact everyday users in the real world will also drive the direction of cognitive computing and AI applications.

We are already seeing the technology being applied to healthcare research and medical diagnostics. Social networks, search engines, and advertising companies are also using machine learning, deep learning, language processors, and content analysis to better understand their ecosystems and improve their value to users, clients, and partners. Financial analysts are using cognitive computing to build algorithms that will allow them to better predict market behaviors and anticipate disruptive shifts. B2C companies are starting to use cognitive computing to visualize the dynamics of their markets in real time and both predict and influence their customers' behaviors.

In other words, machine learning and cognitive computing are perfectly positioned to help realize the full potential of programmatic Big Data investments. To invest in Big Data is ultimately to invest in cognitive computing and vice versa; within the next 10 years, these two technologies will be indistinguishable from one another.



With the ability to analyze quasi-unlimited amounts of data in real time, decision-making for consumers and executives alike will increasingly shift from imperfect "cross my fingers and hope this works" estimates to strategic AI-assisted decisions with far better probabilities of success. Whether the decision involves buying a new car or investing millions of dollars into a new technology solution, intelligent computers will help us make better decisions.

Natural language interfaces promise to eliminate technical barriers of entry between users and software. As AI becomes increasingly embedded in ubiquitous technology solutions, rudimentary input interfaces like keyboards will be replaced by far more natural, conversational, and social interfaces. This ease of use will accelerate adoption of AI in the business world as well as in the realm of con-

sumer products with minimal friction at the low and high ends of the age spectrum.

Speaking of age, we expect to see AI specifically designed to adapt language and behaviors based on the age of its users. The development of companion robots both for children and the elderly is paving the way for these kinds of subtle but important adjustments in AI interactions with their users. The ability to adjust to users' needs will be a vital component of AI applications as the technology becomes increasingly embedded into the fabric of our daily environments. The connective tissue between AI and IoT is particularly rich in possibilities, both on the business and enterprise side of things and in the world of consumer products.

Though the trend towards AI specialization has caught our attention, we expect to see a consolidation of AI applications as AI developers begin to think about environments rather than specific objects and individual interfaces. We are talking about the difference between AI integration into the Internet of Things (IoT), which is object-centric, and AI integration into smart environments, which are ambient in nature. The transition from IoT to smart environments is mostly a matter of market and technological maturity. Although we understand smart environments and are already creating their building blocks, we are still in the IoT phase of this evolution. As we begin to transition to a true ambient technology way of thinking, where AI is designed not simply to be integrated into an application or connected to an object but rather designed as a cognitive OS for smart environments, we expect to seelayers of AI specialization converge into a more elastic and infinitely versatile form of operationally protean AI. Smart offices, homes, cities, and vehicles will eventually cease to be the sum of their IoT and AI partsand will instead be capable of anticipating and responding to the users' spectrum of needs far more intuitively.

We are approaching a fork in the road where economic factors will separate human-AI collaborative synergy from AI-based automation. Jobs that can be automated will be, and as learning computers and natural language interfaces become more human-like, AI will naturally begin to take the place of certain human roles. Data entry, customer service, accounting, copywriting, editing, and digital sales are high on our list of at-risk roles in the coming decade. On a long enough timeline, many more jobs will become obsolete. For the time being, however, organizations looking to integrate cognitive computing into their digital transformation initiatives should focus on a mix of human-AI collaborative synergies, in which cognitive computing both accelerates and improves business outcomes and KPIs, and AI-based automation is leveraged to improve the efficiency and velocity of processes that can and should be automated.

Futurum Research, LLC
www.futurum.xyz
817-480-3038
info@futurum.xyz
Twitter: @futurumxyz