Cognitive technologies in the technology sector

From science fiction vision to real-world value

A Deloitte series on cognitive technologies

Deloitte University Press

Deloitte offers a broad range of services to clients in all sectors of the technology value chain, from computer hardware and software vendors to networking equipment, semiconductor, and IT services organizations. Read more about our Technology industry practice on www.deloitte.com.

About the authors

Daniel T. Pereira

Daniel Pereira, Deloitte Services LLP, is a market insights manager in technology, media, and telecommunications. Prior to joining Deloitte, Pereira was the managing director and research affiliate on two corporate sponsored research projects at the Massachusetts Institute of Technology and a strategic consultant specializing in cross-sector innovation, business model generation, and lean startup methodologies.

David Schatsky

David Schatsky, Deloitte LLP, tracks and analyzes emerging technology and business trends, including the growing impact of cognitive technologies, for Deloitte's leaders and its clients. Before joining Deloitte, Schatsky led two research and advisory firms. He is the author of *Signals for Strategists: Sensing Emerging Trends in Business and Technology* (RosettaBooks, 2015).

Paul Sallomi

Paul Sallomi is a partner in Deloitte Tax LLP and the global technology, media, and telecommunications industry leader. He is also the US and Global Technology Sector Leader. In his role with the US member firm, Sallomi helps clients transform their business and operating models to address the emergence of new, disruptive technologies. For nearly 25 years, he has worked with clients in the technology, media, and telecommunications industries to shape and execute options for growth, performance improvement, regulatory compliance, and risk mitigation.

Robert (Bob) Dalton

Bob Dalton is a principal and 30-year veteran with Deloitte Consulting LLP, where he leads the global relationship with the IBM Corporation. Deloitte and IBM have a complex ecosystem involving a bi-directional client relationship as well as a significant alliance relationship. As part of the alliance relationship, there is a significant focus on business analytics, information management, and cognitive technologies. Deloitte is actively working with the core Watson business unit as well as Watson Health.

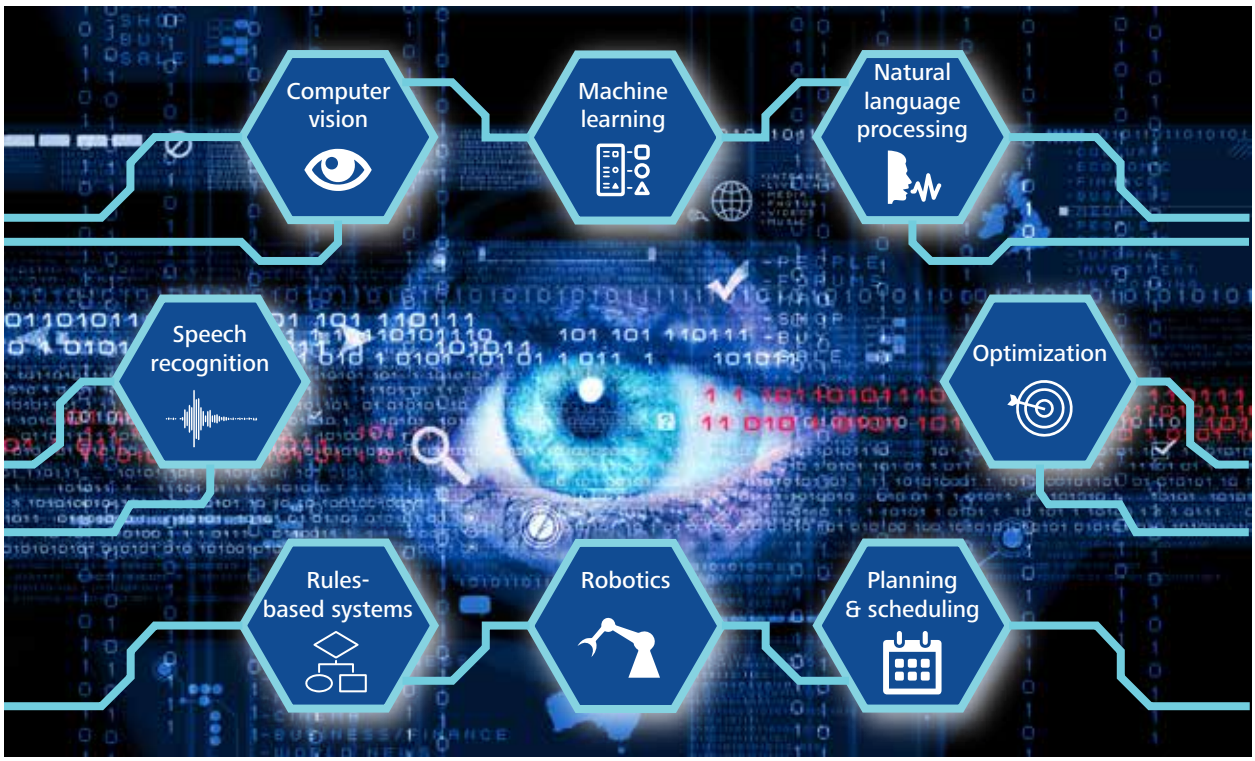
Contents

Introduction

ARTIFICIAL intelligence is certainly no longer considered science fiction—or a source of expensive R&D efforts with unmet potential—by major players in the technology sector.[1] Instead, we are in the midst of a real-world paradigm shift: the final stages of a decades-long transition from the *scientific discipline* known as artificial intelligence (and its various sub-disciplines) into an array of *applied cognitive technologies* made more widely available through innovative enterprise architectures unique to the business culture of the technology sector.

The technology sector's interest in these technologies (figure 1)[2] has exploded in the last several years. Networking companies, semiconductor manufacturers, hardware companies, IT providers, software providers, Internet players—just about every technology subsector has seen a substantial upsurge of activity in this space. In fact, the race to invest in artificial intelligence has been described as "the latest Silicon Valley arms race."[3] Since 2012, there have been 100 mergers and acquisitions (M&A) within the technology sector involving cognitive technology companies, products, and services.[4] And this rush of M&A activity is not the only sign of the industry's interest. Many capabilities that were only just emerging a few years ago are now essentially mature and becoming "democratized" and more readily available for business applications. As a result, leading companies are using cognitive technologies to enhance their existing products and services, as well as to open up new markets.

Figure 1. Widely used cognitive technologies



What is interesting is that the assertive actions of the sector's leaders do not mirror the wholesale adoption of these technologies across the industry. Many technology sector companies have yet to turn their attention to how cognitive technologies are changing their sector or how they—or their competitors—may be able to implement these technologies in their strategy or operations.

Many technology sector companies have yet to turn their attention to how cognitive technologies are changing their sector or how they—or their competitors—may be able to implement these technologies in their strategy or operations.

To help leaders better understand these issues, this report considers three perspectives. First, we examine recent M&A activity to determine which cognitive technology capabilities are attracting the most attention. Second, through the examples of the IBM Watson Group and Alphabet/Google, we explore how cognitive technologies can transform business models, helping companies compete in the future marketplace. We also focus on the two main approaches technology companies are using to pursue marketplace opportunities: cognitive technology development platforms and cognitive technology platform-as-a-service (PaaS) offerings. We conclude with a discussion of the go-to-market considerations for large and midsized technology companies, as well as next steps for not only technology sector companies but also technology-enabled enterprises in any industry or vertical market that want to further explore cognitive technologies' potential.

- **Computer vision**: The ability of computers to identify objects, scenes, and activities in unconstrained (that is, naturalistic) visual environments
- **Machine learning**: The ability of computer systems to improve their performance by exposure to data without the need to follow explicitly programmed instructions
- **Natural language processing (NLP)**: The ability of computers to work with text the way humans do—for instance, extracting meaning from text or even generating text that is readable, stylistically natural, and grammatically correct
- **Speech recognition**: The ability to automatically and accurately transcribe human speech
- **Optimization**: The ability to automate complex decisions and trade-offs about limited resources
- **Planning and scheduling**: The ability to automatically devise a sequence of actions to meet goals and observe constraints
- **Rules-based systems**: The ability to use databases of knowledge and rules to automate the process of making inferences about information
- **Robotics**: The broader field of robotics is also embracing cognitive technologies to create robots that can work alongside, interact with, assist, or entertain people. Such robots can perform many different tasks in unpredictable environments, integrating cognitive technologies such as computer vision and automated planning with tiny, high-performance sensors, actuators, and hardware.

Which cognitive technologies are hot?

The tech sector's big M&A push

COGNITIVE technologies encompass a diverse set of capabilities, and the pattern of technology companies' M&A activity over the last three years reflects this diversity. Targeted deals have recently surged, spanning everything from robotics and sensor specialty firms to machine learning and natural language processing (NLP) companies.[5]

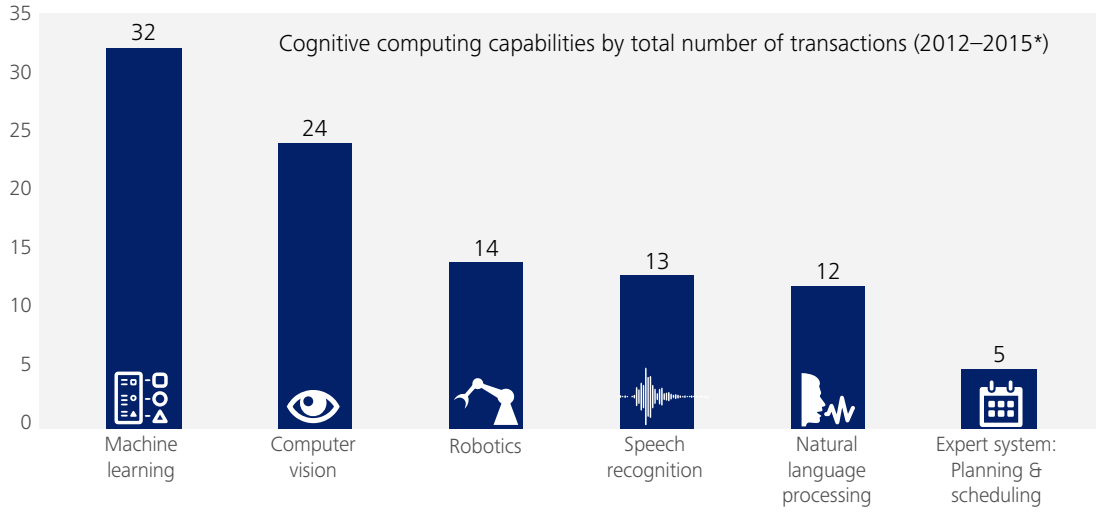
A close analysis of 100 mergers and acquisitions involving cognitive technologies between 2012 and 2015 reveals strong strategic investments by the tech sector in certain technologies.

Some general trends point to which cognitive technology capabilities are the most sought after: M&A activity has been highest among machine learning and computer vision companies since 2012 (figure 2), with noticeable spikes in robotics company acquisitions in 2013 and machine learning and speech recognition company acquisitions in 2014 (figure 3).

Further analysis of the announcements for these M&A deals makes it clear that, in the overwhelming majority of cases, the acquirer's intent is to generate new revenue from new customers and new markets by improving *product and service innovation*. Some companies prefer to use cognitive technologies to fuel innovation in existing products, while others aim to build stronger technology platforms for a wide array of solutions, offerings, and operations.

Our review of the marketplace points to three main ways in which industry leaders are harnessing these technologies:

Figure 2. M&A transactions by cognitive technology capability

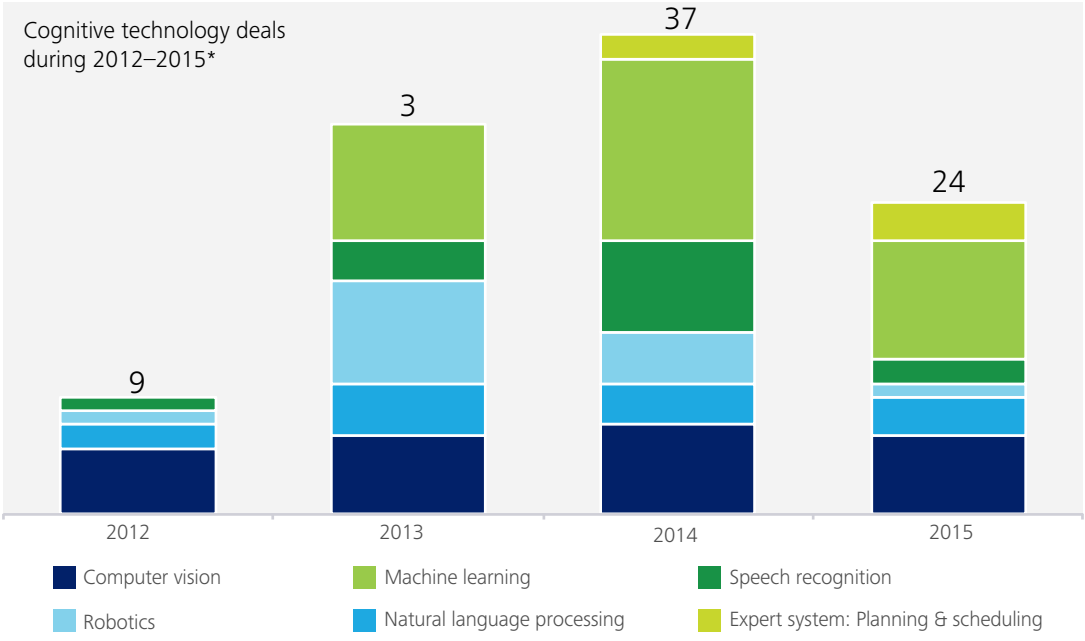


*Until Deceber 1, 2015

Source: Deloitte analysis.

Graphic: Deloitte University Press | DUPress.com

Figure 3. Technology sector M&A deals involving cognitive technologies



*Until Deceber 1, 2015

Source: Deloitte analysis.

Graphic: Deloitte University Press | DUPress.com

Business model transformation: New business units are created to increase volume and grow revenue through cognitive technology-enabled innovation.

Development platforms: Platforms that allow for open collaboration with an extended developer community are built, accelerating the speed and scalability of product development and product release efforts.

Platform-as-a-service offerings: Modular, extensible products are redesigned for the computing-intensive demands of cognitive technologies, allowing both current and new customers to easily transition to PaaS offerings as well as companies to rapidly position their PaaS offerings in new markets.

Why companies embrace cognitive technologies

A path to business model transformation

WHY are technology companies pursuing cognitive technologies so aggressively? Research has shown that companies that exhibit superior performance over the long term have two distinctive attributes: They tend to differentiate themselves based on value rather than price, and they seek to grow revenue before cutting costs.[6] Thus a clear implication of our analysis is that by prioritizing substantial investments in cognitive technologies, companies aim to grow revenue by creating value through new or better products or services rather than by cutting costs. Beyond the incentives of greater revenue and market share, however, a deeper reason appears to be that these companies see cognitive technologies as a way to reinvent themselves to more effectively compete in the future—essentially, as a basis for business model transformation.

Indeed, the most striking finding is that technology companies create new business units to increase volume and generate revenue by using cognitive technologies not only for product innovation but also for structural, operations, process, and business model innovation as well. These new units are also designed to transform the architecture of the parent company over time. Such restructuring underlines cognitive technologies' potential to completely revolutionize the technology sector—and take many vertical industries and markets along.

The most striking finding is that technology companies create new business units to increase volume and generate revenue by using cognitive technologies.

IBM Watson Group

Perhaps the most clear-cut example of a technology company pursuing business model transformation through cognitive technologies is IBM. In January 2014, IBM invested $1 billion to launch the IBM Watson Group business unit; of this $1 billion, $100 million was earmarked as an investment fund "to support IBM's recently launched ecosystem of start-ups and businesses that are building a new class of cognitive apps powered by Watson in the IBM Watson Developers Cloud."[7] As Ginni Rometty, IBM's chairman and CEO, noted at the new unit's launch: "For those of you who watch us, we don't create new units very often. But when we do, it is because we see something that is a major, major shift that

we believe in."[8] This major shift is what IBM considers the dawn of a new era in the technology sector—what it is calling the "cognitive computing era."[9]

Designed as a radical business model transformation, IBM Watson Group seeks to build a robust business ecosystem, which is a complex, dynamic, and adaptive community "of diverse players who create new value through increasingly productive and sophisticated models of both collaboration and competition."[10] To this end, the IBM Watson Group provides open-source infrastructure for strategic partners to develop cognitive technology services in a host of different vertical markets (such as health care, financial services, media, and telecommunications). This business model allows the IBM Watson Developers Cloud to further expand as IBM acquires more cognitive technology companies.

An example of this acquisition strategy is IBM's acquisition of Denver-based AlchemyAPI, a cloud computing platform, now part of the IBM Watson Group.

AlchemyAPI created an NSL-based text analysis solution for developers along with software development kits (SDKs) in various programming languages,[11] as well as a platform for understanding pictures' content and context, which uses computer vision deep learning[12] not only for facial recognition, but also for image tagging and understanding complex visual scenes. The IBM Watson visual recognition service now utilizes this technology to recognize physical settings, objects, events, and other visuals. By January 2015, the service had more than 2,000 classifiers and trained labels for categories such as animal, food, human, scene, sports, and vehicle.[13] At the time of the AlchemyAPI acquisition, 160 ecosystem partners were developing applications on the IBM Watson Group's platform; this deal brought in an additional 40,000 developers who had already built code on top of the AlchemyAPI service platform.

IBM's investment in IBM Watson Group and in its ecosystem-based business model highlights that—as is the case with many cognitive technology product innovations—companies are not attempting to generate revenue directly from an easily identifiable "cognitive technology market." Instead, they are developing and expanding cognitive technology capabilities that are already generating revenue and market share in the fast-growing areas of data analytics and cloud computing. As IBM's Rometty explained in a recent interview, "Now, it is about speed and scale. . . . Our data analytics business is a $17 billion business already; cloud, $7 billion. These are big already. We now scale them: more industries, more people, more places."[14]

As evidence of this commitment to speed and scale—as well as an early sign of the transformation of the company's very architecture—IBM has recently made additional moves in the cognitive technology space. In April 2015, it announced the launch of IBM Watson Health and the Watson Health Cloud platform. Soon after, in August 2015, IBM Watson Health paid $1 billion for Merge Healthcare Inc.'s medical imaging management platform. This acquisition, while not directly involving a cognitive technology capability, gives IBM access to a data and image repository that can become an image training library for cognitive computing solutions directed at the health care market.[15] In October 2015, IBM CEO Rometty proclaimed that transforming health care through cognitive computing is "our moonshot."[16] (Moonshots are a concept fast becoming popular within the technology sector to describe audacious projects—projects that aspire to exponential, tenfold improvements [1,000 percent increases in performance]).[17] Finally, in the same month, IBM formed yet another cognitive technology business unit, the Cognitive Business Solutions Group.[18]

Alphabet, Inc. (formerly Google, Inc.)

In August 2015, Google Inc. announced its reorganization into the giant holding company Alphabet Inc., making Google (including Search, Android, and YouTube) a wholly owned subsidiary of Alphabet. Like IBM Watson Group, Alphabet is an ambitious structural and operational commitment to speed and scale—one that is fundamentally informed by and designed to enable the exponential growth of cognitive technologies.

"Moonshot thinking" was highly encouraged at Google and will continue to be encouraged at Alphabet,[19] as the company hews to an emerging business strategy framework known as "exponentials," which is based on the *exponential* acceleration of technologies such as quantum computing, artificial intelligence, robotics, additive manufacturing, and synthetic or industrial biology. These and other exponential technologies are creating new "competitive risks and opportunities for enterprises that have historically enjoyed dominant positions in their industries."[20]

Alphabet is, by design, an exponential organization (ExO)[21]—an organization "whose impact (or output) is disproportionally large, at least 10 times larger, compared to its peers because of the use of new organizational techniques."[22] Google is No. 5 on the Top 100 ExOs list, along with companies such as Airbnb, Uber, Tumblr, Medium, and Twitch. At No. 1 is the collaborative code and software development site GitHub.[23] Alphabet is making 10x growth a business priority supported from inception by the new company's enterprise architecture.

Judging from Google's recent M&A activity, cognitive technologies are integral to this business model transformation: Google acquired 20 cognitive technology companies between 2012 and 2015. In retrospect, these acquisitions were the strategic precursor to the restructuring of Google into Alphabet. Of these 20 deals, 8 robotics acquisitions were made in 2013 alone, all of which will be integrated into Alphabet. Their robotics capabilities range from humanoid robotic systems, the next generation of robotic arms, high-tech robotic wheels that can move in any direction, robots that use computer vision to better understand what they're looking at and learn how to handle non-standard situations, and robotics in the fields of filmmaking, advertising, and design.[24] A robotics acquisition from June 2014, the Massachusetts-based Boston Dynamics, has been restructured as a standalone Alphabet company.[25]

Another standalone Alphabet company is London-based DeepMind, which was acquired by Google in February 2014 for $400 million. Besides its innovation in neural networks for deep learning, DeepMind also has natural language and computer vision capabilities made available through two Google acquisitions in the fall of 2014 (Vision Factory AI and Dark Blue Labs). Other artificial intelligence capabilities integrated into Alphabet through previous Google M&A deals include facial-recognition software, gesture recognition, camera-based language translation, image recognition via smartphone cameras, machine learning for scheduling and task management, patents for a speech interface for search engines (with a system and method of modifying and updating a speech recognition program), and neural networks that improve voice and image search.[26]

How companies are innovating

Platforms and PaaS

If business model transformation predicated on cognitive technologies is the endgame—or one possible endgame—how are companies pursuing it? Our review of technology companies' activity around cognitive technologies and product innovation suggests that these innovations fall into two categories:

- **Development platforms**: Platforms—which are increasingly supported by global digital technology infrastructures that help to scale participation and collaboration—help make resources and participants more accessible to each other. Properly designed, they can become powerful catalysts for rich ecosystems of resources and participants, defining the protocols and standards that enable a loosely coupled, modular approach to business process design.[27] Cognitive technology developer platforms are emerging that allow organizations to collaborate with a community of passionate developers, which accelerates the speed and scalability of product development and product release efforts. An example is the IBM Watson Group's development platform, the Watson Developers Cloud.

- **PaaS extensions**: PaaS vendors provide a virtual IT environment that allows businesses to develop and run their own customized applications without having to manage the details of a physical or cloud-based data center.[28] Many companies have enhanced current PaaS offerings through modular, extensible products designed for cognitive technologies' computing-intensive demands. This approach allows a company's current and new customers to easily transition to the PaaS offering and enables the company to rapidly position its cognitive technology PaaS offerings in new markets. Again, the IBM Watson Group is illustrative: Watson Services on Bluemix is an open-standard, cloud-based PaaS for building, managing, and running applications of all types, such as mobile, big data, and new smart devices, providing a fully integrated service for cognitive technology innovation.[29]

Typically, these platforms and PaaS offerings target high-value, immediately addressable markets such as analytics, cloud computing, social, mobile, and security—all of which grew almost 20 percent in 2014.[30] Following are some examples from various technology subsectors.

The platform play: Cognitive technology development platforms

Intel's RealSense Technology Platform. Launched in 2014 the RealSense Technology Development Platform and Software Development Kit (SDK) are designed to connect developers with the tools and resources to develop applications with cognitive computing technologies. At RealSense's core are the capabilities of two companies Intel acquired in 2013: Omek Interactive, a computer vision company with a development platform based on 3D depth sensor cameras, and Indisys, an NLP company with a background in computational linguistics, artificial intelligence, cognitive science, and machine learning. With these cognitive technology capabilities, RealSense aims to provide a platform for the development of "perceptual computing"—Intel's term

for gesture, touch, voice, and other sensory technologies. Intel's objective is to transform the human-computer interface by empowering developers to "integrate hand/finger tracking, facial analysis, speech recognition, augmented reality, background segmentation, and more into your apps."[31]

The company is specifically positioning cognitive technologies as enabling the next generation of more intuitive gestural controls in the fast-growing mobile market.[32] Patrick Moorehead of Forbes states that perceptual computing "is the key to Intel's future, as it soaks up high degrees of computing resources."[33] If perceptual computing becomes inherent in the way people use their mobile devices, Moorehead may be right: Sales of mobile devices such as the Apple iPad mobile digital device and Microsoft Surface are expected to reach 21.5 million units this year—an increase of 70 percent over 2014—and 58 million units by 2019.[34] In addition, RealSense is available as a development platform for Windows 10, which has been optimized for cross-platform development (PC, smartphone, tablet, and so on).

> Typically, these platforms and PaaS offerings target high-value, immediately addressable markets such as analytics, cloud computing, social, mobile, and security—all of which grew almost 20 percent in 2014.

Nvidia Corporation's Digits 2 and CUDA Deep Neural Network. A company known for manufacturing graphics processor units (GPUs)[35] and software for the gaming industry, NVidia has released a variety of hardware and software product enhancements designed to increase their applicability to cognitive technology product development and to support customers' cognitive technology applications. Nvidia is placing its bets on GPU-accelerated deep learning, which it says will help developers bring increasingly smarter cognitive technologies to everything, from online image databases to household items to autonomous vehicles. In July 2015, the company announced a series of updates to Digits Deep Learning GPU Training System version 2 (Digits 2), its GPU-accelerated deep learning software, as well as to CUDA Deep Neural Network,[36] its GPU-accelerated library of algorithms to create and train larger, more accurate neural networks through faster and more sophisticated model training and design.[37] Based on company information made available in a Q2 2015 corporate earnings call, Nvidia has developed GPU-accelerated software that doubles deep learning performance for data scientists and researchers. The company also reported that it has over 3,300 developers and companies interested in machine learning and that "deep learning is a new, exciting application."[38]

At the hardware level, the company's Tegra microprocessors are built for embedded products, mobile devices, autonomous machines, and automotive applications. In January 2015, the Tegra® X1, an innovative mobile chip with over one teraflop of processing power[39] and "capabilities that open the door to unprecedented graphics and sophisticated deep learning and computer vision applications,"[40] was released.

The "cloud wars": Cognitive technology PaaS

The so-called "arms race" in cognitive technologies began long ago between the technology company superpowers—Google, Amazon, Microsoft, IBM, Facebook, and Apple—in the form of investments in strategic R&D. With the enterprise cloud market expected to grow from $70 billion to more than $250 billion by 2017, this race has escalated into full-blown combat, with machine learning as the battleground.[41]

Amazon Web Services (AWS) Machine Learning. In the case of Amazon, machine learning as a service dates back to the company's early offerings of infrastructure as a service (IaaS) and software as a service (SaaS) through Amazon Web Services (AWS).[42] Amazon's recent launch of a machine learning-based PaaS offering can be seen as a direct result of its significant, long-term strategic research and development investments, notwithstanding the criticism these investments have attracted from investors and Wall Street.[43]

In April 2015, Amazon.com launched Amazon Machine Learning, an enhancement to AWS that makes it easier for developers to build predictive models for a variety of use cases, including detecting potentially fraudulent transactions, reducing customer churn rates, and improving customer support.[44] Traditionally, building applications with machine learning capabilities necessitated expertise in statistics and data analysis, as well as experience in training a model with machine learning algorithms. Evaluating and refining the model and then generating analytics using the model were extremely labor-intensive. Amazon Machine Learning, in contrast, automates many of these labor-intensive steps and reduces their complexity, making machine learning more accessible to software developers.[45]

It is difficult to directly trace a specific return on investment for Amazon Machine Learning back to the initial strategic R&D investments (spent over a *very* long period). However, one way of framing the value proposition is to view investment in Amazon Machine Learning as creating the future growth opportunities for AWS, which is now positioned as a growing cloud computing capability for the company. Said one industry observer in August 2015:

> It may seem odd for an e-commerce giant like Amazon to expand into machine learning, but it's an important way to enhance its growing cloud business. Amazon's cloud and big data efforts belong to AWS. Amazon doesn't report AWS revenues separately, but analysts at Pacific Crest estimate that AWS generated nearly $5 billion in 2014 revenues, up from an estimated $3.1 billion in 2013. That's just a sliver of Amazon's revenues of $89 billion last year, *but it's growing at a much faster rate than its core product sales revenue*, which rose 15 percent annually to $70 billion.[46] [Emphasis added.]

Soon after, Amazon did report AWS earnings separately, and the results are impressive. The *Wall Street Journal* recently reported that in Q3 2015, the "cloud-computing unit… reported a 79 percent sales increase to $2.09 billion, compared with analyst expectations of just under $2 billion. The division's operating profit of $521 million was nearly as much as the total for Amazon's North America retail operation. Amazon has said AWS… could one day surpass the core retail business in size."[47]

Microsoft's Azure Machine Learning. Like Amazon, Microsoft (through Microsoft Research) has always been committed to long-term strategic R&D in machine learning; the impact of the technology is now pervasive at the company.[48] And like Amazon, Microsoft is seeking to use machine learning as a way to generate new revenue from existing customers of its public cloud computing platform, Microsoft Azure. To this end, in June 2014, Microsoft launched Azure Machine Learning, an open, multisided platform[49] designed to accelerate and scale collaboration within a developer community and among a growing business ecosystem of strategic partners. As a next step, in January 2015, Microsoft acquired Revolution Analytics Inc., a major commercial

contributor to the open-source R project, adapting Revolution's scalable R distribution for Azure Machine Learning, "making it much easier and faster to analyze big data, and to operationalize R code for production applications."[50]

R is one of the first open-source programming languages and developer communities, and is emerging as an industry standard amongst data scientists.[51] Azure Machine Learning is now an advanced analytics service that allows the development of applications in just a few hours (a process which once took a few weeks and required additional internal technical resources).

In an effort to move away from the sluggish PC market, cloud computing is a priority segment for Microsoft. The company, which reported a doubling of revenue for its Azure cloud services in Q3 2015, will continue to rely on Azure Machine Learning for ongoing PaaS-based revenues (as opposed to the single-product sales model of other product segments).[52]

Hewlett-Packard Enterprise (HPE) Haven Predictive Analytics. The recently formed HPE is yet another company that has added a cognitive extension to a platform in an effort to appeal to a growing developer community, scale and accelerate product development, and boost the adoption rates of its cloud computing platform. The platform in question is HPE's Haven Big Data platform, a scalable open platform for enterprise data analytics.[53]

In February 2015, prior to the recent restructuring, Hewlett Packard (HP) rolled out Haven Predictive Analytics, an enhancement designed to accelerate large-scale machine learning, statistical analysis, and graph processing,[54] enabling customers—in this case, cognitive technology developers for IT operations—to build models for comprehensive machine learning and provide enterprise-wide statistical analysis of structured, unstructured, and previously underutilized data volumes.[55]

The features that differentiate this product from the competition include ease of use and (as in Microsoft's case) greater focus on the switching costs for the R programmer/data scientist community.[56] In 2012, the predictive analytics market was a $2 billion category of the overall analytics market worldwide, and is expected to more than triple to $6.5 billion worldwide in 2019.[57] HPE is projecting $3 billion in annual cloud revenue for 2015[58] while further positioning IT operations analytics (data centers optimized by machine learning algorithms for IT systems management) as a strong niche market in the enterprise cloud market.[59]

SalesforceIQ, Oracle Social Cloud, and Pegasystems Pega 7: In July 2014, cloud pioneer Salesforce.com acquired RelateIQ—an American enterprise software company based in Palo Alto, California—for $390 million. RelateIQ's relationship intelligence platform uses unstructured data (such as email, smartphone calls, and appointments) to augment customer relationship management through data science and machine learning. In September 2015, at its annual Dreamforce users' conference, the company rolled out SalesforceIQ for Small Business and SalesforceIQ for Sales—both of which are based on the machine learning capabilities made available by the RelateIQ acquisition and designed as extensible modules to its industry-leading customer relationship management (CRM) platform.[60]

To compete with Salesforce in an emerging CRM market—social customer relationship management, or social CRM—Oracle Corp. and Pegasystems Inc. both made acquisitions of cognitive companies with applications of NLP to unstructured social media conversations. These capabilities are now a part of the Oracle Social Cloud and the Pegasystems Pega 7 platforms—automating analytics of real-time social media, amongst other cognitive-enabled functionalities.[61] By 2019, the global market for social CRM is expected to surpass $13 billion with a CAGR of 38 percent.[62] Overall, CRM is a fast-growing segment of the enterprise cloud computing market—with over 50 percent of CRM implementations expected to be cloud-based in the next five years.[63]

Cisco Systems' Cognitive Threat Analytics. In 2014, Cisco announced new solutions in advanced network security that were based, in large part, on products obtained from its 2013 acquisition of the Czech company Cognitive Security.[64] The new Cisco platform, known as Cognitive Threat Analytics, is a cloud-based solution (which reduces time to discovery of threats operating inside a network) rooted in a set of advanced algorithms and machine learning techniques that Cognitive Security developed over 10 years prior to the acquisition.[65]

Machine learning addresses the growing demand for cybersecurity threat analytics through behavioral analysis and anomaly detection, which identifies disparities in the outer defenses of a network that are then used to identify the symptoms of a malware infection or data breach.[66] Unlike traditional network security techniques (such as incident response systems), Cognitive Threat Analytics does not depend on manual rule sets. Instead, statistical modeling and machine learning are used to analyze multiple parameters while taking in real-time traffic data, identifying new threats, learning from the data volumes, and adapting over time.[67] Cognitive Threat Analytics is available through an add-on license to any Cisco Cloud Web Security solution.

Cybersecurity is one of the largest and fastest-growing markets within the technology sector—with worldwide cybersecurity market estimates of $77 billion in 2015 and $170 billion by 2020.[68] The security analytics segment is expected to grow from $2.1 billion in 2015 to $7.1 billion by 2020, at a CAGR of 27.6 percent from 2015 to 2020.[69] In addition, "the market for Secure Web Gateways (SWGs) solutions is still dominated by traditional on-premises appliances. But the use of cloud-based services is growing rapidly, and advanced threat protection functionality remains an important differentiator."[70]

Market implications and considerations

TECHNOLOGY companies looking to take cognitive technology capabilities to market may want to consider the following factors.

Know where to play. Regarding the go-to-market activities we have discussed, the most discernible trend is the commercial development of machine learning and NLP. Today's PaaS offerings have been designed to lower the barriers to entry to these capabilities and, more importantly, to extract value over the lifetime total value of current customers versus the average revenue per unit of traditional, linear unit sales and distribution. In the short term, we expect machine learning platforms and product innovation opportunities to continue to generate revenue and attract new customers in the following markets: IT operations management, data analytics (specifically predictive analytics, IT operations analytics (ITOA), organizational analytics[71] and advanced threat analytics), along with customer relationship management (CRM). NLP, meanwhile, will fuel the growth of social CRM innovation.

When entering a new market, it bears keeping in mind the conventional wisdom that new markets are more difficult to enter than existing markets.[72] Also keep in mind the baseline metric for the return on investment of these license- or subscription-based business models: The ratio of the lifetime total value of customers for SaaS offerings relative to the cost of customer acquisition can be as high as 5 to 1.[73]

Deep learning algorithms, as well as visual, gestural, and spatial computational needs, are emerging as focus areas for the technology industry because they all require high levels of computational resources. This opportunity to address future processing challenges has not escaped the semiconductor subsector: Besides the previously mentioned NVidia Tegra mobile chip, the IBM TrueNorth chip,[74] Intel's Xeon E7 v3 server chip,[75] and Qualcomm's Snapdragon mobile processor[76] are also designed to address the need for computational innovation.

Deep learning algorithms, as well as visual, gestural, and spatial computational needs, are emerging as focus areas for the technology industry because they all require high levels of computational resources.

The long view. Two long-term, strategic markets have been previously mentioned: The moonshot by IBM in the health care arena and further capabilities (besides the role speech recognition is already playing) designed into mobile devices, contributing to their ease of use and thereby enhancing their rapid adoption rate globally. Other emerging applications and markets for cognitive development platforms include wearables,[77] the Internet of Things (IoT),[78] machine-to-machine

(M2M) communication[79] and the future of transportation mobility.[80]

Act now to avoid paralysis. As these cognitive technology activities demonstrate, artificial intelligence is no longer a pie-in-the-sky endeavor or an R&D initiative isolated from revenue growth or the customer relationship. Arguably, the ability to tactically execute was not broadly available across all the technology subsectors even a year ago. A product innovation approach that utilizes the traditional competitive advantage or "me too" approach to develop products would be an attempt to use old tools to deploy new technologies in a fundamentally transformed product distribution channel, and thus be unsuccessful. In this transformed environment, avoid paralysis and denial. The art of the possible is now. Begin by determining which markets and business priorities are immediately addressable, then apply them to formative cognitive-technology product-innovation value maps, technology roadmaps, and go-to-market strategies, while seeking out new product innovation toolsets.

Change at this speed and scale creates opportunities—and risk—which will challenge strongly held beliefs at the core of a company's business model.

Beware the talent squeeze. Talent is becoming increasingly scarce in the various artificial intelligence sub-disciplines we have discussed.[81] Major US technology players are not only competing for market share but for talented individuals as well.[82] The worst-case scenario is that companies will consider certain in-house talent as mission-critical resources and thus limit access to them. In the best-case scenario, access to these experts and their subject matter expertise is incorporated into open developer communities. We know this has already occurred at IBM Watson Group, for example.

Cultivate both specialized expertise and institutional knowledge. Lowering barriers to entry to what have traditionally been stand-alone, expensive, and complex artificial intelligence projects is the fundamental value proposition we have described, with cognitive computing now an applied technological extension of existent, scalable IT capabilities. However, one cannot assume that all IT professionals have the scientific background that deployment of cognitive technologies may require. With the automation of high-level programming tasks and the management of the interoperability of old and new data sets as examples comes the risk that people will blindly use functions of which they do not have a deep understanding, potentially causing systems to perform poorly when model assumptions are violated by changes in real-world events.[83] Alternatively, a data scientist may not be familiar with how these new technologies should be integrated into an organization's larger enterprise architecture and deployment capabilities.

The API economy. Application programming interfaces (APIs) may be where IT professionals and cognitive technology experts will find common ground. Machine learning APIs are readily available through both AWS[84] and Microsoft Azure Marketplace,[85] while the IBM Watson-powered API Harmony service on Bluemix allows developers to search publicly available APIs based on wide-ranging search criteria.[86] Companies will also find opportunities to provide support for developing and applying cognitive technologies—and APIs will be the form of and the building blocks of these new products and services.[87]

Look for open platforms to support cognitive technologies' development. The

examples cited in our analysis demonstrate the importance of open platforms based on open source technology architectures with their roots in the open source movement for software development. Recently, Google announced the public availability of a portion of its TensorFlow AI deep learning engine[88] and the IBM machine learning system, SystemML, is now an Apache Incubator open source project.[89] Facebook has also donated to Torch, an open source software project that is focused on deep learning.[90]

Open platforms enhance collaboration and create new market behaviors—and the prevalence of open development platforms points to the technology sector's hope that the adoption rate of cognitive technologies will mirror the success of mobile open development platforms—most notably Google's open source Android mobile development platform. By replicating the open source technology architecture, open cognitive technology platforms will experience a rapid expansion similar to that of the mobile market since 2007.

Learn to manage the new, new thing: Risk. Change at this speed and scale creates opportunities—and risk—which will challenge strongly held beliefs at the core of a company's business model. As a result, new value creation opportunities may exist at the edges, not at the core, of your organizational capabilities.[91] Meanwhile, exponential change empowers new entrants while fundamentally challenging the cost structures and delivery models of incumbent companies.[92] It helps technology companies to ask themselves: How is your organization formulating risk vis-a-vis cognitive technologies? And what are the new frameworks and methodologies for quantifying and mitigating risk when applying cognitive technologies to traditional business problems—and utilizing these platforms and PaaS offerings?

Harnessing cognitive technologies

Where to start

ORGANIZATIONS that wish to make or expand investments in cognitive technologies may want to consider the following steps. These steps can apply to not only technology companies but also technology-enabled enterprises in any industry or vertical market that wants to further explore cognitive technologies' potential to enable innovative business partnerships, platform solutions, new business models, and product innovation.

1. **Gain C-suite support**: Ensure you have strong C-level support across your organization for the assessment of business priorities related to cognitive technologies. The CEO should make cognitive technologies an executive-level responsibility, increasing the scale of available resources. Other C-suite executives should support these efforts by encouraging methodologies that are appropriate to each specific technology (machine learning, computer vision, speech recognition, and so on).

2. **Learn and explore**: Continue to learn about and understand these technologies, exploring various use cases where they have been applied, and whether to enable business model transformation or to pursue product innovation.

3. **Flesh out your own possible use cases**: Assess where and how these technologies could positively impact your company,

Figure 4. Use the Three Vs to help identify opportunities for cognitive technologies

Screen	Cognitive technology indicators	Application examples
Viable	• All or part of a task, job, or workflow requires low or moderate level of skill plus human perception • Large data sets • Expertise can be expressed as rules	• Forms processing, first-tier customer service, warehouse operation • Investment advice, medical diagnosis, oil exploration • Scheduling maintenance operations
Valuable	• Workers' cognitive abilities or training are underutilized • Business process has high labor costs • Expertise is scarce; value of improved performance is high	• Writing company earnings reports; e-discover, driving/piloting • Health insurance utilization management • Medical diagnosis; aerial surveillance
Vital	• Industry-standard performance requires use of cognitive technologies • A service cannot scale relying on human labor alone	• Online retail product recommendations • Fraud detection • Media sentiment analytics

keeping in mind customer retention, customer acquisition, and market growth opportunities. Cognitive technologies are not the solution to every problem. Our research on how companies are putting cognitive technologies to work has revealed a framework that can help organizations assess their own opportunities for deploying these technologies. We suggest organizations look across their business processes, their products, and their markets to examine where the use of cognitive technologies may be viable, where it could be valuable, and where it may even be vital. This "Three Vs" framework is summarized in figure 4. Organizations can use it to screen opportunities for applying cognitive technologies.[93]

4. **Build your cognitive capabilities**: Determine which part of your enterprise should start to build cognitive capabilities, possibly by initially using a center of excellence model.

5. **Leverage ecosystem partners**: Discuss business ecosystem and platform partnership options. Both of these may involve partnering with organizations that already have cognitive technology product offerings, as well as with consultants or systems integrators who can help incorporate cognitive technologies for business transformation and/or product innovation.

6. **Pursue POCs**: Form a cognitive technology innovation team. Begin to explore and adopt cognitive technologies through the design of proof-of-concept projects.

7. **Expand where value creation is evident**: Double down, expand, and deploy where the value proposition of cognitive technologies is becoming evident.

Cognitive technologies are delivering measurable value to enterprises across multiple industries. Now is the time to engage these technologies and to frame how best your organization will capture the value these technologies are creating. A thorough evaluation of your company's position with regard to cognitive technologies can help put your organization on the path to reap these concrete benefits.

Endnotes

1. The technology sector, or "tech sector,"is composed of companies that design, develop, or manufacture electronic components, products and/or solutions—and is further classified across multiple sub-sectors, including computer hardware, IT services, networking, Internet, semiconductor, and software.
2. David Schatsky, Craig Muraskin, and Ragu Gurumurthy, *Demystifying artificial intelligence: What business leaders need to know about cognitive technologies*, Deloitte University Press, November 4, 2014, http://dupress.com/articles/what-is-cognitive-technology/. This article is also an overview of cognitive technologies and their improving performance.
3. Brandon Bailey, "Google, Facebook and other tech companies race to develop artificial intelligence," *San Jose Mercury News*, April 23, 2014, http://www.mercurynews.com/business/ci_25627092/google-facebook-and-other-tech-companies-race-develop/.
4. The M&A data is a technology sector analysis of activity in the United States and Canada and does not include global M&A data. The final 100 deals that make up the analysis include cross-sector (media and telecommunications) and cross-industry activity when appropriate in an effort to take into account cross-sector convergence issues, vertical market digitization trends, and broader trends in sensors, actuators, and hardware.
5. Deloitte analysis of M&A data gathered by financial data provider S&P Capital IQ.
6. Michael E. Raynor and Mumtaz Ahmed, *The Three Rules: How Exceptional Companies Think* (New York: Penguin, 2013).
7. KurzweilAI, "IBM forms new Watson group for cloud-delivered cognitive innovations, with $1 billion investment," http://www.kurzweilai.net/ibm-forms-new-watson-group-for-cloud-delivered-cognitive-innovations-with-1-billion-investment/, last accessed November 23, 2015.
8. YouTube, "*IBM Watson Group launch event Jan. 9 in New York*," https://youtu.be/rB7Vk-rUYCAg, last accessed October 2, 2015.
9. Larry Greenemeier, "Will IBM's Watson usher in a new era of cognitive computing?" *Scientific American*, November 13, 2013, http://www.scientificamerican.com/article/will-ibms-watson-usher-in-cognitive-computing/, last accessed November 23, 2015.
10. Eamonn Kelly et al., *Business ecosystems come of age*, Deloitte University Press, April 15, 2015, http://dupress.com/articles/business-ecosystems-boundaries-business-trends/, last accessed November 23, 2015.
11. AlchemyAPI, "AlchemyAPI Products," http://www.alchemyapi.com/products/, last accessed November 24, 2015.
12. "The deep learning algorithm is a powerful general-purpose form of machine learning that is moving into the mainstream. It uses a variant of neural networks to perform high-level abstractions such as voice or image pattern recognition. Pioneered in 2006 by Geoffrey Hinton, a professor at the University of Toronto and researcher at Google, deep learning is proving its metal across a diverse spectrum of challenges—from new drug development to translating human conversations from English to Chinese. Google is using deep learning with its Android phone to recognize voice commands and on its social network to identify and tag images. Facebook is exploring deep learning as a means to target ads and identify faces and objects. A company called DeepMind . . . recently announced a Neural Turing Machine. This computing architecture utilizes a form of recurrent neural networks that can do end-to-end processing from a sensory perception data stream to interpretation and action. This system has been used to learn games from scratch, and in some cases has demonstrated better-than-human-level performance." Source: Bill Briggs and Marcus Shingles, *Exponentials*, Deloitte University Press, January 29, 2015, http://dupress.com/articles/tech-trends-2015-exponential-technologies/.
13. Janet Wagner, "The rapid rise of deep learning computer vision technology," *Programmable Web*, June 6, 2015, http://www.programmableweb.com/news/rapid-rise-deep-learning-computer-vision-technology/analysis/2015/06/19, last accessed October 20, 2015.
14. Charlierose.com, "Ginni Rometty, Chairman and CEO of IBM," http://charlierose.com/watch/60546698/, last accessed June 12, 2015.

15. IBM, "IBM closes deal to acquire merge healthcare," http://www-03.ibm.com/press/us/en/pressrelease/47839.wss, last accessed November 23, 2015.

16. Gadgets360, "IBM plays down earnings miss as part of evolution," http://gadgets.ndtv.com/laptops/news/ibm-plays-down-earnings-miss-as-part-of-evolution-755236/, last accessed November 24, 2015.

17. Peter H. Diamandis and Steven Kotler, *Bold: How to Go Big, Create Wealth and Impact the World*, (New York: Simon and Schuster, 2015), p. 82.

18. Robert McMillan, "IBM's new unit bets on boom in artificial intelligence," *Wall Street Journal*, October 6, 2015, http://www.wsj.com/articles/ibms-new-unit-bets-on-boom-in-artificial-intelligence-1444104061.

19. Alphabet.com, "G is for Google," https://abc.xyz/, last accessed October 19, 2015.

20. Briggs and Shingles, *Exponentials*.

21. Salim Ismail, *Exponential Organizations: Why New Organizations are Ten Times Better, Faster, and Cheaper than Yours (and What to Do about It)*, (New York: Diversion Books, 2014), p. 18–19. Ismael mentions Google Ventures (which will continue as the venture capital business unit of the Alphabet holding company), "an almost perfect exponential organization."

22. Ibid, p. 18.

23. Exponential Organizations.com, "Top 100ExOs," http://top100.exponentialorgs.com/, last accessed October 19, 2015.

24. Deloitte analysis of M&A data gathered by financial data provider S&P Capital IQ.

25. QZ.com, "All of Google's—er, Alphabet's—companies and products from A to Z," http://qz.com/476460/here-are-all-the-alphabet-formerly-google-companies-and-products-from-a-to-z/, last accessed October 19, 2015.

26. Deloitte analysis of M&A data gathered by financial data provider S&P Capital IQ.

27. John Hagel, *The power of platforms*, Deloitte University Press, April 15, 2015, http://dupress.com/articles/platform-strategy-new-level-business-trends/, last accessed October 9, 2015.

28. Paul Clemmons, Jason Geller, and Adam Messer, *Cloud hits the enterprise*, Deloitte University Press, July 1 2012, http://dupress.com/articles/cloud-hits-the-enterprise-the-scoop-on-software-as-a-service/, last accessed October 9, 2015.

29. IBM, "IBM Bluemix," http://www.ibm.com/bluemix, last accessed October 13, 2015.

30. Gil Press, "IBM reinvents itself by establishing a frontier homestead for cognitive computing," *Forbes*, October 27, 2014, http://www.forbes.com/sites/gilpress/2014/10/27/ibm-reinvents-itself-by-establishing-a-frontier-homestead-for-cognitive-computing/, last accessed October 13, 2015.

31. Intel, "Intel Real Sense SDK," https://software.intel.com/en-us/intel-realsense-sdk, last accessed November 23, 2015.

32. Jean Philippe Bouchard et al., "Worldwide smartphone 2014–2018 forecast and analysis," *IDC*, March 2014, http://www.idc.com/getdoc.jsp?containerId=247140, "The pace of mobile adoption is growing significantly; smartphone shipments are expected to grow from 1.2 billion in 2014 to 1.7 billion units by 2018—a CAGR of 11.5 percent during 2014-18."

33. Patrick Moorehead, "Perceptual computing: Critical to Intel's future," *Forbes*, September 20, 2012, http://www.forbes.com/sites/patrickmoorhead/2012/09/21/perceptual-computing-the-key-to-intels-future/, last accessed November 23, 2015.

34. Fool.com, "Why surging sales of hybrid devices is great news for Microsoft and Intel," http://www.fool.com/investing/general/2015/09/17/why-surging-sales-of-hybrid-devices-is-great-news.aspx, last accessed October 13, 2015. iPad is a trademark of Apple Inc., registered in the United States and other countries. The current report is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc.

35. The Graphics Processor Unit (GPU) is "a single chip processor with integrated transform, lighting, triangle setup/clipping, and rendering engines that is capable of processing a minimum of 10 million polygons per second." Source: http://www.nvidia.com/object/gpu.html.

36. NVIDIA® CUDA® is a parallel computing platform and programming model that enables dramatic increases in computing performance by harnessing the power of the graphics processing unit (GPU). Source: https://developer.nvidia.com/about-cuda.

37. Jeffrey Burt, "Nvidia enhances DIGITS, CUDA software for deep learning," *eWeek*, July 8, 2015, http://www.theinquirer.net/inquirer/news/2416690/nvidia-updates-digits-and-cudnn-gpu-accelerated-deep-learning-software.

38. NVidia Corp., "Q3 2015 NVidia Corp conference call," Thomson StreetEvents, August 6, 2015.

39. CIO Review, "NVidia release next generation Mobile Super Chip," http://technology.cioreview.com/news/nvidia-releases-next-generation-mobile-super-chip-nid-4601-cid-19.html, last accessed November 19, 2015.

40. Nvidia, "NVIDIA launches Tegra X1 Mobile Super Chip," http://nvidianews.nvidia.com/news/nvidia-launches-tegra-x1-mobile-super-chip, last accessed October 19, 2015.

41. Jagdish Rebelo, *Enterprise cloud computing: Future market size, growth and competitive landscape*, IHS Quarterly, May 20, 2014, http://blog.ihs.com/q12-enterprise-cloud-computing-future-market-size-growth-and-competitive-landscape.

42. For a history of the development of AWS, Infrastructure as a Service—and the creation of the cloud computing market—all of which are the origins of the Amazon Machine Learning innovation at Amazon, see Brad Stone, "Chapter 7: A technology company, not a retailer," *The Everything Store: Jeff Bezos and the Age of Amazon*, (New York: Back Bay Books, 2013), p. 193.

43. MobyLives, "Wall Street finally says maybe Amazon should, you know, make some money," http://www.mhpbooks.com/wall-street-finally-says-maybe-amazon-should-you-know-make-some-money/, last accessed December 1, 2015.

44. Amazon.com, "Amazon Machine Learning," http://aws.amazon.com/machine-learning/, last accessed August 13, 2015.

45. Marketwatch.com, "Amazon Web Services Announces Amazon Machine Learning," http://www.marketwatch.com/story/amazon-web-services-announces-amazon-machine-learning-2015-04-09/, last accessed October 2, 2015.

46. Fool.com, "The cloud battle heats up between Amazon.com Inc., Google Inc., Microsoft Corp, and IBM," http://www.fool.com/investing/general/2015/04/16/the-cloud-battle-heats-up-between-amazoncom-inc-go.aspx/, last accessed August 8, 2015.

47. *Wall Street Journal*, "Amazon posts surprise profit, while sales surge," http://www.wsj.com/articles/amazon-posts-surprise-profit-while-sales-surge-1445544477?mod=djemCIO_h&alg=y, last accessed October 23, 2015.

48. Mary Branscombe, "How machine learning ate Microsoft," *Infoworld*, February 19, 2015, http://www.infoworld.com/article/2886132/machine-learning/how-machine-learning-ate-microsoft.html/, last accessed September 29, 2015.

49. Multisided platforms (MSPs) are *technologies, products or services that create value primarily by enabling direct interactions between two or more customer or participant groups*. See Andrei Hagiu, "Strategic decisions for multisided platforms," *MIT Sloan Management Review*, December 19, 2013, http://sloanreview.mit.edu/article/strategic-decisions-for-multisided-platforms/.

50. Microsoft, "Machine learning blog: Microsoft closes acquisition of Revolution Analytics," http://blogs.technet.com/b/machinelearning/archive/2015/04/06/microsoft-closes-acquisition-of-revolution-analytics.aspx/, last accessed October 19, 2015.

51. DeZyre.com, "R Programming Language—A powerful statistical programming tool written by statisticians for statisticians," https://www.dezyre.com/article/-why-r-programming-language-still-rules-data-science/161, last accessed December 1, 2015.

52. *Wall Street Journal*, "Microsoft profit tops estimates," http://www.wsj.com/articles/microsoft-profit-climbs-1445545134?mod=djemCIO_h, last accessed October 23, 2015.

53. Hewlett Packard, Inc. "HP Haven Big Data Platform," http://www8.hp.com/us/en/software-solutions/big-data-platform-haven/index.html, last accessed September 29, 2015.

54. Hewlett Packard, Inc. "Haven Predictive Analytics," http://www8.hp.com/us/en/software-solutions/predictive-analytics-r-big-data/, last accessed September 29, 2015.

55. Adrian Bridgewater, "HP Haven Predictive Analytics: Operationalizing large-scale machine learning," *Computer Weekly*, February 2015, http://www.computerweekly.com/blogs/cwdn/2015/02/hp-haven-predictive-analytics-operationalising-large-scale-machine-learning.html/, last accessed September 29, 2015.

56. Ibid. As Adrian Bridgwater of Computer Weekly also noted: "Now the global developer community can employ R to scale to more than a billion predictive records of data—and this is said to be 'an order of magnitude improvement' over traditional R-based performance. This offering from HP also retains the consistency with R and enables data scientists to use their familiar R console and RStudio to work with Distributed R—and this could indeed be important for R converts."

57. Techcrunch, "The next wave of enterprise software powered by machine learning," http://techcrunch.com/2015/07/27/the-next-wave-of-enterprise-software-powered-by-machine-learning/, last accessed October 19, 2015.

58. Larry Dignan, "HP Enterprise: Can it overcome layoffs, split growing pains, and FUD," *ZDNet*, September 16, 2015, http://www.zdnet.com/article/hp-enterprise-can-it-overcome-layoff-split-growing-pains-and-fud/, last accessed October 19, 2015.

59. Hewlett Packard, Inc., "Operations Analytics," http://www8.hp.com/us/en/software-solutions/operations-analytics-operations-analysis/, last accessed December 3, 2015.

60. Charles Babcock, "SalesforceIQ gathers intelligence for customers big and small," *Information Week*, September 17, 2015, http://www.informationweek.com/cloud/software-as-a-service/salesforceiq-gathers-intelligence-for-customers-big-and-small/, last accessed November 23, 2015.

61. Pegasystems, "Pegasystems transforms customer service with advanced social collaboration and predictive analytics," http://www.pega.com/about/news/press-releases/pegasystems-transforms-customer-service-advanced-social-collaboration-and, last accessed November 23, 2015; Oracle, "Oracle social cloud," http://www.oracle.com/us/solutions/social/overview/index.html/, last accessed November 23, 2015; Pegasystems, "Marketing analytics," http://www.pega.com/marketing-analytics/, last accessed December 1, 2015.

62. Markets and Markets, "Social Customer Relationship Management (CRM) Market by Solution—Global Forecasts to 2019," http://www.marketsandmarkets.com/Market-Reports/social-customer-relationship-management-market-124012616.html, last accessed December 11, 2015.

63. CRMSearch, "Cloud computing CRM," http://www.crmsearch.com/cloud.php/, last accessed November 23, 2015.

64. Cisco Systems, Inc. "Introducing Cisco Cognitive Threat Analytics," http://blogs.cisco.com/security/introducing-cisco-cognitive-threat-analytics, last accessed August 28, 2015.

65. Ibid.

66. Ibid.

67. Cisco Systems, "Cisco Cognitive Threat Analytics," http://www.cisco.com/c/en/us/solutions/enterprise-networks/cognitive-threat-analytics/index.html, last accessed August 28, 2015.

68. Steve Morgan, "Dell's secret cybersecurity IPO," *Forbes*, October 14, 2015, http://www.forbes.com/sites/stevemorgan/2015/10/14/dells-secret-cybersecurity-ipo/print/, last accessed October 16, 2015.

69. Markets and Markets, "Security analytics market by application—global forecast to 2020," http://www.marketsandmarkets.com/Market-Reports/security-analytics-market-1026.html, last accessed November 19, 2015.

70. Lawrence Orans and Peter Firstbrook, *Magic quadrant for secure web gateways, Gartner, Inc., May 28, 2015.* Gartner does not endorse any vendor, product or service depicted in its research publications, and does not advise technology users to select only those vendors with the highest ratings or other designation. Gartner research publications consist of the opinions of Gartner's research organization and should not be construed as statements of fact. Gartner disclaims all warranties, expressed or implied, with respect to this research, including any warranties of merchantability or fitness for a particular purpose.

71. Venturebeat, "Microsoft acquires people analytics startup VoloMetrix, will integrate organizational tech into Office 365," http://venturebeat.com/2015/09/03/microsoft-acquires-people-analytics-startup-volometrix-will-integrate-organizational-tech-into-office-365/, last accessed November 23, 2014.

72. Steve Blank, *The Four Steps to the Epiphany: Successful Strategies for Products that Win* (San Mateo: Café Press, 2005), p. 133.

73. Thomas Steenburgh, Jill Avery, and Nadeem Dahod, "Hubspot: Inbound marketing and Web 2.0," *Harvard Business School Publishing*, January 24, 2011; interview with Michael A. Cusumano, *Sloan School of Management*, Sloan Management Review (SRM) professor in management.

74. Nextbigfuture, "IBM wants to commercialize silicon brains with deep learning for smarter phones," http://nextbigfuture.com/2015/10/ibm-wants-to-commercialize-silicon.html, last accessed November 23, 2015.

75. Agam Shah, "Intel's 18-core Xeon chips tuned for machine learning, analytics," *PC World*, May 5, 2015, www.pcworld.com/article/2918852/intels-18core-xeon-chips-tuned-for-machine-learning-analytics.html, last accessed December 1, 2015.

76. Aaron Tilley, "Intel and Qualcomm battle to bring computer vision into phones and drones," *Forbes*, August 26, 2015, http://www.forbes.com/sites/aarontilley/2015/08/26/

intel-and-qualcomm-battle-to-bring-computer-vision-into-phones-and-drones/, last accessed November 23, 2015.

77. GSMA Mobile Economy, "The mobile economy 2015," http://www.gsmamobileeconomy.com/GSMA_Global_Mobile_Economy_Report_2015.pdf/, last accessed November 16, 2015.
78. *CIO Journal*, "Connected device data an enterprise windfall," http://deloitte.wsj.com/cio/2015/10/05/connected-device-data-an-enterprise-windfall/, last accessed December 1, 2015.
79. Darrell M. West, *The state of the mobile economy, 2014: Its impact and future*, The Brookings Institution, September 2014, http://www.brookings.edu/~/media/research/files/papers/2014/09/10-state-of-mobile-economy-west/state-of-mobile-economy_v13.pdf/.
80. Scott Corwin, Joe Vitale, Eamonn Kelly, and Elizabeth Cathles, *The future of mobility: How transportation technology and social trends are creating a new business ecosystem*, Deloitte University Press, September 24, 2015, http://dupress.com/articles/future-of-mobility-transportation-technology/.
81. GSMA Mobile Economy, "The mobile economy 2015," http://www.gsmamobileeconomy.com/GSMA_Global_Mobile_Economy_Report_2015.pdf/, last accessed November 16, 2015.
82. Amir Mizroch, "Artificial intelligence experts are in high demand," *Wall Street Journal*, May 1, 2015, http://www.wsj.com/articles/artificial-intelligence-experts-are-in-high-demand-1430472782?alg=y.
83. Interview with Daniel Byler, Deloitte data scientist and manager, strategic planning, October 16, 2015.
84. Amazon Web Services, "Welcome to Amazon Machine Learning," http://docs.aws.amazon.com/machine-learning/latest/APIReference/Welcome.html/, last accessed December 1, 2015.
85. Microsoft Azure, "Machine Learning APIs," https://azure.microsoft.com/en-us/services/machine-learning/api/, last accessed December 1, 2015.
86. IBM, "IBM unveils matchmaking technology to navigate API economy," http://www-03.ibm.com/press/us/en/pressrelease/48026.wss, last accessed December 1, 2015.
87. George Collins and David Sisk, *API economy: From systems to business services*, Deloitte University Press, January 29, 2015, http://dupress.com/articles/tech-trends-2015-what-is-api-economy/; Thomas H. Davenport and Bala Iyer, "Move beyond enterprise IT to an API strategy," *Harvard Business Review*, August 6, 2013, https://hbr.org/2013/08/move-beyond-enterprise-it-to-a/, last accessed November 23, 2015.
88. Cade Metz, "Google's open source AI Tensorflow signals fast changing hardware world," *Wired*, November 10, 2015, http://www.wired.com/2015/11/googles-open-source-ai-tensorflow-signals-fast-changing-hardware-world/, last accessed November 23, 2015.
89. ZDNET.com, "IBM's SystemML machine learning system becomes Apache Incubator project," http://www.zdnet.com/article/ibms-systemml-machine-learning-system-becomes-apache-incubator-project/, last accessed December 1, 2015.
90. Quentin Hardy, "Facebook offers artificial intelligence tech to open source group," *New York Times*, January 16, 2015, http://bits.blogs.nytimes.com/2015/01/16/facebook-offers-artificial-intelligence-tech-to-open-source-group/, last accessed November 23, 2015.
91. Jacob Bruun-Jensen and John Hagel III, *Minimum viable transformation*, Deloitte University Press, April 15, 2015, http://dupress.com/articles/minimum-viable-business-model-transformation-business-trends/; John Hagel, John Seely Brown, and Duleesha Kulasooriya, *Scaling edges: A pragmatic pathway to broad internal change*, Deloitte University Press, http://www2.deloitte.com/us/en/pages/center-for-the-edge/articles/scaling-edges-methodology-to-create-growth.html/, last accessed November 24, 2015.
92. Deloitte, "Exponentials: Brace yourself for the next wave of disruption," http://www2.deloitte.com/us/en/pages/dbriefs-webcasts/events/august/2015/dbriefs-exponentials-brace-yourself-for-the-next-wave-of-disruption.html/, last accessed December 1, 2015; interview with Andrew Blau, director, Deloitte US, Enterprise Risk Services, October 16, 2015.
93. David Schatsky, Craig Muraskin, and Ragu Gurumurthy, *Cognitive technologies: The real opportunities for business*, Deloitte University Press, January 26, 2015, http://dupress.com/articles/cognitive-technologies-business-applications/.

Acknowledgements

The authors would like to thank **Elina Ianchulev** and **Karthik Ramachandran** for their contributions. In addition, many Deloitte colleagues contributed with their time and industry-specific insight: A special thanks to **Andrew Blau** and **Daniel Byler**.

Significant research contributions were provided by **Deepan Kumar Pathy**, **Negina Rood**, and **Prathima Shetty**. Additional research support was provided by **Gaurav Khetan**, **Alok Ranjan**, **Shankar Lakshman**, **Chandrakala Veerabomma**, **Amit Kumar Sudrania**, **Divya Ravichandran**, **Abhimanyu Singh Yadav**, **Vasudev Neehar Chinnam**, and **Gitanjali Venkatesh**.

For their contributions to the development and review of this article, the authors extend their thanks to **John Shumadine**, **Dr. Preeta Banerjee**, **Anupam Narula**, **Sandy Rogers**, **Junko Kaji**, **Jon Warshawsky**, **William Eggers**, **Kristin Martin**, and **Lynette DeWitt**. Finally, for their integrated media production expertise, special thanks to **Troy Bishop** and **Alok Nookraj Pepakayala**.

Contacts

Daniel Pereira
Manager
Market Insights
Deloitte Services LP
+1 617 437 3429
dapereira@deloitte.com

David Schatsky
Senior manager
Deloitte Innovation
Deloitte LLP
+1 646 582 5209
dschatsky@deloitte.com

Paul Sallomi
Vice chairman
Global technology, media, and telecommunications industry leader
Global/US technology sector leader
Partner
Deloitte Tax LLP
+1 408 704 4100
psallomi@deloitte.com

Bob Dalton
Analytics alliances leader
Principal
Deloitte Consulting LLP
+1 404 631 3939
rdalton@deloitte.com

 Follow @DU_Press

Sign up for Deloitte University Press updates at DUPress.com.

About Deloitte University Press

Deloitte University Press publishes original articles, reports and periodicals that provide insights for businesses, the public sector and NGOs. Our goal is to draw upon research and experience from throughout our professional services organization, and that of coauthors in academia and business, to advance the conversation on a broad spectrum of topics of interest to executives and government leaders.

Deloitte University Press is an imprint of Deloitte Development LLC.

About this publication

About Deloitte