

# Getting Smarter by the Day: How AI is Elevating the Performance of Global Companies

TCS Global Trend Study: Part I





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## Executive Summary and Key Findings

# AI Goes Mainstream

After about 50 years of largely languishing in technology labs and the pages of science fiction books, today artificial intelligence (AI) has taken center stage and is under the bright lights. Barely a day goes by without dozens of new magazine and newspaper articles, blog posts, TV stories, LinkedIn columns, and tweets about cognitive technologies.

It shouldn't be at all surprising. The impact of AI has been very upfront and highly personal these days. The technology is beginning to reshape the jobs people hold, the cars they drive, the medical procedures they undertake, and the games they play. Nearly 20 years after IBM's AI computer system beat Russia's chess champion, AlphaGo, an AI program created by search engine giant Google defeated a grandmaster of the popular Southeast Asia board game, Go, in 2016. Go was considered to be a far more complex game for a computer to beat than chess.<sup>1</sup> A robotic surgeon stitched up a pig's intestines better than the doctors assigned the same job.<sup>2</sup> Even articles in the business pages are being written by AI software, as you'll see in our case study on the global news service, the Associated Press.

Although the term 'robotics' is thought to have been used for at least 75 years (starting with short stories by science fiction great, Isaac Asimov)<sup>3</sup>, there still isn't universal agreement on exactly what is -- or is not -- artificial intelligence, as Stanford University AI pioneer John McCarthy said.<sup>4</sup> What do we mean by 'artificial intelligence'? For the purposes of our research, we define the term to mean technologies that can perform four core tasks:

- **Sense** – Being able to recognize images, sound, voice, video and other 'unstructured' data (as well as structured data that has appeared in computer databases for years)
- **Think** – Deciding what such digital data means, and doing so at light speed, based on algorithms
- **Act** – Determining what to do about insights after arriving at them
- **Learn** – Being able to continuously and automatically refine the knowledge and algorithmic models of an AI system based on its interactions with digital data; increasingly, such learning is referred to as 'machine learning'

In this report and the one that will follow, we use the terms 'cognitive technologies' and 'artificial intelligence' interchangeably.

Defined this way, glamorous, high investment, and high stakes AI projects abound today. For example, almost everyone has heard of Google's driverless car by now, a project in motion since 2009.<sup>5</sup> But the concept of an automobile that motors along on its own goes back at least to 1935. The problem was it wasn't until the 21st century that the technologies for sensing, processing digital data, and reacting to it were robust enough: better software for following roads and steering clear of collisions, high-powered radar and laser sensors, and powerful digital maps.<sup>6</sup>

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1 Jonathan Cheng, "AlphaGo Software Storms Back to Beat Human in Final Game," The Wall Street Journal, March 15, 2016. <http://www.wsj.com/articles/alphago-software-storms-back-to-beat-human-in-final-game-1458047121> Accessed March 15, 2016.

2 Eliza Strickland, "Autonomous Robot Surgeon Bests Humans in World First," IEEE Spectrum, May 4, 2016. Accessed July 7, 2016. The research was led by a surgeon, Dr. Peter C.W. Kim, at the Children's Research Institute in Washington, D.C. found <http://spectrum.ieee.org/the-human-os/robotics/medical-robots/autonomous-robot-surgeon-bests-human-surgeons-in-world-first>

3 From the AI & Robotics page of the Computer History Museum in the Silicon Valley city of Mountain View, Calif. Accessed July 25, 2016. <http://www.computerhistory.org/timeline/ai-robotics/>

4 Gary Lea, "The Struggle to Define What Artificial Intelligence Actually Means," Popular Science magazine, Sept. 3, 2015. Accessed July 25, 2016. <http://www.popsci.com/why-we-need-legal-definition-artificial-intelligence> The McCarthy interview (accessed July 25, 2016) can be found here: <http://www-formal.stanford.edu/jmc/whatisai/node1.html>

5 Google webpage on its self-driving cars. <https://static.googleusercontent.com/media/www.google.com/en/selfdrivingcar/files/reports/report-0216.pdf> Accessed March 15, 2016.

6 Computer History Museum web page. <http://www.computerhistory.org/atchm/where-to-a-history-of-autonomous-vehicles/> Accessed March 15, 2016.

With the threat of technology companies driving them off the road, a number of global automotive manufacturers have entered the multibillion-dollar race to develop technologies that will do your driving for you. In 2015, Toyota Motor Corp. announced it would spend \$1 billion over the rest of this decade on initiatives that will put AI into its cars and the factory robots that build them. Toyota, one of the world's largest automakers with fiscal 2016 revenue of US \$237 billion,<sup>7</sup> also created a new AI research center in California's Silicon Valley, demonstrating the company's huge commitment to AI.

Yet our study found that the size of Toyota's AI investment isn't unprecedented. Some 6% of the 835 executives we surveyed in four regions of the world said their companies would each invest \$250 million or more in 2016 in cognitive technology initiatives. With those kinds of investments, companies are competing heavily for AI talent, especially executives to lead the way. Toyota has hired a top AI expert (Dr. Gill Pratt), who had worked at a US defense agency that was building robots that could respond to disasters, to run its new center.<sup>8</sup> In fact, there is such a strong industry need for top AI experts that many companies are recruiting them from academia, offering them strong financial incentives. As the *Economist* magazine wrote in 2016, "In the past, universities employed the world's best AI experts. Now tech firms are plundering departments of robotics and machine learning ... for the highest-flying faculty and students, luring them with big salaries similar to those fetched by professional athletes."<sup>9</sup>

The enormous spending on AI by some companies extends beyond companies like Toyota and Google that routinely make big investments in information technology. For example, Big Four accounting firm Ernst & Young announced in 2016 it would spend \$400 million in using AI to automate much of the labor involved in auditing clients' finances.<sup>10</sup>

Companies are using AI to enhance products and services or create entirely new offerings today that touch people's lives. Amazon and Google are competing over whose device – Amazon's Echo or Google's Home – will be your digital assistant. News organizations such as the Associated Press are churning out thousands of stories written by software, not by journalists. At the same time, Google, already motoring fast with its own self-driving car, is training its AI software, DeepMind, to detect two common types of eye diseases.<sup>11</sup> Microsoft has been using AI for about eight years to improve its online search engine, as you'll read in our case study.

Many big-company chief information officers have been envisaging a future with AI for years, with some funding lavish experiments and applications of the technology. But that passion for AI is rising to the top of large organizations more and more. One of the most recent CEOs to profess his fascination for the technology was Target Corp's Brian Cornell. The chairman and CEO of the \$74 billion Minneapolis-based mass merchandiser told a reporter the company is "looking at the role that AI will play, using machine learning to advance how we make decisions."<sup>12</sup>

The CEO of a retail company waxing eloquently about machine learning? Who would have imagined that would happen 10, even five years ago? Based on the research we conducted, we believe it will become the norm over the rest of this decade in nearly every industry.

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7 Toyota revenue according to a Toyota press release May 11, 2016. Accessed July 7, 2016. <http://corporatenews.pressroom.toyota.com/releases/toyota-april-march-2016-financial-results.htm>

8 Geoffrey Smith, "Here's why Toyota is spending \$1 billion on AI in Silicon Valley," *Fortune*, Nov. 6, 2015. Accessed July 7, 2016. <http://fortune.com/2015/11/06/toyota-ai-silicon-valley-robotics/>

9 *Economist*, "Million-dollar babies," April 2, 2016. Accessed July 25, 2016. <http://www.economist.com/news/business/21695908-silicon-valley-fights-talent-universities-struggle-hold-their>

10 Michael Rapoport, "Auditing Firms Count on Technology for Backup," *The Wall Street Journal*, March 7, 2016. [http://www.wsj.com/article\\_email/auditing-firms-count-on-technology-for-backup-1457398380-1MyQjAxMTA2NzAzODkwNjg0Wj](http://www.wsj.com/article_email/auditing-firms-count-on-technology-for-backup-1457398380-1MyQjAxMTA2NzAzODkwNjg0Wj) Article accessed March 8, 2016.

11 Allana Akhtar, "Google's DeepMind to use AI in diagnosing eye disease," *USA Today*, July 6, 2016. Accessed July 6, 2016. <http://www.usatoday.com/story/tech/news/2016/07/05/google-deepmind-artificial-intelligence-ai-eye-disease-london-go-diabetes/86722906/>

12 Kim S. Nash, "Q&A: Target CEO Brian Cornell Says Tech is 'Thread that Connects All Initiatives,'" *The Wall Street Journal*, July 8, 2016. Accessed July 8, 2016. <http://blogs.wsj.com/cio/2016/07/08/qa-target-ceo-brian-cornell-says-tech-is-thread-that-connects-all-initiatives/>





## Our First of a Two-Part Study on AI

This research report is one of two that Tata Consultancy Services (TCS) will release in 2017 on how large companies in four regions of the world are using cognitive technologies. This report explores and compares how companies in North America, Europe, Asia-Pacific, and Latin America have been using the technology since 2015, and the direction in which they see their AI initiatives heading in the year 2020 and beyond. Our research is based on an extensive survey of 835 executives in companies (average revenue of \$20 billion and median of \$2.8 billion) from 13 global industries.

Our second report, which we will release later in 2017, will examine in depth how the technology is being used in each of those industries globally: automotive; banking and financial services; consumer packaged goods; energy; healthcare and life sciences; high tech; industrial manufacturing; insurance; media, entertainment and information services; retail; telecommunications; travel, transportation, and hospitality; and utilities.

# How are Big Companies Using A.I. Today, and What's Ahead?

TCS' seventh global trend study examines how large companies in North America, Europe, Asia-Pacific, and Latin America are using AI to improve, and in some cases reimagine, the way they operate. We conducted this study in 2016, by surveying more than 800 companies (835 respondents to be exact), as well as interviewing three industry leading global companies. We tell the AI stories of these companies in this report: the global news service, Associated Press, Microsoft, and data management and analytics provider, Cloudera.

In addition, we gathered dozens of examples of corporate AI initiatives from secondary research, from articles written about and by these companies, presentations their executives have given and which are available on the web, investment research reports (for example, from Citigroup), and other sources.

From our research, the picture today of AI in big global companies is best described as one of widespread experimentation but limited transformation. Some 84% of the 835 companies surveyed across the world are using some amount of AI technology today in their businesses. That is not surprising, given today's 'perfect technology storm':

**Products and processes that are highly software-intensive:** Call it 'software-defined everything'. Many, many products today run on embedded software, and not just the cars we drive: electronic toothbrushes, smoke alarms, and an increasing number of medical devices that report how patients are using them (and if they are using them). What's more, aspects of nearly every function, from marketing and manufacturing to sales and HR, are increasingly online processes. Every CPG company's marketing campaign has an online marketing component these days. Factories are wired so that computers and sensors report their operating condition continuously. HR departments increasingly pore over internal email and other networks to see patterns in communications: who's talking to whom?

**An avalanche of digital data from hyper-connected and instrumented products and business processes:** All those products with digital sensors and wireless technology transmit what they're monitoring, spewing enormous volumes of digital data. Companies have never had such large amounts of data that they have coursing through their data centers today.

**Immense yet affordable data processing power:** The cost of crunching data has dropped for many years due to breakthroughs in processing power. More recently, it has been plummeting because of the rise of cloud service providers that rent out their data centers to companies that don't want to invest in huge server farms. "[Companies] used to throw data away because it was too expensive to keep," says Mike Olson, chief strategy officer of Cloudera. "Now we can keep data just because it might be interesting or useful later on. ... Storing the data at scale allows us to do new things."

These three trends have conspired to put artificial intelligence and its subdomain of machine learning on center stage today. All of a sudden, large companies can use the technology to automate work that some employees do; help employees do far better, less mindless and more interesting work; and do work that wasn't possible to do in the past because it would have overwhelmed the workforce.

The vast majority of companies have begun to understand the possible applications and potential implications of these cognitive technologies. That's why 84% of them told us they're using the technology today. Among the companies that we surveyed that are and are not using the technology currently, more than four out of five (84%) believe it will be important to staying competitive by the end of the decade.

However, our survey found that merely stating AI to be important to a company doesn't necessarily translate into big investments. While companies like Toyota have stated publicly they will make big investments in AI (again, in Toyota's case, \$1 billion over the rest of the decade),



they are the clear exceptions. Only 7% of the 835 executives we surveyed said their companies would spend \$250 million or more in 2016 on AI initiatives. The average investment -- \$67 million per company (which was 0.33% of average revenue) might suggest that most companies have ponied up for hefty AI investments. On the contrary: The planned median spend was only \$3 million in 2016. Only 15% of the companies we surveyed planned to spend \$67 million in 2016; about twice as many (29%) expected to spend less than \$1 million each.

Spending on AI appears highly correlated with company size. Of the companies surveyed with \$50 billion or more in annual revenue, 48% planned to invest at least \$75 million apiece in 2016 on cognitive technology initiatives.

That's today. Over the rest of the decade, the companies we surveyed appear to have aspirations for AI that go far beyond what they're doing today. They plan to spend a lot more on it. The average annual spend of companies in the four regions is expected to rise 31% by 2020 (compared with 2016's level), to \$88 million per survey respondent company. In fact, 16 of the 835 executives we surveyed projected their firms would spend at least \$1 billion each that year on cognitive initiatives.

That's a staggering investment by a surprising number of companies. But perhaps these companies were heartened by the 2016 headlines about the auto industry that they read -- for example, Volkswagen, General Motors<sup>13</sup>, Ford, and Toyota have all said their AI-enabled self-driving cars will be on the market by the end of this decade.<sup>14</sup>

But what will be the nature of the best AI investments that companies make over the rest of this decade? Will they merely be to automate labor-intensive processes that are costing them too much today? Will they essentially go toward improving the business as it works today? Or will they go toward transforming the business -- that is, leading to whole new products, services and business models that were not possible to explore before the advent of the technology?

In fact, the companies we surveyed estimated that nearly half (48%) of their AI investments in 2020 will be of the transformative type.

A great illustration of that comes from our discussion with leaders at the Associated Press. Today, through AI software, the news service is able to churn out 3,700 short quarterly earnings stories on publicly listed companies in the US That is 12 times the number that its staff of 65 could write without the technology.

You might call AP's AI initiative one of business 'improvement': producing more of the same product. However, AP has also used the technology to supply its newspaper customers with stories its journalists didn't write in the past: short articles on the weekly in-season game performance of National Football League players. As Jim Kennedy, AP's senior vice president of strategy and enterprise development, told us: AP must create new demand without adding people -- brand new news products that its staff doesn't have the time to write, yet which readers would want. That's a future AP and other media properties see for AI.

After companies get comfortable with AI and see how it helps improve their current products and processes, we believe a lot more -- like AP, like Microsoft, like Cloudera, as you'll read in the pages ahead -- will discover the technology's transformation potential.

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13 John D. Stoll, "GM Executive Credits Silicon Valley for Accelerating Development of Self-Driving Cars," The Wall Street Journal, May 10, 2016. Accessed June 1, 2016. <http://www.wsj.com/articles/gm-executive-credits-silicon-valley-for-accelerating-development-of-self-driving-cars-1462910491>

14 Other sources are [Wired](#) magazine (for Toyota), [Automotive News](#) (for Ford), and [Focus](#) (for VW)

## 8 Key Findings on How Big Companies are Using AI, Across and Within Four Regions of the World

The findings of this research report are wide-ranging, covering how big companies in North America, Europe, Asia-Pacific, and Latin America are spending on, using, benefiting from, and managing the adoption challenges of AI. We believe these eight findings stand out:

- 1 More than four out of five companies view AI to be essential, and nearly half see it as a transformative technology:** The vast majority of companies (84%) are using AI, and 62% view the technology as being important or highly important to remaining competitive by 2020. In that year, companies project nearly half their AI investments (48%) will go toward *transforming* their business, not merely improving the status quo.
- 2 Only a few are making bold investments today, which may trigger a competitive imbalance tomorrow:** Only a minority of companies planned to make substantial investments in AI in 2016. While the average spend in 2016 was expected to be \$67 million per survey respondent company, the expected median is only \$3 million. Even some of the biggest companies surveyed planned on spending very little, relatively speaking. For example, 57% of companies with revenue of between \$20 billion and \$50 billion each spent less than \$20 million on AI in 2015. Conservative spending may come to haunt the majority; the companies with the greatest revenue and cost improvements in 2015 from their AI initiatives outspent those with the smallest improvements by a factor of five (in terms of spending as a percent of company revenue).
- 3 The biggest AI spenders are North American and European companies:** The average AI spend by North American companies was \$80 million in 2015, the highest of the four regions, followed by European firms (\$73 million). But in 2016, the average European company surveyed anticipated outspending the average North American firm at \$80 million to \$64 million. Nonetheless, 8.5% of North American firms planned to spend at least \$250 million in 2016 on AI initiatives vs. 6.5% of European companies.
- 4 By the end of the decade, AI's impact is seen as expanding far beyond the IT function:** The most frequent user of AI in 2016 was the IT department, but the biggest beneficiaries of the technology by the year 2020 are predicted to be outside of IT. In 2016, 68% of companies were using AI in their IT function – more than double the next most common user (customer service, at 32%). However, by 2020, 70% of executives believe AI's greatest competitive impact will be on functions outside of IT. About a third (32%) believe the impact will be greatest in sales, marketing, or customer service, while 20% see it in non-customer-facing corporate functions of the corporate center, finance, strategic planning and/or corporate development, or HR.







- 5 AI is helping employees do better work, and companies do work they couldn't do before.** What they're doing with AI in 11 key business functions is a mixture of automating, helping employees, and doing work no one had done before in the organization – for example, automating routine answers to customer questions (replacing people) and automating assembly line activities; guiding service reps on how to resolve customer problems (helping employees); and anticipating future customer purchases and automatically presenting offers (enabling work the company didn't do before).
- 6 The technology is seen producing many new jobs but automating jobs as well.** While it varies by business function, executives predict AI will result in a net loss of jobs in each function by 2020 of between 4% (for example, in R&D) and 7% (for instance, in procurement). However, companies with the biggest revenue and cost improvements from AI in 2015 see the need for at least three times as many new jobs in each function by 2020 than companies with the smallest improvements from AI in 2015.
- 7 Companies rated four factors as most important to generating benefits from AI:** a) making AI systems secure against hacking; b) developing systems that continually learn on their own to make better decisions; c) developing systems that make reliable and safe decisions; and d) getting employees and managers to trust what AI is advising them to do. The first two, of course, are huge technical challenges while the third is largely about codifying the right human knowledge for a particular AI system. The fourth factor is about convincing people that a computer can make better decisions than they can on a specific business problem.
- 8 The companies with the biggest revenue and cost improvements from AI in 2015 shared five main characteristics.** They a) outspent the companies with the smallest improvements from AI by a factor of five; b) use AI more broadly across their organizations, and especially in areas that appear incidental to generating short-term revenue; c) yet also focus on areas that directly impact their ability to make (and lose) money; d) pay more attention to addressing fears of unemployment; and e) ensure their IT departments didn't suffer the 'cobbler's children' syndrome of using AI everywhere else but in IT.



The background is a vibrant, abstract digital composition. It features a gradient of green and yellow hues, with glowing, pixelated lines and geometric shapes like hexagons and circles. The overall effect is futuristic and high-tech, suggesting themes of artificial intelligence and digital connectivity.

# AI in Action at Big Companies in Four Regions of the World

## Highlights

- /// More than four out of five (84%) companies surveyed across North America, Europe, Asia-Pacific, and Latin America are using AI in some aspect of their businesses.
- /// The average per-company spend on the technology in 2015 was \$70 million, but the median spend was \$3 million. Only 16% of companies spent at least \$75 million each on AI initiatives in 2015.
- /// Most companies say they achieved revenue and cost improvements last year in the areas of their cognitive technology initiatives.
- /// The four most highly rated factors in generating improvements from the technology were
  - a) making systems secure,
  - b) developing systems that continually learn,
  - c) developing systems that make good, safe decisions, and
  - d) getting employees and managers to trust what AI is advising them to do.

# AI Spreads to All Corners of the Globe

Large banks in the US use AI algorithms to help them sift through hundreds of thousands of transactions every month, automating the laborious task of complying with anti-money laundering regulations.<sup>15</sup> Japanese auto giant Toyota Motor Corp. is pouring \$1 billion during the next four years into a research institute that will develop AI systems to help motorists avoid accidents.<sup>16</sup> German athletic gear giant Adidas has completed a successful test of an automated factory and plans to open a second.<sup>17</sup>

Corporate investments in cognitive technology are spreading across businesses of all kinds, in every corner of the globe. In our research, the vast majority of companies (84%) say they use cognitive tools today; the rest plan to do so by 2020.

The 835 respondents work in large enterprises in four regions: North America (43%), Europe (30%), Asia-Pacific (20%), and Latin America (7%).<sup>18</sup> Participants work in 13 industries, with the largest portion (22%) coming from banking and financial services, followed by hightech (hardware and software businesses, 19%) and industrial manufacturing (12%).<sup>19</sup> The companies in our study had an average revenue of \$20 billion, with a median of \$2.8 billion.

In addition to geographical and industry sector diversity, we sought a cross-functional view on what companies do with cognitive technology today and plan to do in the future. Perhaps because the IT group has the broadest knowledge of the use of cognitive technology by the organization, IT executives make up the largest percentage of our survey respondents (42%). We also surveyed other corporate leaders to get a deeper understanding of how their groups were using the technology (if at all). These groups include: corporate level (CEO, COO, and corporate staff); finance and accounting; sales; R&D and product design and development; marketing; customer service; manufacturing (or operations in service companies); strategic planning and corporate development; HR; procurement; distribution and logistics; and legal.

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15 Ben DiPietro, "Financial Firms Turn to Artificial Intelligence to Handle Compliance Overload," The Wall Street Journal, May 19, 2016, <http://blogs.wsj.com/riskandcompliance/2016/05/19/financial-firms-turn-to-artificial-intelligence-to-handle-compliance-overload>, accessed June 21, 2016.

16 Naomi Tajitsu, "Toyota to build artificial intelligence-based driving systems in five years," Reuters, June 20, 2016, <http://www.reuters.com/article/us-toyota-ai-idUSKCN0Z60BE>, accessed June 21, 2016.

17 David Meyer, "Why Adidas is Turning to Robots in Germany and the US," Fortune, May 25, 2016, <http://fortune.com/2016/05/25/adidas-robot-speedfactories/>, accessed June 22, 2016.

18 Note: In this study, we define North America as Canada and the US; Europe as Denmark, France, Germany, Switzerland, and the UK; Asia-Pacific as Australia, China, India, and Japan; and Latin America as Brazil and Mexico.

19 Note: These 13 industries are the same fields that TCS has researched in its previous global trend studies: Internet of Things (2015), digital technology (2014), Big Data and analytics (2013), social media (2013), and mobile technology (2012).

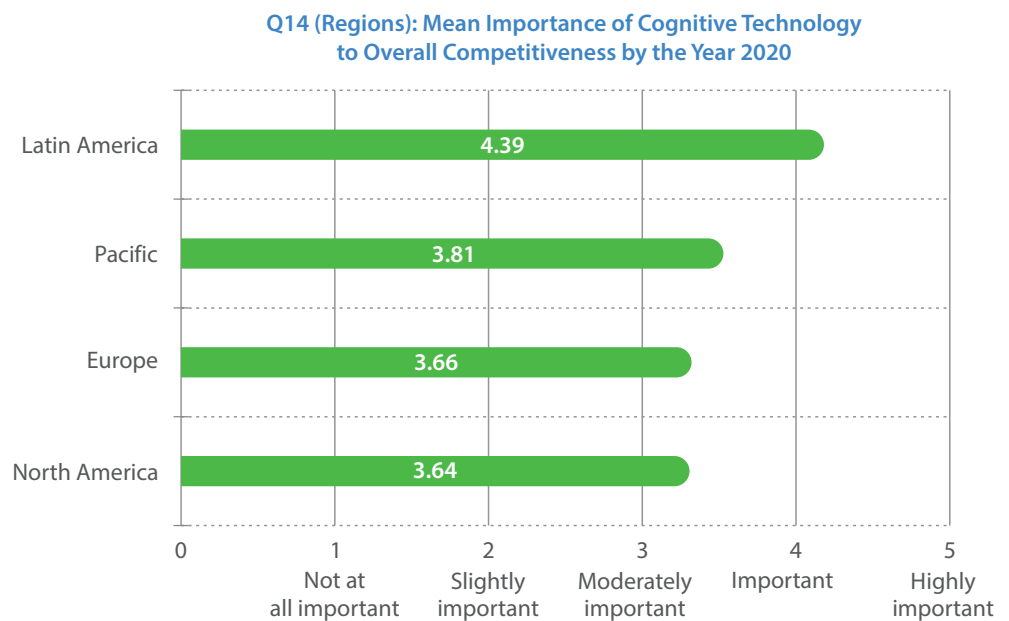


## The Importance of Cognitive Technology to Competitiveness

We asked managers how important cognitive technology would be to their companies' ability to compete by the year 2020. On a five-point scale (1 being 'not at all important' and 5 signifying 'highly important'), respondents across all four regions rated cognitive technology at 3.73, between moderately important and important. The importance that companies attach to cognitive technology varies significantly, however, by geography.

Latin American firms see cognitive technology as being far more important to their success by the end of the decade, rating an average of 4.39 on our 1-5 scale (see Exhibit II-1). It could be that companies in these emerging economies of Mexico and Brazil see AI as a way to leapfrog their competitors from established economies.

Asia-Pacific companies were next, rating the technology a 3.81. European and North American firms rated the technology lower, at 3.64 and 3.66 respectively.



**Exhibit II-1: How the Four Regions Rate the Importance of Cognitive Technology to Competitiveness**

## Big Spenders with Big Projects

Facebook is on a quest to build 1.5 billion artificial intelligence agents, about one per Facebook user, as the company plans a machine learning-based future for its social network.<sup>20</sup> As part of its ongoing investments in AI, Facebook signed a deal to buy high-powered graphics processing units from NVIDIA.<sup>21</sup>

Many companies in our study are following the lead of tech giants like Facebook. Companies are investing millions in cognitive systems, including the technology itself plus staff, service partners, hardware, and consulting. In 2015, the average company in our study spent \$70 million (see Exhibit II-2 for details). However, the median spend was much lower: \$3 million. In fact, 84% of the managers surveyed said their companies each spent less than \$75 million in 2015 on AI initiatives.

### Q10 (Regions): 2015 Spend on Cognitive Technology Initiatives

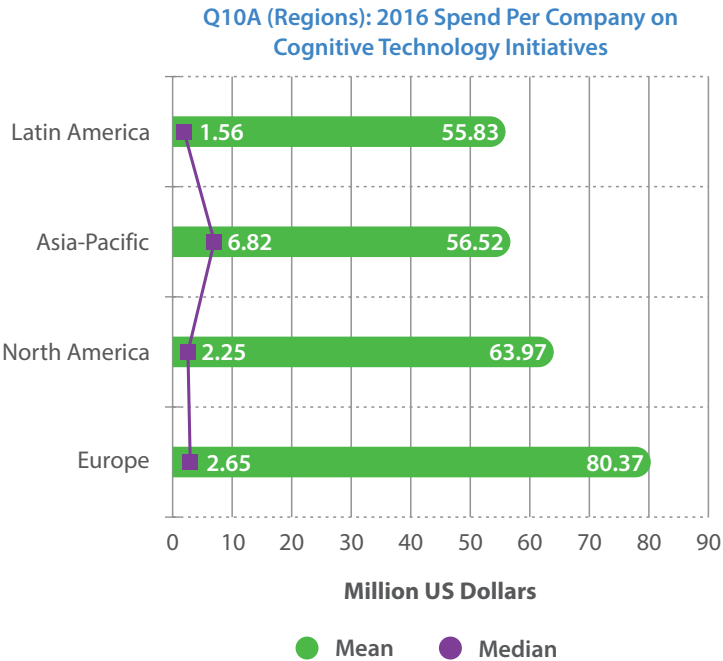


### Exhibit II-2: Spend Per Company in Each Region on Cognitive Technology Initiatives in 2015

20 Stacey Higginbotham, "Inside Facebook's Biggest Artificial Intelligence Project Ever," Fortune, April 13, 2016, <http://fortune.com/facebook-machine-learning>, accessed June 23, 2016.

21 Julie Bort, "Facebook is giving away a powerful new technology for building smart computers," Business Insider, Dec. 10, 2015, <http://www.businessinsider.com/facebook-open-sources-its-ai-hardware-2015-12> accessed August, 2016.

North American and European firms spent more than those in Asia-Pacific and Latin America in 2015, and projected to do so again in 2016 (see Exhibit II-3). In their 2016 plans, European firms lead, averaging \$80 million per company – 26% higher than planned investments cited by respondents in North America (\$64 million on average). Asia-Pacific companies (at \$57 million, on average) and Latin American firms (\$56 million) are close behind.



**Exhibit II-3: Mean and Median 2016 Spend**

Some firms spent much more in 2015 (see Exhibit II-4): 51 (or 7% of the 741 respondents who answered this question) reported each of their companies spent \$250 million or more in 2015 on cognitive systems initiatives. Eighteen companies invested \$1 billion or more in 2015 on cognitive initiatives; 16 of the 18 were companies with an annual revenue of \$50 billion or more, among the biggest firms in the survey. Seven of these companies were based in North America and seven were based in Europe.

Spend was predicted to fall by 4% in 2016 to an average of \$67 million among all firms in the study, perhaps slowed by economic headwinds encountered in Latin America, Europe, and Asia.

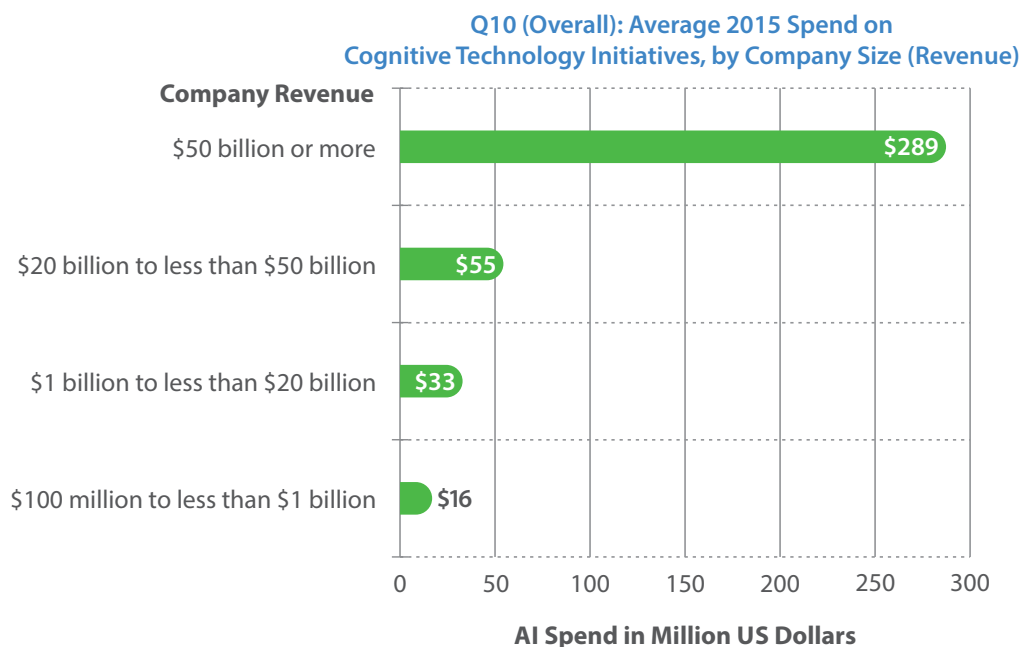


Exhibit II-4 shows the locations of the biggest spenders – those who spent \$250 million or more in 2015. More companies in this category are based in North America (26, or 8.5% of respondents), followed by Europe (15 firms, or 6.5%), Asia-Pacific (8, or 5.2%) and Latin America (2, or 3.9%).

Q10 (Regions): Where the Biggest-Spending Companies on Cognitive Technology Initiatives are Located (2015 Spend Data)				
	North America	Europe	Asia-Pacific	Latin America
\$250M–\$500M	10	3	1	1
\$500M–\$750M	3	2	4	0
\$750M–\$1B	6	3	0	0
\$1B or more	7	7	3	1
<b>Total</b>	26	15	8	2
<b>Percentage</b>	8.5%	6.5%	5.2%	3.9%

#### Exhibit II-4: Where the Big Spenders Are

As one might expect, there's a strong correlation between company size and AI spend (see Exhibit II-5). Companies with a revenue of \$50 billion or more averaged \$289 million in 2015 spend on the cognitive initiatives. Firms with revenue between \$100 million and \$1 billion averaged only \$16 million in spend per company.



#### Exhibit II-5: The Biggest Companies Spend Far More than the Rest

## Cognitive Systems: Dollars and Sense

We asked managers at companies that were using AI in 2015 to estimate the revenue gains and cost savings impact of their cognitive initiatives. We asked about the impact in the business area where cognitive technology is being used -- on a product line, a division, a single product -- not on the entire company.

In terms of revenue, respondents worldwide reported a 17% average increase (in the business area corresponding to the cognitive initiative) in 2015 as compared to 2014. Among these respondents, 1% said revenue declined; one-quarter said revenue increased between one and 5%; one-third said revenue rose between 6% and 15%; and 27% said revenue increased by 16% or more. On a regional basis, Latin American survey respondents reported the highest average revenue increase (25%), followed by Asia-Pacific (19%), North America (16%), and Europe (14%).

When it comes to cost savings, managers in our study said cognitive technology initiatives led to cost reductions averaging 12% in 2015 compared to 2014. Latin American companies again cited the biggest benefit here, averaging a 20% cost reduction in the business area hosting the cognitive systems, followed by Asia-Pacific firms (15%). European managers said they saw 11% cost declines, and North American companies estimated the cost reduction at 9% -- still significant.

## The Impact on Jobs: Rough or Rosy?

Not all the news about AI has been heartwarming. Several studies have ignited fears of massive unemployment. A 2016 study, published by the International Labour Organization (an agency of the United Nations), warned that in five Southeast Asian nations (Cambodia, Indonesia, the Philippines, Thailand, and Vietnam), 56% of workers could lose their jobs to robots and other automation over the next two decades. Three sectors in those countries were found to be most vulnerable to job elimination through cognitive technology: textiles, clothing, and footwear.<sup>22</sup>

Other studies have painted similarly bleak pictures. A 2013 report from Oxford University predicted that nearly half (47%) of US jobs could be automated. The researchers analyzed 702 occupations for their susceptibility to being automated. Those at greatest risk of being automated soon, according to the researchers: driving trucks and writing legal briefs.<sup>23</sup> A 2016 Citigroup study predicted that automation in retail banking could reduce staff at branches and associated personnel by 30% between 2015 and 2025. That would be a 40%-50% drop from the days before the Great Recession that began in late 2007.<sup>24</sup>

Yet other studies project a less dire future for employment. McKinsey & Company's think tank, the McKinsey Global Institute, believes that only 5% of jobs at the most will be completely replaced by technology in the near or medium term. However, in looking at 800 occupations (both high wage, high skill and low wage, low skill), the group believed that 45% of their work activities could be computerized. These work activities, McKinsey argued, in many cases did not constitute entire jobs, just certain aspects of them.<sup>25</sup>

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22 "Technology transforming industries critical for growth and jobs in ASEAN," International Labor Organization, July 7, 2016, [http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS\\_496766/lang-en/index.htm](http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_496766/lang-en/index.htm), accessed July 7, 2016.

23 Carl Benedikt Frey and Michael A. Osborne, "The Future of Employment: How Susceptible are Jobs to Computerization?" Oxford Martin School, Sept. 17, 2013, [http://www.oxfordmartin.ox.ac.uk/downloads/academic/The\\_Future\\_of\\_Employment.pdf](http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf), accessed March 14, 2016.

24 Citigroup report, "Digital Disruption: How FinTech is Forcing Banking to a Tipping Point," March 29, 2016, <https://www.citivelocity.com/citigps/ReportSeries.action>, accessed April 11, 2016.

25 Michael Chui, James Manyika, and Mehdi Miremadi, "Four fundamentals of workplace automation," McKinsey & Co., November 2015, <http://www.mckinsey.com/business-functions/business-technology/our-insights/four-fundamentals-of-workplace-automation>, accessed March 14, 2016.

Academics, business leaders, and politicians continue to discuss the effect that automation will have on certain kinds of jobs in the future.<sup>26</sup> Cognitive technology, as well as robotics and autonomous vehicles, will reshape some staffing needs. Computers that understand and respond to language, for example, may obviate the need for huge contact centers with large numbers of customer service representatives.

Our study also explored the potential impact of AI on jobs. We asked the 835 executives who took part in the survey to estimate the impact on jobs in their business function – both jobs eliminated and new jobs created to better harness and maintain the technology.<sup>27</sup> They estimated that by 2020 there would be a net loss of jobs of only between 4% and 7% depending on the function (for example, a net loss of 4% of jobs in customer service and 7% in procurement).<sup>28</sup>

Surprisingly, companies said that by 2020, they expect to see the technology eliminate 23% of today's jobs in the corporate center (most likely staff who support the CEO, COO, presidents, divisional GMs). That represents the highest job loss rate among all business functions in the survey. For other functions, managers predicted job losses ranging from 17% to 21% by 2020. While respondents saw a reduction in current jobs, they also saw cognitive technology leading to an 18% increase in new jobs created in the corporate center. Indeed, respondents predicted cognitive tools would require a sizable number of new jobs in every business function, with increases ranging between 12% and 15% by 2020 (see Exhibit II-6).

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26 Rachael King, "Lawmakers Investigate Impact of Automation and Robotics on U.S. Jobs," The Wall Street Journal, May 25, 2016, <http://blogs.wsj.com/cio/2016/05/25/lawmakers-investigate-impact-of-automation-and-robotics-on-u-s-jobs>, accessed June 27, 2016.

27 Note: To get more accurate assessments, we asked the executives to estimate the potential job impact of AI only in their functional area – that is, the one in which they would be most familiar.

28 Note: The net loss of jobs (of between 4% and 7% depending on the business function) does not mean a 4-7% net loss of jobs across companies. The data doesn't take into account that some functions employ many more employees than other functions. For example, the typical procurement department (which predicted a 7% loss in net jobs in their area by 2020 due to AI) employs far fewer people than the typical IT department (which projected a 5% net loss of jobs by 2020). Nonetheless, managers in all 13 functional areas we surveyed predicted a net loss of jobs in their functions by 2020 from implementing AI.



Q18 and Q19: Percentage of Jobs that are Likely to be Lost and Gained by 2020 because of Cognitive Technology			
Function	Average Percentage of Jobs That Cognitive Technology is Predicted to Eliminate by 2020	Average Percentage of Jobs that Cognitive Technology is Predicted to Create by 2020	Net Change in Jobs by 2020
Corporate level	23%	18%	-5%
Procurement	21%	14%	-7%
Legal	21%	15%	-6%
IT	20%	15%	-5%
HR	19%	14%	-5%
Distribution and logistics	19%	15%	-4%
Finance and accounting	19%	14%	-5%
Strategic planning and corporate development	18%	14%	-4%
Marketing	18%	13%	-5%
Manufacturing or operations	17%	12%	-5%
Customer service	17%	13%	-4%
Sales	17%	12%	-5%
R&D	17%	13%	-4%

### Exhibit II-6: Predictions of Jobs Gained and Lost, by Business Function

The expectations for jobs eliminated and created vary slightly by region. Asia-Pacific and Latin American companies expect AI to reduce their employee numbers in the functions using the technology by 19% on an average, per function, by 2020. European managers expect their reductions to reach 14% and North American managers estimate 11%.

On the new hire front, North American firms expect an average 8% increase in jobs per function by 2020, while European firms estimate a 10% increase in job creation related to cognitive tools. Managers in Asia-Pacific expected a 16% rise in hires and Latin American firms said they saw employment rising by an average 17% per function.<sup>29</sup>

<sup>29</sup> Note: These figures represent the average increase in jobs per function, averaged across all functions – not the average increase across the entire company.

## Critical Success Factors for Cognitive Technology Initiatives

What are the key success factors for companies pursuing business benefits from cognitive systems? We asked managers to rate factors, ranging from security risks to employee acceptance, using a scale of 1 to 5 (1 being not at all important, 5 being highly important). The average scores fell in a narrow range – between 3.58 and 4.09. That suggests respondents don't see one critical success factor for gaining high returns from AI. Rather, they see many issues as important.

However, looking at managers' ratings of these factors provides insights on what companies believe they must do right. Six issues emerge as priorities worldwide, led by technological challenges. Managers identified three top success factors: making systems secure, developing systems that continually learn, and developing systems that make good, safe decisions.

The fourth and fifth-rated success factors are cultural: getting internal teams to trust advice from cognitive systems, and getting them to adopt new technologies and ways of working. The sixth-rated factor is changing business processes to capitalize on automation and the like.

Exhibit II-7 lists the key success factors as ranked by respondents across the globe and by region, where some differences emerged. For instance, in North America, managers ranked securing cognitive systems as the top success factor, followed by getting teams to trust the advice of cognitive systems. Latin American managers ranked getting teams to trust the advice of cognitive systems as the top factor. They cited system quality (developing systems that continually learn and make better decisions) as second-most important.

**Q17 (Overall and by Regions): Most Important Factors in Getting Benefits from Cognitive Systems**

Rank	Across World	North America	Europe	Asia-Pacific	Latin America
1	Making systems secure against hacking (4.09)	Making systems secure against hacking (4.12)	Making systems secure against hacking (4.00)	Making systems secure against hacking (4.05)	Getting managers and employees to trust what our cognitive systems are advising them to do (4.46)
2	Developing systems that continually learn and make better decisions (4.00)	Getting managers and employees to trust what our cognitive systems are advising them to do (4.04)	Developing systems that continually learn and make better decisions (3.90)	Getting employees to learn and adopt new processes and systems (4.01)	Developing systems that continually learn and make better decisions (4.46)
3	Developing systems that make good, reliable, safe decisions (3.99)	Developing systems that make good, reliable, safe decisions (4.04)	Getting employees to learn and adopt new processes and systems (3.90)	Getting managers and employees to trust what our cognitive systems are advising them to do (3.93)	Determining where to use the technology in the company (4.44)
4	Getting managers and employees to trust what our cognitive systems are advising them to do (3.99)	Developing systems that continually learn and make better decisions (4.03)	Developing systems that make good, reliable, safe decisions (3.88)	Developing systems that make good, reliable, safe decisions (3.93)	Addressing layoff fears (4.44)
5	Getting employees to learn and adopt new processes and systems (3.96)	Getting employees to learn and adopt new processes and systems (3.93)	Getting managers and employees to trust what our cognitive systems are advising them to do (3.86)	Developing systems that continually learn and make better decisions (3.92)	Making systems secure against hacking (4.43)
6	Changing our business processes to capitalize on automated decisions, actions, and so on (3.91)	Changing our business processes to capitalize on automated decisions, actions, and so on (3.93)	Changing our business processes to capitalize on automated decisions, actions, and so on (3.79)	Changing our business processes to capitalize on automated decisions, actions, and so on (3.91)	Changing our business processes to capitalize on automated decisions, actions, and so on. (4.39)
7	Determining where to use the technology in the company (3.86)	Determining where to use the technology in the company (3.88)	Determining where to use the technology in the company (3.78)	Getting top management approval for funding (3.88)	Developing systems that make good, reliable, safe decisions (4.39)
8	Getting top management approval for funding (3.84)	Getting top management approval for funding (3.87)	Getting top management approval for funding (3.68)	Deciding whether to use the technology to help or replace people (3.85)	Deciding whether to use the technology to help or replace people (4.37)
9	Deciding whether to use the technology to help or replace people (3.71)	Deciding whether to use the technology to help or replace people (3.56)	Deciding whether to use the technology to help or replace people (3.67)	Determining where to use the technology in the company (3.85)	Getting employees to learn and adopt new processes and systems (4.33)
10	Addressing layoff fears (3.58)	Addressing layoff fears (3.40)	Addressing layoff fears (3.58)	Addressing layoff fears (3.69)	Getting top management approval for funding (4.26)

Importance rated on scale of 1-5 (1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = highly important)

**Exhibit II-7: The Keys to Generating Benefits**



## AI at AP: How Technology Has Expanded Reporting at a 170-Year-Old News Service

The Associated Press news service has been around so long it reported on General George Armstrong Custer's last stand in Montana in 1876. (Mark Kellogg, the AP reporter who covered it died in the battle.) Actually, the AP's earliest stories came 30 years prior to that with dispatches on the Mexican-American War in 1846.<sup>30</sup> Fast forward to today, and you'll find the AP using the internet to speed the delivery of news, videos, and images, and (in the last three years) utilizing artificial intelligence to write the news.

AP leadership believes AI constitutes a huge technological opportunity for the New York-based company. Owned by US daily newspapers, and serving 15,000 news outlets around the world, AP is a \$568 million (2015 revenue), not-for-profit organization with no debt, and operating income of \$14 million (three times the 2014 total).<sup>31</sup> It produces 2,000 stories a day, and one million photos and 50,000 videos a year.

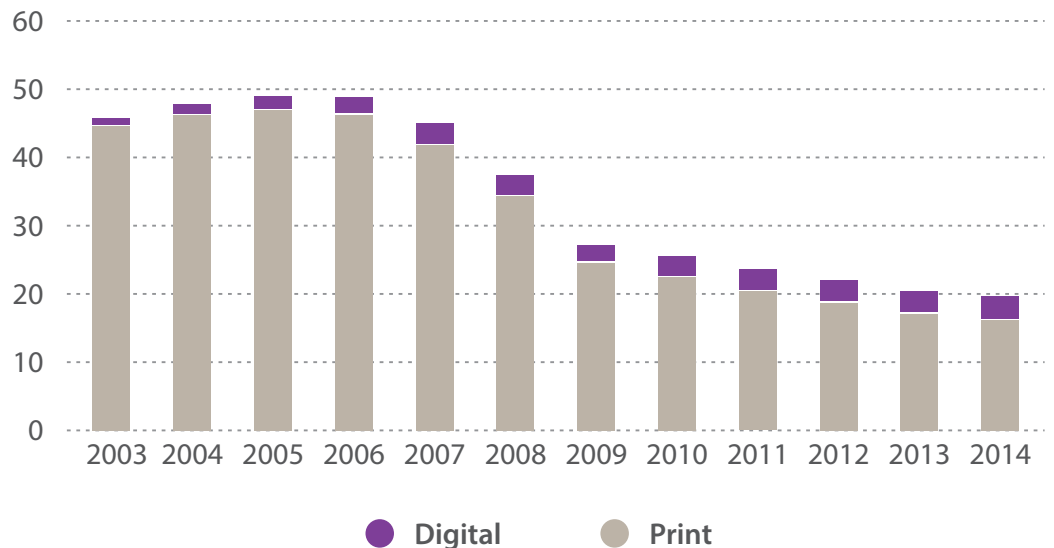
In its first century, AP delivered news by pigeon, pony express, railroad, steamship, telegraph, and teletype. That gave way to wire, radio networks and, ultimately, the internet. Today, artificial intelligence is writing a new story for AP. Since 2014, AP has been using AI to automate the production of routine stories on the quarterly financial reports of public companies. That has freed up AP reporters to generate more in-depth stories for readers.

30 "AP's History," Associated Press, <http://ap.org/company/history/ap-history>, accessed June 22, 2016

31 "2015 Consolidated Financial Statements," Associated Press, March 30, 2016, [http://www.ap.org/annual-report/2015/AssociatedPress\\_2015FinancialStatements.pdf](http://www.ap.org/annual-report/2015/AssociatedPress_2015FinancialStatements.pdf), accessed June 21, 2016



## Newspaper Ad Revenue from Digital Print



*Annual revenue in billions of US dollars*

Newspaper Association of America (through 2013), BIA/Kelsey (2014)  
PEW RESEARCH CENTER

## The Implosion of the US Newspaper Industry

All this comes at a critical time for the news service and the newspapers that fund it. AP's newspaper and broadcast media customers have been squeezed severely since websites such as Craigslist started siphoning off the classified ad business 20 years ago. The annual advertising revenue of the US newspaper industry plummeted more than 50% from 2003 to 2014, from \$46 billion to \$20 billion in 2014.<sup>32</sup> From 2008 to 2014, the period of deepest decline, AP's yearly revenue fell only 19% (from \$747 million to \$604 million)<sup>33</sup> — less than half the newspaper industry's 47% decline in advertising revenue. Clearly, AP has been doing numerous things right.

One of them is using information technology to produce news articles more efficiently, and generate even more of them, and in more formats (live streaming video, virtual reality, and more). Now AP executives see AI as critical to producing far more content for its members at a price they can afford.

The AP's experience in using AI to write routine news articles has provided numerous lessons, including how to create software with the capacity to write articles from financial numbers; how to mitigate the impact on employees of automating work; and how best to free up staff to focus on higher-value work.

<sup>32</sup> "The State of the News Media 2015," Pew Research Center, April 29, 2015, <http://www.journalism.org/2015/04/29/newspapers-fact-sheet-2015/>, accessed June 22, 2016

<sup>33</sup> "2015 Consolidated Financial Statements," Associated Press, March 30, 2016, [http://www.ap.org/annual-report/2015/AssociatedPress\\_2015FinancialStatements.pdf](http://www.ap.org/annual-report/2015/AssociatedPress_2015FinancialStatements.pdf), accessed June 22, 2016

## How AP's AI Initiative Began

About 5,300 companies list their shares on US stock exchanges.<sup>34</sup> In theory, if AP were to cover them all, it would need to produce at least 5,300 news stories every three months; that is, every time the companies filed their quarterly financial reports with the Securities and Exchange Commission (SEC). In reality, with 65 business reporters and editors, there is no way AP could churn out that many stories every quarter. Since it takes AP an average 30 minutes to write and edit each quarterly earnings story, producing stories on all 5,300 companies would consume nearly 10% of the time of AP's business news staff. Says Lisa Gibbs, AP's business desk editor, "That would curtail our ability to devote the requisite time to more enterprising stories such as how technology is changing the way people shop, the state of the US housing market 10 years after the bust, and how food companies market junk food as healthy." Gibbs says those stories are usually not only far more interesting for readers (because there's less chance that other news sources have them), they're also more interesting for reporters to write. The Nieman Reports, a non-profit self-styled watchdog of journalism, refers to these kinds of articles as 'stories that matter.'<sup>35</sup>

In fact, prior to using AI to write these earnings report stories, AP's journalists were able to cover only about 6% of all possible quarterly earnings filings, or about 300 stories per quarter, Gibbs says. Today, AP can cover about 100 of them in more depth because the automated software has freed up staff time. AP sees these as the most important earnings stories for both investors and consumers, the readers of AP's business coverage. "For companies like Walmart and McDonald's, we have beat reporters who cover their earnings, not just because people invest in them, but also because people shop with them," explains Gibbs, who has been in charge of the news service's business reporters and editors worldwide since she joined the organization in August 2014. AP editors working on the other 200 quarterly earnings stories now typically begin with the automated versions and then add content.



**Lisa Gibbs, Business Desk Editor,  
Associated Press**

Yet, there are many other far smaller public companies that matter to the readers of daily newspapers around the US. For these newspapers to matter to their readers in a highly competitive market, AP's executives believed they had to find a way to cover more of them — many more — explains Jim Kennedy, AP's senior vice president of strategy and enterprise development. "We had complaints from member newspapers that our business coverage was not reaching down far enough in earnings reports for smaller companies," he says.

Accordingly, in 2013, AP began working with a North Carolina firm, Automated Insights, to develop an AI-based system. Launched in 2007, the company had Wordsmith, an AI system that AP hoped could be trained to take quarterly financial data and generate stories without the need for a human reporter.

In July 2014, AP assigned an assistant business editor, Philana Patterson (who had written and edited thousands of earnings stories at AP, Dow Jones Newswires, and Bloomberg), to work with Automated Insights and its software developers.<sup>36</sup> Using financial data from Zacks Investment Research, Patterson and several AP colleagues determined what data and directions the software would need to create brief earnings articles. Automated Insights' software developers then wrote the algorithm that would guide the robot reporter.

*"In fact, prior to using AI to write these earnings report stories, AP's journalists were able to cover only about 6% of all possible quarterly earnings filings, or about 300 stories per quarter," Gibbs says.*

34 Michael Campagna, "Distinguished Speakers Series: Jason DeSenaTrennert," CFA Society Chicago, February 4, 2016, <https://blog.cfachicago.org/2016/02/04/distinguished-speakers-series-jason-desena-trennert/>, accessed June 23, 2016

35 Celeste Lecompte, "Automation in the Newsroom," Nieman Reports, September 1, 2015, <http://niemanreports.org/articles/automation-in-the-newsroom/>, accessed June 16, 2016

*"We are using the technology to add value, not to replace humans with robots," Kennedy says.*

## **The Result: 3,700 Earnings Stories a Quarter Authored by the Software**

By the end of 2015, the new system was working, and quite impressively too. The software was writing about 3,700 quarterly earnings stories covering all US listed companies, and several hundred Canadian firms with a market capitalization of at least \$75 million. Those 3,700 stories are more than 12 times the number that AP's human reporters were able to do.

By AP's reckoning, developing those 3,700 quarterly earnings stories was at least the work of three full-time people, which was now automated. AP did not lay off any reporters because of AI. Instead, it's accomplishing much more work with the same headcount.

What's more, by Gibbs' admittedly informal estimate, by freeing reporters from having to write so many quarterly earnings stories, AP has increased the number of major enterprise projects — in-depth explorations of business trends and companies that may or may not be triggered by a financial report — by 20%. For example, one of her editors who had written and edited many earnings stories could now cover the cable and telecom industries. "We have more beat coverage now on what those companies and consumers are doing with streaming services, mobile apps, and other technologies," says Gibbs. "It's something that we wouldn't have been able to do pre-automation." Part of the shift to more enterprising stories was based on Gibbs' insistence that AP's business reporting staff do a greater number of deeper stories about business and companies.

What about accuracy? Are AI-written stories as accurate as those done by human hands? In fact, AP has found that its AI-written earnings stories have a lower error rate than those written by reporters. "That is a huge win," as Gibbs says.

## **What AP Did Right**

Why did the AP's AI project go so well? The odds looked to be against it given that the work relied on human judgment and creativity, and the industry, staffed by people trained to be cynical, has long appeared to be in dire straits. How did Kennedy, Gibbs, and other AP leaders get their editors and reporters to cooperate and not rebel against the automation that might be viewed as a threat to their jobs and profession?



**Jim Kennedy, Senior Vice President,  
Associated Press**

One of the first things they did was put job fears to rest. "At the beginning, there were fears, not just at AP, but in the entire journalism industry," Gibbs says. "But the fact is it didn't cost us any jobs. So whatever uneasiness there might have been has been eased."

What's more, she says, AP's business reporters were reassured that the stories that were being automated didn't ask the software to understand the nuances of companies it was writing about; it was just asked to report the numbers companies released in a way readers could absorb.

"An automated earnings story does not replace a thoughtful earnings story about a company by a beat reporter," Gibbs says.

That kind of transparency with the workforce about how AP planned to use AI has turned out to be a key element in the organization getting its employees on board. As Kennedy explains, "Our guiding principle with automation is to tell the world we are doing it, to be totally transparent." In

fact, every story generated by the software is identified as such. "We are using the technology to add value, not to replace humans with robots," Kennedy says.

The culture of the newsroom at AP was open to technologies that could improve the work of the news services' journalists from the very beginning. In fact, it was members of AP's newsroom who introduced Automated Insights to senior AP management, remembers Kennedy.

At first, he was skeptical. But Automated Insights showed him what it had done for Yahoo Sports fantasy league, and the Cleveland Indians' baseball sites. "It was pretty impressive," Kennedy says. "Looking at the stories [the software] produced, I couldn't tell they were written by a machine."

Prior to unleashing the software on the business news desk, AP management used it to produce the copy it provides to newspapers to augment their coverage of the National Football League. They tuned the software to rank NFL players on their game performance from a stream of data each week, and then write copy on their performance. The rankings and text turned out to be "readable and insightful," says Kennedy.

With the success of automated earnings stories, AP made a small equity investment in Automated Insights — one that paid off soon afterward when the AI company was purchased by a private equity firm, Vista Equity Partners, in 2015.

## Where AP Goes from Here

The Associated Press continues to look for ways that artificial intelligence can help it produce more and better news content. It's looking to automate more sports reporting and other news beats. In Kennedy's view, automation will allow AP to create content that consumers want but aren't getting today.

"The big thing in the news business today is that the supply and demand equilibrium has been disrupted," Kennedy explains. "Anyone can create content, and anyone can publish a piece of news. People are doing it all the time on Facebook and Twitter. We're in an oversupplied marketplace that is big and getting bigger all the time."

What AP must do, he believes, is to "create new demand" without adding resources. That will require automating the production of content that can be automated, thereby freeing up staff to produce "the kind of content no one else has."

"I think the next 20-25 years will be amazing," concludes Kennedy. "I see an amazing rebirth of the journalist." In that future, Kennedy sees professional journalists, supported by data and technology, liberated from mundane reporting grunt work, unleashed and armed to do the more investigative reporting that news organizations will need to thrive, and that society needs.

A person in a business suit and red tie is pointing their right index finger towards a digital interface. The interface features several circular icons: a magnifying glass, a speech bubble, a laptop, a padlock, and a document with a checkmark. A network of blue lines connects these icons, suggesting a flow of information or a process. The background is a blurred image of the person's face and suit.

# AI Spreads Beyond IT to Other Functions



## Highlights

- AI has taken hold in IT more than in any other function. Some 68% of companies are using AI in the IT function. That was more than twice the percentage (32%) of the next most frequent user of AI: customer service.
- In the IT function, most often, companies are using AI to detect and deter security intrusions into their networks. Some 68% of companies using AI in the IT function are doing this today.
- There is little unanimity about where AI will have the greatest beneficial impact by 2020. The IT function was selected more often than any other function, but only by 30%. Sales (chosen by 12%), customer service (11%) and marketing (9%) came next.

We asked respondents to indicate the functions, such as IT or marketing, where their companies use cognitive technology. Across all regions, the IT department is by far the most frequently cited – 68% of respondents(see Exhibit III-1). While this may be shaped by the survey design, since 43% of those polled work in the IT function, we asked every respondent to name which company departments (in addition to their own) are using, or plan to use, cognitive technology.

It’s easy to see why IT is central to the AI trend. Hitachi, the \$81 billion Japanese conglomerate, announced in 2015 that it would inject artificial intelligence into IT systems that power business processes. Hitachi’s goal: Use AI capabilities to boost efficiency in work orders and logistics tasks.<sup>37</sup>

After IT, customer service was the second most frequently mentioned function, cited by 32% of respondents, followed closely by sales, marketing, and finance.

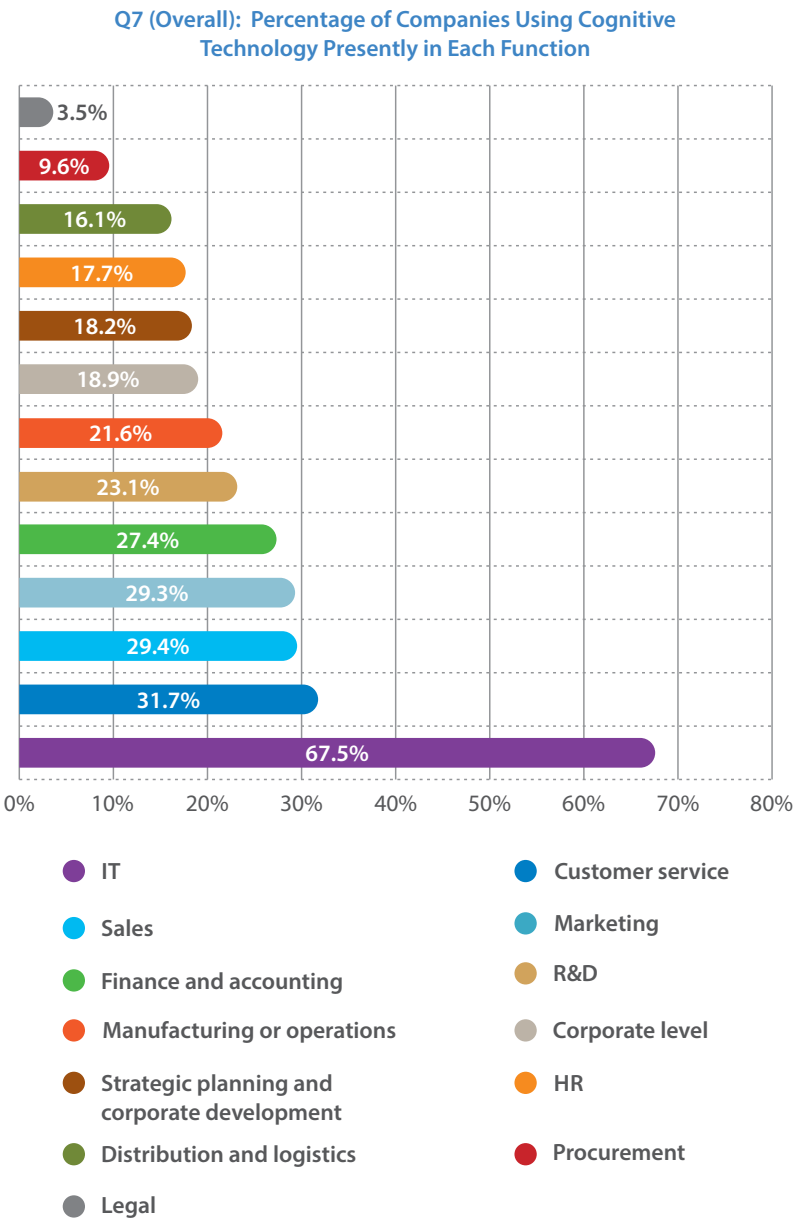


Exhibit III-1: Deployment of Cognitive Technology by Function

37 Hitachi press release, “Development of Artificial Intelligence issuing work orders based on understanding of on-site kaizen activity and demand fluctuation,” September 4, 2015, <http://www.hitachi.com/New/cnews/month/2015/09/150904.html>, accessed June 27, 2016.

We probed more deeply on how each business group uses cognitive technology. The pages that follow show the percentage of application adopted, and how companies apply the technology in each function.

**IT:** Two-thirds of firms in IT use cognitive technology to detect and deter security intrusions.

Q8 (Overall): How Companies are Using Cognitive Technology in IT	
Percentage Using the Technology	How these Companies Use the Technology in IT
68%	Detecting and deterring security intrusions (66%) Resolving tech user problems (60%) Reducing production management work (51%) Gauging internal compliance in using approved vendors (51%) Doing run-book automation (24%)

**Microsoft uses machine learning algorithms to predict who will attack its computer networks.<sup>38</sup>**

**Customer service:** In contact centers, cognitive technology helps companies answer customer queries, by automating the process as much as possible, assisting staff, and training them to do a better job. Close to half (48%) of companies use cognitive systems to automate customer call distribution. Another 42% deploy cognitive systems to guide contact center representatives on recommended actions to resolve customer issues.

Q8 (Overall): How Companies are Using Cognitive Technology in Customer Service	
Percentage Using the Technology	How these Companies Use the Technology in Customer Service
32%	Automating call distribution (48%) Guiding contact center reps on how to resolve customer issues (42%) Automating responses to routine customer questions (39%) Solving complex customer problems (38%) Identifying training needs (36%) Automating personnel scheduling (32%)

**Hilton Worldwide has been running a pilot program since 2016 that uses a robot called Connie. The robot, named after the hotel chain's founder, Conrad Hilton, answers visitor questions about hotel services, local attractions, and other issues.<sup>39</sup>**

**USAA, the \$24 billion American insurance company, uses 'Eva' (the Enhanced Virtual Assistant), to handle customer transactions such as transferring money and paying bills. Customer interactions with Eva resemble conversations with Apple's Siri assistant. In 2015, USAA had plans to further develop the system, to add more customer service capabilities.<sup>40</sup>**

38 Fahmida Y. Rashid, "Microsoft's machine learning vision includes security, too," Infoworld, April 4, 2016, <http://www.infoworld.com/article/3051134/security/microsofts-machine-learning-vision-includes-security-too.html>, accessed June 27, 2016.

39 Hilton press release, "Hilton And IBM Pilot 'Connie,' The World's First Watson-Enabled Hotel Concierge," March 9, 2016, <http://news.hiltonworldwide.com/index.cfm/news/hilton-and-ibm-pilot-connie-the-worlds-first-watsonenabled-hotel-concierge>, accessed Aug. 2, 2016.

40 Brad Power, "Artificial Intelligence Is Almost Ready for Business," Harvard Business Review, March 19, 2015, <https://hbr.org/2015/03/artificial-intelligence-is-almost-ready-for-business>, accessed June 23, 2016.

**Sales:** Twenty-nine percent of companies use cognitive technology to support the sales function. These tools can guide salespeople on negotiating tactics (cited by half of the firms in this category), qualify sales leads, and connect prospects to the correct sales person.

Q8 (Overall): How Companies are Using Cognitive Technology in Sales	
Percentage Using the Technology	How these Companies Use the Technology in Sales
29%	<p>Guiding salespeople on discussions with customers: what to offer, how to negotiate, and so on (50%)</p> <p>Qualifying sales leads and inquiries (43%)</p> <p>Matching sales leads to the right salespeople (38%)</p> <p>Shifting resources between online and offline sales initiatives (35%)</p>

**Staples, the \$21 billion office supplies retailer, deployed voice recognition technology that lets business customers enter orders by voice, using a smartphone app or a device installed in the customer's supply room. The system can store information about repeat orders, like brands for pens or types of paper stocked.<sup>41</sup>**

**Marketing:** Twenty-nine percent of respondents use cognitive technology in marketing, with almost two-thirds of these companies saying they have deployed systems that anticipate future purchases and present corresponding offers to customers.

Q8 (Overall): How Companies are Using Cognitive Technology in Marketing	
Percentage Using the Technology	How these Companies Use the Technology in Marketing
29%	<p>Anticipating future customer purchases and presenting offers accordingly (65%)</p> <p>Improving media buying (56%)</p> <p>Monitoring social media comments and brand affinity (56%)</p> <p>Tailoring promotions -- online or offline (53%)</p> <p>Enabling dynamic pricing (21%)</p>

**Nestle, the \$91 billion food giant, has brought the technology into Japanese stores in the form of Pepper, a robot with a touch screen that speaks to customers about their coffee preferences and answers product questions. The robot is designed to learn about customer needs while boosting sales of its coffee machines: It can read people's facial expressions and voices to determine how they feel.<sup>42</sup>**

**In 2013, automaker BMW used an AI tool called 'BMW i Genius' to answer customers' text message questions about its new electric vehicles.<sup>43</sup> It enabled the company to concurrently conduct hundreds of conversations with potential customers, as well as generate more accurate and standard answers.<sup>44</sup>**

41 Staples Easy System, via Staples Innovation website, <http://www.staplesinnovation.com/innovations/staples-easy-system>, accessed June 26, 2016.

42 Nestle press release, "Nestle to use humanoid robot to sell Nescafe in Japan," Oct. 29, 2014, <http://www.nestle.com/media/news/nestle-humanoid-robot-nescafe-japan>, accessed June 26, 2016.

43 BMW Group press release, "BMW i Genius launched," Aug. 23, 2013, [https://www.press.bmwgroup.com/united-kingdom/article/detail/T0145091EN\\_GB/bmw-i-genius-launched?language=en\\_GB](https://www.press.bmwgroup.com/united-kingdom/article/detail/T0145091EN_GB/bmw-i-genius-launched?language=en_GB), accessed Aug. 1, 2016.

44 Charlotte McEleny, "Rise of the machines: Artificial intelligence and the future of advertising," CampaignLive.com, June 29, 2015, <http://www.campaignlive.com/article/rise-machines-artificial-intelligence-future-advertising/1353696>, accessed Aug. 1, 2016.



**Finance and accounting:** Some 27% of companies use cognitive technology in the finance function, with a majority of these respondents (62%) citing use in financial trading. Another popular use: identifying customers' credit risk and potential problems (named by 53% of those using the technology in finance). Some companies also use AI for financial forecasting.

Q8 (Overall): How Companies are Using Cognitive Technology in Finance and Accounting	
Percentage Using the Technology	How these Companies Use the Technology in Finance and Accounting
27%	Doing financial trading (62%) Identifying potential customer credit problems (53%)

**Oil company Royal Dutch Shell and oil services firm Baker Hughes were testing an AI platform called Amelia in 2014, whose first application was answering accounts payable questions from vendors. Since Baker Hughes has thousands of suppliers, it was hoping that Amelia could help it reduce the thousands of hours of labor in its accounts payable department to handle inquiries about vendor payments.<sup>45</sup>**

**Microsoft uses AI to help predict software sales and licensing revenue. Joseph Sirosh, leader of Microsoft's machine learning initiatives, told a reporter that CFO Amy Hood "is a big fan of this. She can sleep nicer knowing that a machine learning model predicted her quarter."<sup>46</sup>**

**R&D:** Twenty-three percent of companies in our study use cognitive technology in R&D. A majority (56%) of companies using AI in R&D said the technology enables product monitoring and automated repairs. Half of these companies are operating products without human intervention.

Q8 (Overall): How Companies are Using Cognitive Technology in R&D	
Percentage Using the Technology	How these Companies Use the Technology in R&D
23%	Enabling products to be monitored and to fix problems (56%) Enabling products to operate without human intervention (50%) Creating a product that can answer customer questions (44%) Creating a product that gets smarter over time (41%) Creating a product that protects itself against security intrusions (19%)

**General Motors is installing driver monitoring devices in cars to detect whether drivers are distracted or tired. One system under development causes a driver's seat to vibrate when he or she stops watching the road.<sup>47</sup>**

**In 2012, pharmaceutical giant Merck conducted a contest to see who could pore through a database of more than 30,000 small molecules and see how each one would act on 15 target molecules. The winner of the contest, a University of Toronto research, used AI.<sup>48</sup>**

45 Karen Boman, "Cognitive Worker Amelia Could Transform Oil, Gas Operations," Rigzone, Aug. 7, 2015, [http://www.rigzone.com/news/oil\\_gas/a/140030/Cognitive\\_Worker\\_Amelia\\_Could\\_Transform\\_Oil\\_Gas\\_Operations](http://www.rigzone.com/news/oil_gas/a/140030/Cognitive_Worker_Amelia_Could_Transform_Oil_Gas_Operations), accessed Aug. 1, 2016.

46 Dina Bass, "Inside the New Microsoft, Where Lie Detection Is a Killer App," BloombergBusiness, Feb. 22, 2016, <http://www.bloomberg.com/news/articles/2016-02-22/inside-the-new-microsoft-where-lie-detection-is-a-killer-app>, accessed Mar. 7, 2016.

47 Elizabeth Dwoskin and Mike Ramsey, "Car Makers Test Technology to Make You Pay Attention to the Road," The Wall Street Journal, March 11, 2016, <http://www.wsj.com/articles/car-tech-that-watches-how-you-drive-1457692201>, accessed June 26, 2016.

48 Nicola Jones, "Computer science: The learning machines," Nature, <http://www.nature.com/news/computer-science-the-learning-machines-1.14481>, accessed Aug. 1, 2016.

**Manufacturing and operations:** Within the manufacturing and operations function, applications include optimizing staff scheduling (cited by 54% of firms using AI in this function), as well as improving operations.

Q8 (Overall): How Companies are Using Cognitive Technology in Manufacturing or Operations	
Percentage Using the Technology	How these Companies Use the Technology in Manufacturing or Operations
22%	Automating and adjusting staff scheduling (54%) Scheduling and load balancing manufacturing runs (46%) Automating plant management (42%) Identifying and correcting assembly line problems (42%) Automating assembly line activities (35%)

**At National Oilwell Varco, a \$14.8 billion oil field services firm, AI helps automate oil drilling for petroleum companies in the Gulf of Mexico. The company says that computers can do this work 40% faster than humans, by processing real-time data on underwater well conditions and making in-the-moment adjustments to the process.<sup>49</sup>**

**Adidas is piloting an automated 'Speedfactory' to make shoes in Germany.<sup>50</sup>**

**Netflix uses computer vision technology to determine how to capture movie images for smaller screens (mobile devices).<sup>51</sup>**

49 Christopher Helman, "The Robot Roughnecks: Out of the Oil Bust Comes a Golden Age of Drilling Technology," Forbes, September 7, 2015, <http://www.forbes.com/sites/christopherhelman/2015/08/19/the-robot-roughnecks-out-of-the-oil-bust-comes-a-golden-age-of-drilling-technology>, accessed June 26, 2016.

50 David Meyer, "Why Adidas is Turning to Robots in German and the U.S.," Fortune, May 25, 2016, <http://fortune.com/2016/05/25/adidas-robot-speedfactories>, accessed July 26, 2016.

51 Michael Russell, "Announcing Electric Eye," The Netflix Tech Blog, Sept. 22, 2015, <http://techblog.netflix.com/2015/09/announcing-electric-eye.html>, accessed August 2015; "Extracting image metadata at scale," The Netflix Tech Blog, March 21, 2015, <http://techblog.netflix.com/2016/03/extracting-image-metadata-at-scale.html>, accessed August 5, 2016.

**Corporate level:** AI has also reached the corporate level to provide decision support in the C-suite, say 19% of these managers. Most of these firms use the technology to analyze customers – for example, examining customer sentiment (cited by 63% of companies using AI at the corporate level), anticipating and analyzing problems with payments (cited by 61%), and examining why their customers choose them (52%).

**Q8 (Overall): How Companies are Using Cognitive Technology at the Corporate Level**

Percentage Using the Technology	How these Companies Use the Technology in the Corporate Level
19%	<p>Gauging customer sentiment (63%)</p> <p>Identifying and advising on problems with customer payments, invoices, and so on (61%)</p> <p>Determining why customers buy from us (52%)</p> <p>Optimizing budget allocations (45%)</p> <p>Determining broad economic trends (44%)</p> <p>Gauging investor sentiment (42%)</p>

**Goldman Sachs is working to apply artificial intelligence to economic analysis—and investing accordingly.<sup>52</sup> The Wall Street bank is reported to be the largest investor in Kensho, a machine learning startup that is automating the collection and analysis of financial data such as government economic data releases.<sup>53</sup>**

**HR:** Even though the HR function would seem to be a ripe area for cognitive technology – perhaps automating parts of the recruiting process for a large company – only 18% of respondents use cognitive technology in HR. Of these early adopters, 71% said they use AI to improve the quality of hires, while 62% said the technology helps them speed up the hiring process.

**Q8 (Overall): How Companies are Using Cognitive Technology in HR**

Percentage Using the Technology	How these Companies Use the Technology in HR
18%	<p>Hiring better employees (71%)</p> <p>Reducing hiring times (62%)</p> <p>Identifying employees who need training (57%)</p> <p>Improving knowledge sharing among employees (52%)</p> <p>Decreasing employee turnover (48%)</p> <p>Matching employees to jobs (38%)</p> <p>Identifying and addressing potential areas of legal liability (29%)</p>

**UK-based Mears Group uses a cognitive system to gain faster insights into worker safety incidents.<sup>54</sup>**

52 Nathaniel Popper, "The Robots Are Coming for Wall Street," The New York Times Magazine, Feb. 25, 2016, <http://www.nytimes.com/2016/02/28/magazine/the-robots-are-coming-for-wall-street.html>, accessed June 26, 2016.

53 Steven Bertoni, "Goldman Sachs Leads \$15 Million Investment in Tech Start Up Kensho," Forbes, November 24, 2014, <http://www.forbes.com/sites/stevenbertoni/2014/11/24/goldman-sachs-leads-15-million-investment-in-tech-start-up-kensho>, accessed June 26, 2016.

54 Margi Murphy, "10 innovative ways companies are using IBM Watson," June 24, 2016, <http://www.cio-asia.com/tech/computer-hardware/10-innovative-ways-companies-are-using-ibm-watson>, accessed August 2016.

**Distribution and logistics:** Sixteen percent of respondents use artificial intelligence in their warehousing and supply chain operations. Of this group, 75% are reducing warehouse staff effort (picking and loading orders). Half use the technology to automate product distribution and half are identifying process bottlenecks.

**Q8 (Overall): How Companies are Using Cognitive Technology in Distribution and Logistics**

Percentage Using the Technology	How these Companies Use the Technology in Distribution and Logistics
16%	Reducing warehouse picking effort (75%) Automating product distribution (50%) Identifying bottlenecks (50%)

**DHL Group, the \$49 billion transportation company, conducted a successful test of robots in a German warehouse. The robotic trolleys follow pickers through the facility and carry the freight, thus relieving workers from most of the heavy lifting and carrying over long distances. DHL, owned by Deutsche Post AG, called such robotics “only one part in the automation revolution that will transform the world of logistics.”<sup>55</sup>**

**Procurement:** Procurement is still an emerging area for the respondents in our study, with 10% saying they deployed AI. Automation plays well here: 60% of companies using AI in procurement automate the request-for-quotation process, while 50% identify new suppliers and pinpoint areas of wasteful spending.

**Q8 (Overall): How Companies are Using Cognitive Technology in Procurement**

Percentage Using the Technology	How these Companies Use the Technology in Procurement
10%	Automating the request-for-quotation process (60%) Identifying new suppliers (50%) Identifying wasteful spending (50%) Predicting supply shortages (40%) Determining the best vendors to use (40%) Identifying fraud (30%) Identifying supplier quality problems (20%)

**Siemens, the \$87 billion German engineering giant, has been using sophisticated systems to predict energy supplies and procurement for years. Its neural network can forecast electricity prices for the next 20 days to identify optimal purchase times.<sup>56</sup>**

**Hitachi infused its business and IT systems with AI to improve work orders and other functions.<sup>57</sup>**

<sup>55</sup> DHL press release, “DHL employs robot as picker’s best companion,” June 6, 2016, [http://www.dpdhl.com/en/media\\_relations/press\\_releases/2016/dhl\\_employs\\_robot\\_picker\\_best\\_companion.html](http://www.dpdhl.com/en/media_relations/press_releases/2016/dhl_employs_robot_picker_best_companion.html), accessed Aug. 8, 2016.

<sup>56</sup> “Autonomous Systems: Getting Machines to Mimic Intuition,” Siemens website information, <http://www.siemens.com/innovation/en/home/pictures-of-the-future/digitalization-and-software/autonomous-systems-machine-learning.html>, accessed June 27, 2016.

<sup>57</sup> Hitachi’s press release, “Development of Artificial Intelligence issuing work orders based on understanding of on-site kaizen activity and demand fluctuation,” September 4, 2015, <http://www.hitachi.com/New/cnews/month/2015/09/150904.html>, accessed August 2016.



**Legal:** Experts in the legal field have long used electronic discovery tools to accelerate and reduce costs in the laborious task of sorting through roomfuls of documents.<sup>58</sup> Now leading practitioners are working to marry artificial intelligence with legal thinking in deeper ways. Yet only 4% of companies in our study are using such technology to highlight potential legal risks, automate reviews of legal documents, and identify legal cases that need attention.

Q8 (Overall): How Companies are Using Cognitive Technology in Legal	
Percentage Using the Technology	How these Companies Use the Technology in Legal
4%	Identifying potential legal problems (50%) Automating contract examination (or other legal documents) (50%) Identifying legal cases (50%)

**RR Donnelly, the \$11.3 billion print services firm, uses AI software from eBrevia to perform contract reviews and due diligence.<sup>59</sup>**

Viewed by region, we see similar patterns of cognitive technology usage across the world, with several exceptions. Companies in Asia-Pacific and Latin America cite more frequent use of AI in IT. North American firms are investing more in marketing applications than other regions. Enterprises in the Asia-Pacific region show more frequent usage in finance, HR, and R&D functions (see Exhibit III-2).

58 JR Jenkins, "The Rise of Analytics in E-discovery," FTI Journal, December 2015, <http://www.ftijournal.com/article/the-rise-of-analytics-in-e-discovery>, accessed June 27, 2016.

59 Julie Sobowale, "How artificial intelligence is transforming the legal profession," American Bar Association Journal, April 1, 2016, [http://www.abajournal.com/magazine/article/how\\_artificial\\_intelligence\\_is\\_transforming\\_the\\_legal\\_profession](http://www.abajournal.com/magazine/article/how_artificial_intelligence_is_transforming_the_legal_profession), accessed June 27, 2016.

Q7 (Regions): Percentage of Companies Using Cognitive Technology in Each Function

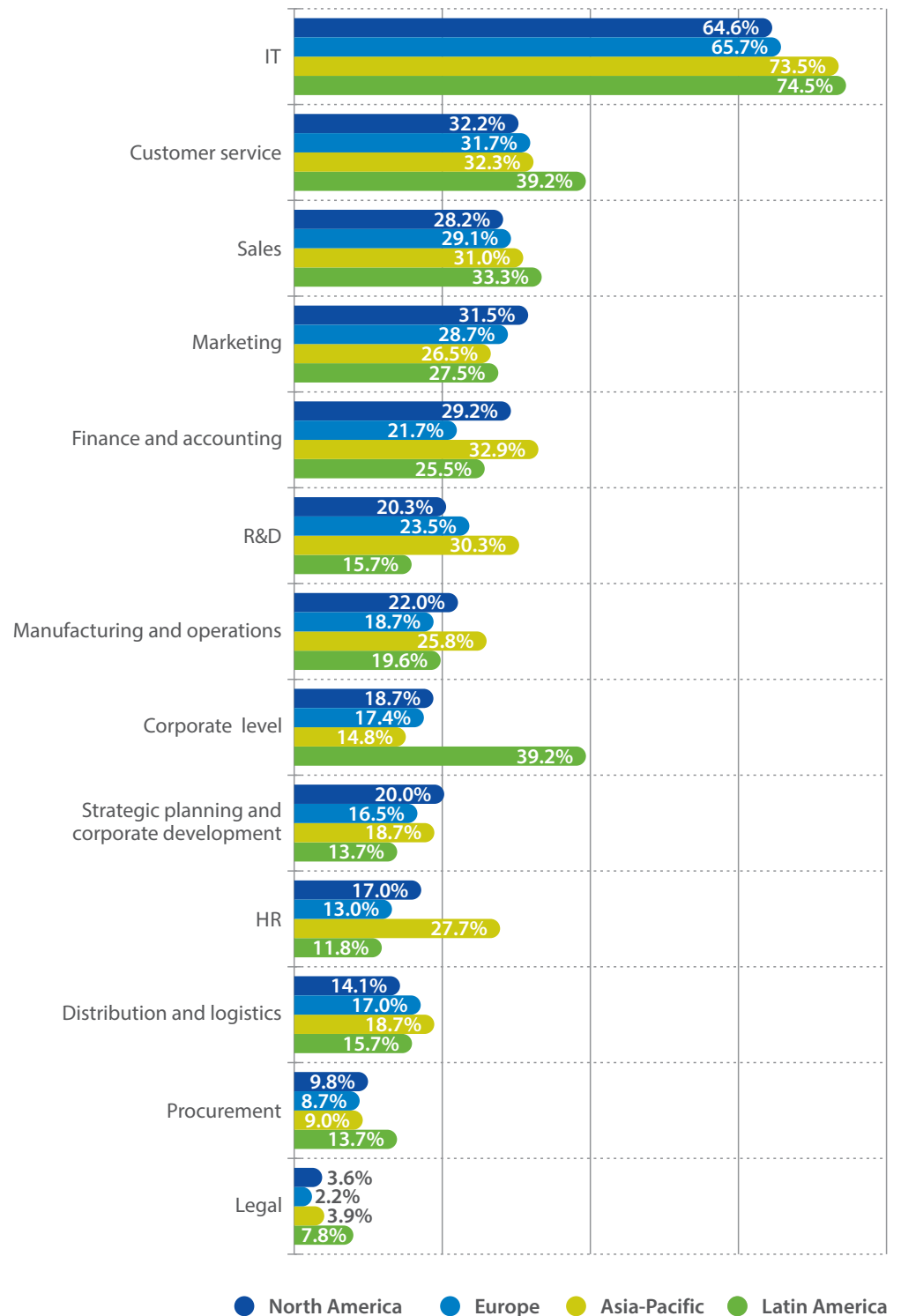
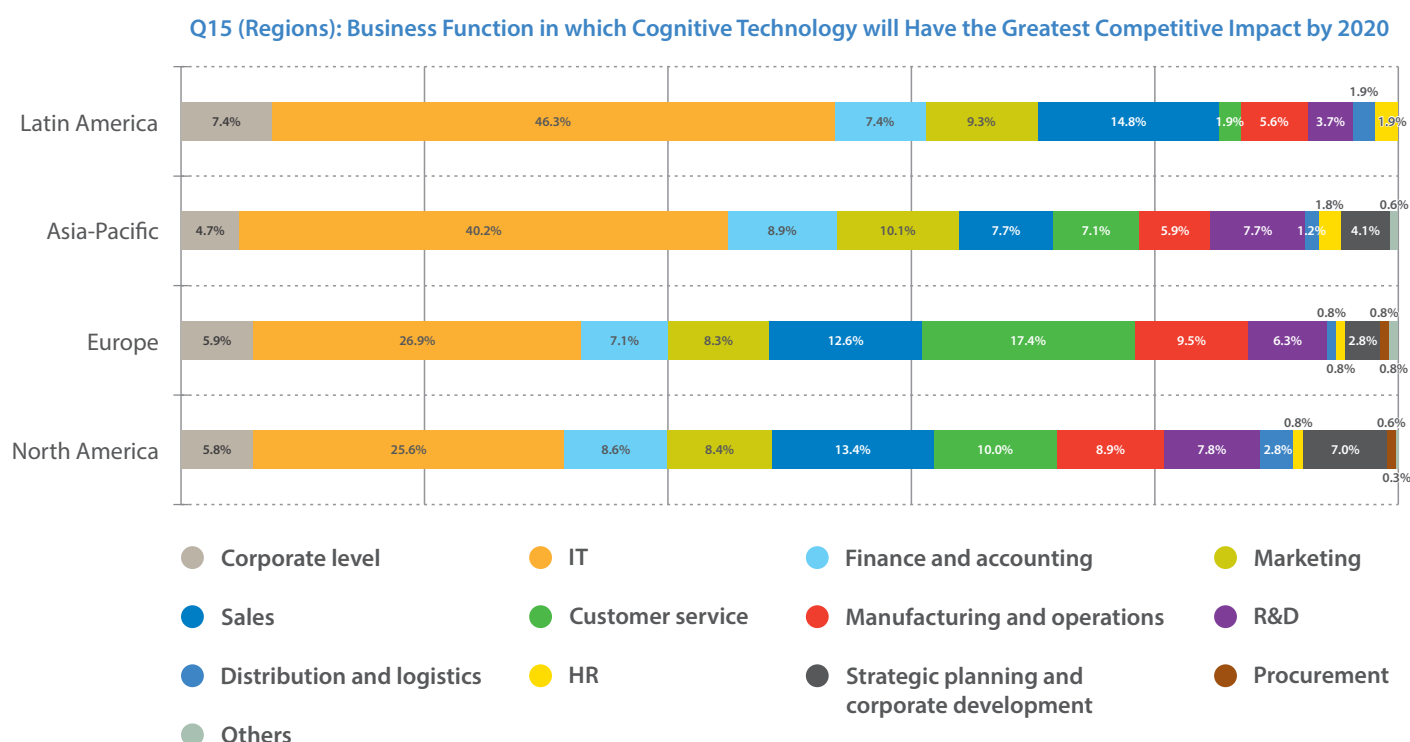


Exhibit III-2: Functional Uses of Cognitive Technology, by Region

## Looking Ahead to 2020: In Which Business Function Will Cognitive Technology Have the Greatest Beneficial Impact?

We asked managers to predict which business function will benefit the most from cognitive technology by the year 2020. No clear consensus emerged, suggesting that they lack enough experience with the technology to make precise predictions. IT was the function selected most often, but only by 30% of respondents. Other functions selected include sales (12%), customer service (11%), marketing (9%), manufacturing or operations (8%), and finance (8%).

Respondents in all regions said they expect cognitive technology to have the greatest impact in IT. The highest proportion picking IT was in Latin American firms (46%), followed by Asia-Pacific (40%), Europe (27%), and North America (26%) (see Exhibit III-3).



**Exhibit III-3: Predictions on Where the Impact Will Be Greatest by 2020**



## At Microsoft, AI is a Big, Big Deal

Making the \$93 billion in software and software-related services it sells a year continually smarter is the reason why Microsoft Corporation hired Joseph Sirosh from Amazon in 2013. His stint at Amazon had prepared him well for the task.

At the end of his nine years at the online retailer, Sirosh led the development of machine learning systems as the chief technology officer for Amazon's consumer business. To Sirosh, focusing his Amazon career on machine learning in 2013 made total sense. From the moment he joined the company in 2004, he had seen how automating the process of approving a customer or supplier transaction — through machine learning, statistics, and other techniques — could reduce fraud, bad debt, and the number of angry customers who didn't get their goods, and angry suppliers who didn't get their money. Amazon put him in charge of building and running a group to do that, starting with 35 people. By the time he left, after Amazon's revenue had grown more than 10-fold (from \$6.9 billion to \$74 billion<sup>60</sup>), his group had more than 1,000 scientists, engineers, and operations people.<sup>61</sup>

Over the last four years, Sirosh and others have been helping Microsoft CEO Satya Nadella broaden the company's expertise in machine learning. Sirosh is the corporate vice president of information management and machine learning.

Machine learning originated as a branch of AI at least 60 years ago, with the intent for computer algorithms to automatically improve themselves.<sup>62</sup> In machine learning, the algorithms that

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60 Annual net revenue of Amazon 2004-2015, Statista, <http://www.statista.com/statistics/266282/annual-net-revenue-of-amazon.com/>, accessed July 7, 2016

61 Joseph Sirosh, LinkedIn, <https://www.linkedin.com/in/joseph-sirosh-39803b1>, accessed August 4, 2016

62 David Auerbach, "The Programs That Become the Programmers," The Slate, September 25, 2015, [http://www.slate.com/articles/technology/bitwise/2015/09/pedro\\_domingos\\_master\\_algorithm\\_how\\_machine\\_learning\\_is\\_reshaping\\_how\\_we.html](http://www.slate.com/articles/technology/bitwise/2015/09/pedro_domingos_master_algorithm_how_machine_learning_is_reshaping_how_we.html), accessed July 7, 2016

*Microsoft's top management team believes machine learning is critical to improving every product and (increasingly) technology service that Microsoft sells.*

instruct a computer are in effect designed by the system, after analyzing the data it collects. In other words, in machine learning, algorithms continually fine-tune themselves, as University of Washington Prof. Pedro Domingos described in his 2015 book on the history of machine learning, *The Master Algorithm*.<sup>63</sup> The result of machine learning that most people are familiar with are things like the recommendation engines of Amazon and Netflix.

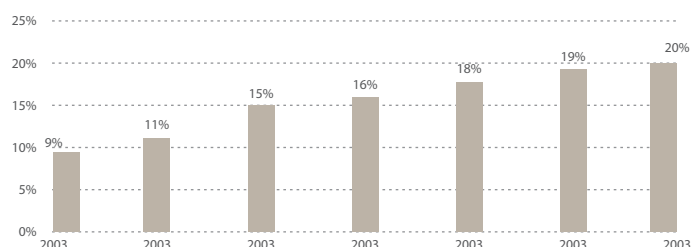
Microsoft's top management team believes machine learning is critical to improving every product and (increasingly) technology service that Microsoft sells.

Through machine learning, Microsoft has significantly improved the products for which it has become known: the Bing search engine, Skype internet phone service, MS Office software suite, and more. (Up next: LinkedIn, the online business networking and recruiting tool, which Microsoft acquired in June 2016.) Machine learning has also become important for improving Microsoft's business processes in finance (for example, customer credit checking), IT (for example, detecting computer security threats), and other areas.

Nadella has been very public about the importance of machine learning — and AI in general — to Microsoft's future. Before he became CEO, he was in charge of engineering and technology strategy for the search engine business. As a *Bloomberg Businessweek* article put it, Nadella "has been sprinkling machine learning like fairy dust on everything his company touches."<sup>64</sup>

After interviewing the CEO in 2016, a reporter for the web magazine, *The Verge*, penned an article declaring AI to be at the center of the company's strategy.<sup>65</sup> Nadella told *Bloomberg Businessweek* that one form of AI — so-called chatbots (software using AI that can understand a myriad of verbal orders and make things happen, such as order a product, book a trip, or execute a stock trade) — was the new, new thing in technology circles today. It's what comes after smartphones and smartphone apps, Nadella said.<sup>66</sup>

### Microsoft doubles search share



Source : ComScore 2009-2015 Search Report US

### How Machine Learning Has Helped Boost Bing

Microsoft's AI initiatives go back long before Nadella became the CEO in 2014, and Sirosh joined the company in 2013. In fact, Microsoft's AI initiatives stretch back almost two decades, when the company was roughly half the age it is today. (The company was founded in 1975 by Bill Gates and Paul Allen in Albuquerque, New Mexico, before moving to the Seattle area — an often overlooked fact.)

63 David Auerbach, "The Programs That Become the Programmers," *The Slate*, September 25, 2015, [http://www.slate.com/articles/technology/bitwise/2015/09/pedro\\_domingos\\_master\\_algorithm\\_how\\_machine\\_learning\\_is\\_resaping\\_how\\_we.html](http://www.slate.com/articles/technology/bitwise/2015/09/pedro_domingos_master_algorithm_how_machine_learning_is_resaping_how_we.html), accessed July 7, 2016

64 Dina Bass, "Inside Microsoft, Where Lie Detection Is a Killer App," *Bloomberg Businessweek*, February 22, 2016, <http://www.bloomberg.com/news/articles/2016-02-22/inside-the-new-microsoft-where-lie-detection-is-a-killer-app>, accessed June 24, 2016

65 Casey Newton, "Exclusive: Why Microsoft is betting its future on A.I.," *The Verge*, July 7, 2016. Accessed July 7, 2016. <http://www.theverge.com/2016/7/7/12111028/microsoft-bot-framework-artificial-intelligence-satya-nadella-interview>

66 Dina Bass, "Clippy's Back: The Future of Microsoft Is Chatbots," *Bloomberg Businessweek*, March 30, 2016, <http://www.bloomberg.com/features/2016-microsoft-future-ai-chatbots/>, accessed July 7, 2016



## Machine Learning's Big Bang at Bing

One of Microsoft's biggest AI initiatives over the last eight years has been its Bing search engine. "The quality of the ranking results that are produced by Bing depends entirely on the machine learning models behind it," explains Sirosh. These models help Bing figure out the best content to summon in online searches. "Machine learning is totally built into the fabric of the product, and is one of its biggest differentiators."

In 2008, the company brought in a data scientist, Qi Lu (now a Microsoft EVP), who told the Bing engineers they needed to develop tools for machine learning that would continually tune the search algorithms, and build a computer storage platform that could store all the data the company collects (in part, to help the machine learning models continually refine their algorithms). The Bing engineers responded quickly, with the result being a rapid improvement in the search engine — i.e., far more relevant search results for users. Ever since, machine learning has propelled Bing's fortunes. Its share of the search engine market has steadily risen, from 9% in 2009 to 20% in 2015, according to the search engine market tracker, ComScore.<sup>67</sup> Since 2015, Bing has generated more than \$1 billion in revenue every quarter. The search engine also became a profitable business for Microsoft in 2015.<sup>68</sup>

Microsoft began making major investments in machine learning in 2008 to help its search engine, Bing, gain share. Those investments have had a significant impact, helping Bing more than double its share of the search market from 2009 to 2016, to 21%, according to ComScore.<sup>69</sup> Bing's revenue has grown handsomely, to a rate of \$1 billion a quarter, and the search business in 2015 became profitable for Microsoft for the first time, according to the company.<sup>70</sup>

Bing, in a nutshell, is powerful evidence of the competitive value and profit potential of machine learning.

## How Machine Learning is Improving Other Microsoft Offerings

Sirosh explains that machine learning at Microsoft goes far beyond Bing. It extends now to the company's Hotmail email service, its MSN portal, online advertising on every Microsoft web page, the recommendation engines on MSN, the Xbox video game site, the Cortana digital personal assistant, and its fast-growing public cloud service, Azure. That business today has reached an annual run rate of \$10 billion, a number that Microsoft has projected to double by 2018.<sup>71</sup>

Bing is not the only Microsoft online service that machine learning has improved, according to Sirosh. "It is critically important for Microsoft to filter bad content on the web," he explains. "Any page that you render, whether it be an MSN page or a search results page, or even Hotmail emails with spam, must be reduced." Microsoft flags all that objectionable content — text, images, videos, and so on — through machine learning algorithms. "They make it extremely accurate and very effective, otherwise it would be very, very hard to do this at any scale," he says.

Even the ads that Microsoft displays on its various websites (for example, Bing and MSN) are now targeted based on user interests. "The machine learning algorithms behind the scenes optimize this," Sirosh says. "Irrelevant content is never shown, and it makes the customer's experience of seeing ads significantly better."

This also holds true for recommendations that Microsoft provides customers for other products that may interest them. "If you look at any of the recommendations that we make anywhere, whether it be on MSN News or Xbox, all of them are being done by machine learning," Sirosh says.

*Bing, in a nutshell, is powerful evidence of the competitive value and profit potential of machine learning.*

67 "Jason Wilcox at the Cortana Intelligence Workshop 2015: The Future of Analytics," Microsoft Cloud Platform, YouTube, September 23, 2015, <https://www.youtube.com/watch?v=At7uGZc37zs>, accessed June 25, 2016

68 Chris Matthews, "Microsoft's biggest gamble is finally making money," Fortune, October 23, 2015, <http://fortune.com/2015/10/23/microsoft-gamble-bing/>, accessed July 7, 2016

69 ComScore press release, "comScore Releases January 2016 U.S. Desktop Search Engine Rankings," February 15, 2016, <https://www.comscore.com/Insights/Rankings/comScore-Releases-January-2016-USDesktop-Search-Engine-Rankings>, accessed July 7, 2016

70 Victor Luckerson, "Microsoft's Bing Search Engine is Finally Profitable," Time, October 23, 2015, <http://time.com/4084975/microsoft-bing-search-engine-profitable/>, accessed July 9, 2016

71 Emil Protalinski, "Microsoft reports \$22.1 billion in Q3 revenue, cloud business passes \$10 billion annual run rate," VentureBeat, April 21, 2016, <http://venturebeat.com/2016/04/21/microsoft-reports-22-1-billion-in-q3-2016-revenue-cloud-business-passes-10-billion-annual-run-rate/>, accessed July 6, 2016

Microsoft is using machine learning to make Cortana, the digital personal assistant it unveiled in 2015, competitive with those of Google (Now), Amazon (Alexa), Apple (Siri), and others. The company believes that machine learning algorithms that drive Cortana — the tools meant to gauge the personal tastes of each and every user — are what will make it truly different in the marketplace of ‘digital assistants.’

## How Machine Learning is Boosting Microsoft Business Processes

Microsoft’s machine learning initiatives stretch beyond the products and services it sells to customers. The company has been putting machine learning to work in such areas as making its computer networks more secure against hacking, making sharper sales forecasts, more accurately determining how many servers it needs to acquire, and focusing salespeople’s time on certain customers, according to Sirosh.

Machine learning is even helping the company reduce credit card fraud, which is especially important for products such as the Xbox videogame system. Says Sirosh, “Every order placed on an Xbox or on any of our websites, from a Windows laptop or Microsoft store, is automatically screened by machine learning algorithms for credit card and other types of fraud that might cause us a significant loss.” Sirosh can’t reveal numbers pertaining to how much fraud Microsoft’s machine learning has nipped in the bud, other than saying that machine learning models are “keeping us safe.”

## What’s Next for Machine Learning?

Sirosh’s job today is all about helping Microsoft’s Azure cloud service grow on the back of new tools and approaches for machine learning. That is what captures his attention. One key area in Azure is determining which of the customer databases that reside now in Microsoft data centers will need to be serviced. It’s an area called predictive maintenance.

“Predictive maintenance is a very interesting area where machine learning is applied,” Sirosh explains. “If you look at all the servers, systems, and even industrial machines around us today, the way they were serviced traditionally has been very manual. Truck brakes, elevators, and construction equipment just stop working, and then they must be fixed,” he says. That is changing rapidly with the installation of wireless sensors. “Because these machines now have sensors sending data about their health, it is possible now to look at large amounts of data and predict when a machine will need to be serviced,” he says.

Sirosh and his team have applied machine learning to monitor 1.8 million customer databases on Microsoft’s cloud. “Behind the scenes, we have put machine learning based on logs and data coming out of our servers,” he says. “We know when any database is likely to go into an unhealthy state. We can automatically trigger programs that will move a database or make other moves that will improve its efficiency.”

That capability has enabled Microsoft to save untold amounts of manual effort and grow its cloud business rapidly. “Competing in the cloud world will come down to how reliable your service is for the end customers — how much they trust your service,” Sirosh notes. “We are investing a tremendous amount in that area using intelligence, machine learning, and data. Customers get the most reliable [cloud] service experience.” And Microsoft, in turn, gets high performance out of its cloud systems.

Yet Sirosh believes machine learning will soon take hold in nearly every big company that manages its business processes with large amounts of manual effort. “Everything at scale in this world will be managed by algorithms and data,” he said in a May 2016 presentation.<sup>72</sup> Manual management of business processes will become ‘antiquated’ as machine learning technologies displace them. It’s a technology future for machine learning that figures to be at hand sooner than many think, and one in which Microsoft appears to be very well-positioned to lead.



**Joseph Sirosh, Corporate Vice President of Information Management and Machine Learning, Microsoft**

*“The company has been putting machine learning to work in such areas as making its computer networks more secure against hacking, making sharper sales forecasts, more accurately determining how many servers it needs to acquire, and focusing salespeople’s time on certain customers,” says Sirosh.*

<sup>72</sup> Taylor Soper, “The future of machine learning: 5 trends to watch around algorithms, cloud, IoT, and big data,” GeekWire, May 11, 2016, <http://www.geekwire.com/2016/future-machine-learning-5-trends-watch-around-algorithms-cloud-iot-big-data/>, accessed July 5, 2016

A grid of office windows at night, showing various office scenes. The windows are arranged in a grid pattern, with some showing people working, others showing empty desks, and some showing plants. The overall tone is professional and modern.

# How Leading Companies Use AI



## Highlights

- ▮ The companies with the greatest revenue and cost improvements from AI in our sample are the 'leaders', while the 'followers' are firms with the smallest revenue and cost improvements. Leaders outspent followers by a factor of five (in terms of spending as a percent of company revenue).
- ▮ More leaders than followers see AI as crucial to their competitiveness, and are likely to use the technology at the corporate level.
- ▮ A higher proportion of leaders use AI in distribution and logistics, HR, and finance and accounting than followers do.
- ▮ Leaders are likely to believe that the IT function, more than any other function, will be the biggest beneficiary of AI by the year 2020.

From our previous sections, it's clear that some companies are much further ahead in using cognitive technologies: in getting value (as measured in revenue and cost improvements in the areas of their business that funded the initiatives), in boosting the value of a product (for example, Microsoft, and its Bing search engine), in improving the way a business process operates (for example, how Cloudera identifies customer service problems before customers do, as we explore in our case study later), and even in opening the door to new products and services (like the Associated Press' weekly NFL player performance stories).

But that doesn't explain why these companies are ahead of the pack in tapping the potential of these technologies. What have the companies that have derived the greatest value from AI done differently from the firms that gained little or no value?

To begin to answer that question, we looked at two subgroups in our online survey:

**AI leaders:** These companies (151 in all) told us they achieved greater than average cost reductions and revenue gains from their AI initiatives in 2015 vs. 2014 — that is, in the area of the business in which they had deployed the initiative (151 surveys). These companies achieved a) a 16% or more increase in revenue in the area of the initiative, and b) a 16% cost decrease or more.

**AI followers:** They had a) at most a 5% increase in revenue (and in a few cases, a revenue decline), and b) at most a 5% cost decrease and (in many cases) a cost increase. Here too there turned out to be 151 respondents.

The differences between the two survey groups couldn't be more striking. What follows are the biggest distinctions that we found, illustrated by the best practices we heard in our interviews.

### **Leaders are making far bigger AI investments because they see them as central — not tangential — to remaining competitive.**

The AI technology is not inexpensive, and neither are the very scarce professionals with the expertise to develop them. This is the reason why, on average, leaders spent nearly nine times as much as followers did in 2015 on their cognitive systems projects: \$157 million per survey respondent vs. only \$18 million for the average followers. And even though their companies were twice as big in annual revenue on average as followers (\$30 billion vs. \$15 billion), leaders still outspent them on AI initiatives as a percentage of company revenue by a ratio of five to one. AI leaders' spend in 2015 was 0.5% of revenue, compared with only 0.1% for the followers.

When asked to project their investments in cognitive initiatives in the year 2020, the AI leaders indicate they will vastly outspend the AI followers, by a factor of five (not adjusted for firm revenue). Leaders estimate they will spend an average \$195 million that year vs. only \$39 million for followers.



But why are leaders spending so much more money on AI initiatives than the followers? We found two key reasons:

- **Many more leaders than followers view the technology as crucial over the rest of the decade.** Nearly three quarters of leaders (72%) say the technology will be highly important or important to their competitiveness by the end of the decade. In contrast, less than half the followers (48%) say the same thing. In fact, 40% of followers say the technology is only moderately important, with 11% believing it's only slightly or not at all important to their competitiveness.
- **Leaders are much more likely to be using AI at the top of the company.** Even though a minority of leaders today use the technology in the corporate center, strategic planning, and finance groups, their percentages are higher than those of the followers (see Exhibit IV-1). The way we read this data is that by getting a taste of what AI can do for them in their jobs, executives at the highest level in these organizations more easily become proponents of AI.

Q7 (Leaders vs. Followers): Percentage of Survey Respondents Using Cognitive Technologies at the Top of the Company			
	Leaders	Followers	All Respondents
Corporate level	31%	12%	19%
Strategic planning and corporate development	22%	13%	18%
Finance and accounting	35%	22%	27%

### Exhibit IV-1: How AI is Used at the Top of the Company

**Leaders are using AI more broadly across their organizations, especially in areas that appear incidental to generating short-term revenue.**

AI leaders and followers alike are using the AI technology to automate the IT function. This is critical because IT costs are rising and network protection has increasingly become a battleground between machine learning and hackers (as Microsoft has found). The exact same percentage of AI leaders and followers are using AI in the IT function: 66%. Surprisingly, a higher percentage of followers were using AI in customer service: 36% vs. 32% of the leaders.

However, AI leaders were more frequently using AI in other areas than followers. The functions with the biggest differentials in usage were (see Exhibit X):

- Corporate level (31% of leaders vs. 12% of followers)
- Distribution and logistics (20% of leaders vs. only 6% of followers)
- Human resources (25% of leaders vs. 12% of followers)
- Finance and accounting (35% of leaders vs. 22% of followers)

None of those four functions touches customers every day. Yet the companies we surveyed that generated the greatest value from their AI initiatives in 2015 — our leaders — were much more likely to be using the technology in those functions (see Exhibit IV-2). AI systems used in finance can spot customers with credit problems before credit is granted. Microsoft has used machine learning to decrease credit card fraud for its consumer products like Xbox. HR departments have huge amounts of digital data today that they could use to identify unhappy, highly productive,

highly influential, and other employee types. But without AI to do the trend-spotting, companies can't easily do it manually. Most companies have learned that highly motivated employees are key to corporate productivity, and that certain employees' opinions are cherished by far many more people in an organization than others'.

<b>Q7 (Leaders vs. Followers): Where Companies are Currently Using Cognitive Technologies (in Each Function as Percentage of Total Respondents)</b>			
	<b>AI Leaders</b>	<b>AI Followers</b>	<b>All Respondents</b>
IT	66%	66%	68%
Finance and accounting	35%	22%	27%
Customer service	32%	36%	32%
Corporate level	31%	12%	19%
Marketing	31%	30%	29%
Sales	30%	23%	29%
R&D	29%	19%	23%
Human resources	25%	12%	18%
Manufacturing or operations	22%	18%	22%
Strategic planning and corporate development	22%	13%	18%
Distribution and logistics	20%	6%	16%
Procurement	13%	6%	10%
Legal	4%	1%	4%

### **Exhibit IV-2: AI Gets More Traction for Leaders in Nearly Every Function**

The differences between the way leaders and followers use AI at the top of their companies become even more distinct when you look at how they are using the technology in those functions. For example, of the leaders and followers that are using AI in finance and/or accounting, nearly twice as many leaders — 83% vs. 46% of followers — are using the technology to identify and advise on customer payment problems and other vital signs of company revenue, expenses, and profitability.

Additionally, more than four times as many leaders as followers (67% vs. 15%) that use AI in finance are using it to determine broad economic trends. Three times as many leaders (54% vs. 15%) use AI in finance to gauge investor sentiment (see Exhibit IV-3).

Q8 (Leaders vs. Followers): Key Differences in How Leaders and Followers are Using Cognitive Technologies Today (as a Percentage of Companies Using the Technology in Each Function)				
Function	Functional Application	Leaders	Followers	All Respondents
Corporate level	Identifying and advising us on problems in our financial systems (for example, customer payments, invoices, and other 'vital signs' on revenue, expenses and profitability)	83%	46%	61%
	Determining broad economic trends	67%	15%	44%
	Gauging investor sentiment	54%	15%	42%
IT	Resolving users' technology problems	71%	56%	60%
	Gauging internal compliance in using approved technology vendors	66%	50%	51%
	Detecting and deterring security intrusions	69%	65%	66%
	Doing run-book automation	33%	12%	24%
Finance	Identifying potential customer financial problems that would force us to withdraw credit	60%	21%	53%
Marketing	Improving media buying	83%	33%	56%
Sales	Shifting resources between online and offline sales initiatives	44%	25%	35%
Customer service	Identifying the training needs of contact center representatives	50%	17%	36%
Manufacturing or operations	Automating plant management	40%	0%	42%
	Automating assembly line activities	40%	0%	35%
R&D	Creating products that get smarter over time	67%	25%	41%

**Exhibit IV-3: How Leaders and Followers Differ by Specific Functional Applications**

We found other profound differences in the ways that leaders and followers plan to use AI by the end of the decade. When asked to predict the one business function that would benefit the most from AI by 2020, leaders were much more likely than followers to point to three non-customer-facing functions: IT (chosen by 40% of the leaders), the corporate center (9%), and finance and/or accounting (11%). In other words, a majority of leaders (60%) believe AI will add the greatest competitive value to their organizations in these functions by 2020. In comparison, only 37% of followers said the same (see Exhibit IV-4).

<b>Q15 (Leaders vs. Followers): Functions in which Companies Believe Cognitive Technologies will have the Greatest Competitive Impact in their Organizations by 2020</b>			
	<b>AI Leaders</b>	<b>AI Followers</b>	<b>All Respondents</b>
IT	40%	25%	30%
Finance and accounting	11%	9%	8%
Sales	10%	16%	12%
Corporate level	9%	3%	6%
Marketing	9%	13%	9%
Customer service	7%	14%	11%
Manufacturing or operations	6%	8%	8%
R&D	5%	5%	7%
Human resources	1%	1%	1%
Strategic planning and corporate development	1%	5%	5%
Distribution and logistics	1%	2%	2%
Procurement	0%	1%	1%
Legal	0%	0%	0%

#### **Exhibit IV-4: Which Function Will Gain the Most from AI by 2020**

### **Leaders focus on areas that immediately affect their ability to make — and lose — lots of money.**

From our survey data and case studies, it's clear that most companies are still quite unsure where they should be using cognitive technologies. This is the case for even the most advanced users of the technology — the leaders in our survey. Besides IT, in no other function were more than 35% of leaders using the technology today. In other words, investments appear to be highly fragmented — even in the companies that had the greatest revenue and cost improvements from the technology in 2015. Their answers to our question about the one business function that would have the greatest payback from AI by the year 2020 similarly reflected little unanimity. The IT function was chosen, but by only 40%. No other function received more than 11% of the votes.

In looking at specific functional applications of AI among leaders and followers, and from our case study interviews with companies, one thread emerges about where the focus should be: on business activities involving enormous amounts of daily digital interactions that can have an immediate impact on a company's ability to make or lose money, and which require nearly real-time responses.

What are examples of such business activities?

- **Potential customer payment problems:** We found that 83% of leaders using AI in their corporate center are using it to identify potential revenue and profitability problems from data in their financial systems. An example of such a problem might be a customer who is late in paying dozens of invoices to multiple business units of a large company. Also, 60% of leaders that use AI in finance are using the technology to identify high-risk customers. For example, Microsoft told us that machine learning has been highly effective in identifying fraudulent credit card transactions.
- **Hacking and other attacks on corporate computer networks:** Many big companies' information systems are attacked daily (according to one estimate, 317 million new pieces of computer viruses and other malicious software were introduced in 2014<sup>73</sup>). A company's ability to detect and secure its networks is increasingly vital to protecting customer records, preventing proprietary and valuable intellectual capital from leaking out, and keeping the business running. Leaders and followers alike appear highly attuned to the value of AI in protecting their information systems from external or internal attacks. Some 45% of the leaders are using AI for this purpose today (calculated by multiplying the 66% of leaders who are using AI in IT by the 69% of those using AI in IT for this purpose). Protecting the company against computer attacks is one of the most popular ways that the companies we surveyed are using AI now.
- **Crucial products and services powered by digital technologies, and whose performance for customers can never slip:** The self-driving car is a perfect example. If the goal is to reduce accidents (and for taxi companies, to minimize personnel costs), then the product must have excellent accident-avoidance performance. In their cloud businesses, the ability of Cloudera's and Microsoft's machine learning technologies to detect customers' IT maintenance needs, even before customers become aware of them, appear to be a key selling feature. Even Microsoft's use of machine learning for its Bing search engine is a great example of a product that has millions of digital interactions every day (customers' online search entries) that require better and better real-time responses (i.e., better search results). Google has embraced machine learning and is trying to implement it in all of its products. As its CEO Sundar Pichai said in 2015 to investment analysts, "Machine learning is a core, transformative way by which we're rethinking how we're doing everything ... across all our products, be it search, ads, YouTube or Play."<sup>74</sup> Added Jeff Dean, senior fellow at Google's Research Group, "Previously, we might use machine learning in a few sub-components of a system. Now, we actually use machine learning to replace entire sets of systems, rather than trying to make a better machine learning model for each of the pieces."<sup>75</sup>

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73 Virginia Harrison and Jose Pagliery, "Nearly 1 million new malware threats released every day," CNN Money, April 14, 2015, <http://money.cnn.com/2015/04/14/technology/security/cyber-attack-hacks-security/>, accessed July 8, 2016

74 Steven Levy, "How Google is Remaking Itself as a 'Machine Learning First' Company," Backchannel, June 22, 2016, <https://backchannel.com/how-google-is-remaking-itself-as-a-machine-learning-first-company-ada63defcb70#8yewwa9gs>, accessed July 8, 2016

75 Steven Levy, "How Google is Remaking Itself as a 'Machine Learning First' Company," Backchannel, June 22, 2016, <https://backchannel.com/how-google-is-remaking-itself-as-a-machine-learning-first-company-ada63defcb70#8yewwa9gs>, accessed July 8, 2016



- **Buying of online advertising:** Of the companies using AI in marketing, 83% of them said they're using it for media buying. In the online world, computer programs buy more than 50% of online display advertising, according to ClickZ. However, the firm says the purchases are vulnerable to fraud and ad blocking software. An estimated \$41 billion loss in online advertising revenue was expected in 2016 because of ad blocking technology.<sup>76</sup> This technology has taken off because the number of fraudulent, virus-based, and other problematic online ads is rising. Dealing with this problem has become a labor-intensive process that's ripe for AI. Early in 2016, Google said it had a global team of more than 1,000 people "dedicated to fighting bad ads." It also said technology and the team disabled more than 780 million online ads that violate its policies.<sup>77</sup>

These are just a few examples of business activities at large companies where big money can be made or lost depending on how well they manage huge numbers of digital interactions each day. In each case, these companies couldn't hire nearly enough people to manage these activities manually, nor (if they could) would they. This is because AI technology can continually refine and improve its performance — and become better and better at the appointed tasks — it is far better than manual methods in dealing with crucial and digitally-intensive business processes in real time.

## Leaders pay more attention to addressing fears of massive job losses.

Of the 10 challenges we asked companies to rate, addressing workers' layoff fears finished at the bottom in importance. It wasn't that it was unimportant (rated 3.58 on a 1-5 scale, with 1 the lowest and 5 the highest); still, it was rated far lower than the top two AI success factors. Each was rated at least 4.00 on our scale: making systems secure against hacking, and developing systems that continually learn on their own to make better decisions (a goal of machine learning).

In contrast, a much higher percentage of leaders (72% vs. 48% of followers) said it was important or highly important to address employees' layoff fears. In addition, nearly four out of five leaders (79%) say it's important or highly important to determine whether to use AI to replace or support people. Only half the followers said the same thing.

In its initiative to use AI to generate earnings stories, the Associated Press from the start told its business reporters that the goal was not to replace them but rather to make their life easier. No reporters have been laid off as a result. "The fact is it didn't cost us any jobs," says Lisa Gibbs, AP's business desk editor. "So whatever uneasiness there might have been has been erased."

That said, the leaders don't appear to be unafraid of making layoffs after implementing AI. In fact, by 2020, the leaders estimate a higher average percentage of potential job losses in the functions we surveyed: 29% vs. 11% for followers. At the same time, however, the leaders also predicted a higher average percentage of new functional jobs created as a result of using the technology: an average 25% increase per function vs. only 7% for followers.

## Leaders don't suffer from the 'cobbler's children' syndrome: Most use AI in the IT department.

It would be easy for companies to focus the bulk of their cognitive technology initiatives on their products and services. If the technology can provide a big competitive edge — a huge boost in performance for customers — that translates immediately to the top and bottom line. However, in deploying AI, the best companies at using the technology in our survey don't overlook using it in their IT function.

<sup>76</sup> "A Marketer's Guide to Artificial Intelligence," ClickZ Intelligence, <https://www.clickz.com/wp-content/uploads/sites/2/2016/03/ClickZ-Artificial-Intelligence-Report-UK-1.pdf>, accessed July 11, 2016

<sup>77</sup> "How we fought bad ads in 2015," Google Blog, January 21, 2016, <https://googleblog.blogspot.com/2016/01/better-ads-report.html>, accessed July 11, 2016

In fact, the greatest percentage of leaders (40%) believe the IT function will be the site of AI's greatest beneficial impact to the organization by 2020. Only a quarter of the followers believed the same. Among the leaders, the very department that's developing AI systems to improve another part of the business (products; functions such as marketing, sales, service, and finance; and so on) is also typically using the same technology to improve itself. The cobbler's children syndrome (the shoemaker whose children go shoeless) isn't happening in two-thirds of the leading companies that we surveyed. (To be sure, the same percentage of followers are using AI in the IT function as well: 66%.)

If your firm is slowly or quickly becoming a 'digital business' — a company whose products or services are increasingly offered online — then your digital infrastructure that supports that business must be in order. To IT managers, this means ensuring security against attackers and keeping other technology problems at bay.

Why is AI so important to the IT department? One reason is that IT operations, to a large degree, is still manual work that depends on tacit knowledge, experience, and intuition. IT people gain that expertise after years of running systems. With new systems and applications being introduced at a high rate, and with soaring volumes of digital data, it's gotten much harder for IT professionals to make and implement IT operational decisions quickly.

Even run-book automation (where companies introduce a standard operating procedure for a manual IT process and convert it into software that monitors systems and network workflows) increasingly needs systems based on machine learning technologies. The run-book automation model is rooted in manufacturing processes, where the environment changes infrequently. However, in big IT departments, change is far more frequent: in workloads, underlying technologies, applications and application functionality, and attacks on systems. The higher up the tech stack — meaning, the more that a piece of technology touches the customer — the greater the rate of change. In turn, that means run-book automation that doesn't use AI is likely to become obsolete faster.





# Case Study

## Cloudera's Formula: Big Data + Machine Learning = Business Transformation

Founded in 2008 by an all-star roster of talent coming from tech giants such as Google, Yahoo, Facebook, and Oracle, California-based Cloudera is the first provider and supporter of Apache Hadoop for enterprises. What this means is that Cloudera sells a software system that has become highly popular at big companies for collecting and crunching Big Data.

Cloudera has been leading the transformation of analytics and Big Data for enterprises. With funding of \$670 million to date, and 1,200 employees worldwide, Cloudera collaborates with the global open source community to build the next-generation platform for the world's biggest Big-Data challenges, including storage, access, management, analysis, and security.

Before Hadoop, there really wasn't an inexpensive way to think about handling a petabyte of data. The accepted wisdom was that a company could keep perhaps a quarter's worth of financial transactions in a point-of-sale system data warehouse. With Hadoop, retailers can now store a decade's worth. That's exponential growth that translates into a host of new opportunities for data-driven improvements.

"These days we've got many customers that are [storing] more than a petabyte," says Mike Olson, Cloudera co-founder and chief strategy officer. Organizations like banks, hospitals, and government agencies can now ingest and store huge amounts of information affordably. "We used to throw data away because it was too expensive to keep," says Olson. "Now we can keep data just because it 'might' be interesting or useful later on. All of a sudden, retailers are able to ask what happened the last time there was a category five hurricane in Florida because they still have the data. So just storing the data at scale allows us to do new things."

And when one adds machine learning to Big Data, organizations can supercharge the uses to which they can put all that data. For example, banks and credit card companies have been leveraging data

for years to fight fraud. In the past, those fraud prevention systems were powered by what now seems to be relatively little data. "Their algorithms were often hand-coded; there were a bunch of rules that some smart people thought up," Olson explains. "But nowadays we can input 10 years' worth of transactions. Machine algorithms can ingest all that data and look for patterns across all of them. If you can keep enough data to spot those trends over time, you can build a more accurate fraud model." And as computer scientists build more effective machine learning approaches, accuracy improves accordingly.

Just as machine learning is becoming an increasingly important element in customers' Big Data strategies, it's also an ever more critical component of Cloudera's operations. Both its internal and its customer applications continue to feed Cloudera's understanding of the power and limits of machine learning in using Big Data to improve its own business.

## Addressing Customer Complaints Before They Happen

Cloudera uses machine learning in conjunction with its own enterprise data hub in a number of ways: to model the market in which it operates, to assess individual customer value over time, and more.

One of the most advanced uses of machine learning, however, is to improve performance and the customer experience for its growing base of large enterprise customers. These companies are running multiple installations of Cloudera software. Each Hadoop cluster typically comprises hundreds or thousands of computers working together. "If you're a systems guy, [you'd think], 'Well, that's complicated. You've got all that hardware and all that software running in that distributed way. I'll bet you that when it fails, it fails spectacularly in ways that are difficult to diagnose.' And that systems guy would be exactly right," says Olson.

Enter the learning machines. Cloudera is able to absorb the details from customer cases, the log data, as it arrives. (Customers must opt-in to this data-sharing program, dubbed 'phone home.') As the data pours in, those computer clusters are continually sharing key data about themselves: loads, the numbers of users, the mix of processes, and so on. So when a customer calls with a problem, Cloudera adds that to the description of the issue within the system, along with every article ever written about Hadoop.

"The result is we've got this very powerful Big Data platform that can reason about software," says Olson. In fact, the platform has become so smart that Cloudera now opens 15% of its support cases for customers 'before they even call'. Using machine learning and advanced analytics, Cloudera can identify customer clusters that are likely to have a problem before the client knows it has an issue.

"We proactively open a case. The system [attaches] a recommended fix because it sees what we've done in other similar situations, and we contact the customer and let him know this is an issue, and he might want to apply this fix," Olson says.

The machine-learning solution has been a customer pleaser. Most customers aren't in a good mood when they have to call their technology vendor for support. Their system is down; they're frustrated; they're upset. The interaction takes on an entirely different character when Cloudera calls first. As Olson says, "You wouldn't believe the difference when we call to tell them that they might have a problem later on, and suggest a fix that will keep them up and running. It's all built on machine learning, and a very complex data set: system logs, chats with customer support agents, and documents describing system architecture."

Cloudera aims to increase their number of proactively opened and solved cases to 25% or higher. So far, this approach has already reduced error and escalation rates, as well as support costs.

"If I call you before the problem breaks out and we fix it, that's a much less expensive interaction for me than if you call me and send me some logs. In that case, I have to dedicate an engineer to look into your issue," says Olson. "You and I both save money if we can be proactive. We're driving support costs down, and improving our operating margins with Big Data."

## Tackling Big Problems with Bigger Data

Cloudera is also helping its customers solve a wide range of issues by incorporating machine learning into their Big Data platforms. One major US financial regulatory authority uses Cloudera to gather and store daily trade data from every bank in the country — 30 billion market events per day on



**Mike Olson, Co-founder and Chief Strategy Officer, Cloudera**

*"We're driving support costs down, and improving our operating margins with Big Data," says Olson.*



*"The result is we've got this very powerful Big Data platform that can reason about software," says Olson. In fact, the platform has become so smart that Cloudera now opens 15% of its support cases for customers 'before they even call'. Using machine learning and advanced analytics, Cloudera can identify customer clusters that are likely to have a problem before the client knows it has an issue.*

average, with spikes as high as 75 billion market events on busy trading days. The regulator uses the inputs to build a comprehensive graph of interactions among traders at different firms, and then uses machine learning to look at complex patterns over time to spot collusion in the markets or other proscribed activities, and thereby make the US financial markets more secure.

Cloudera in 2016 announced its involvement in President Obama's Precision Medicine Initiative, committing to training 1,000 precision medicine researchers over the next three years in the latest Big Data technologies and data science techniques.

"The idea is to use technology and Big Data to better understand the onset progress of disease in individuals," Olson says. "We used to design drugs for the average patient and test it across 10,000 people. If it was good for the majority, then everybody that got that disease would get that drug."

However, as science is making increasingly evident, not everyone responds to, or benefits from medicine in the same way. Diseases express themselves differently in different individuals, depending on their genetic markers. This is the foundational understanding behind precision, or personalized medicine. By using analytic techniques on a large scale, machines can analyze an individual's genetic data to design more effective, beneficial, and less-costly custom treatments. Cloudera has also partnered with a genomic research center, the Broad Institute, to develop its next-generation Genome Analysis Toolkit. The goal is to put real-time genetic data into the hands of clinicians, researchers, and providers, more cost effectively.

Cerner Corporation, a medical records and payments company, is expanding its focus on electronic medical records to use the data they collect to improve health and care across the board. The company uses Cloudera to assimilate and normalize two petabytes (and counting) of healthcare data to reduce costs, increase efficiency, and improve outcomes. Cerner's systems are currently used in over 14,000 medical facilities around the world. The company also has a number of unique projects running on its enterprise data hub. One gives hospitals the ability to predict the probability that a discharged patient will be readmitted for the same or a similar condition. Using a similar method, the system can accurately determine the probability that a person has a bloodstream infection in order to treat the potentially deadly sepsis more quickly, which Cerner's healthcare customers say already has saved hundreds of lives.

### **Shrink-Wrapping Genius**

Machine learning today is still very dependent on human intelligence, says Olson. "You've got to pick the right algorithms, and understand the data sets, and what variables may or may not be independent of one another. In practice, what that means is that fewer applications can be created because you need geniuses to create each one. If every single customer of ours has to custom build their own applications, we will have a critical genius shortage."

This is hardly surprising. Skills shortages and new technology go hand in hand. "We just need the population of developers to get smarter about this new technology," Olson says. "We're at best 10 years into deploying this stuff commercially."

The tech industry faced a similar issue with relational databases 25 years ago. "There were no shrink-wrapped applications that ran on those systems," recalls Olson. "Every bank and every hospital that brought them in had to build their own. Over time, vendors emerged that built banking applications and patient management applications." That meant customers didn't need to hire their own geniuses anymore.

"We are starting to see that happen," says Olson, noting that Cloudera works with such companies as Amdocs and BAE Systems, who are developing mobile data management applications using advanced analytics and machine learning techniques for commercial use.

Those ready-made applications will hit the market, says Olson, but they will still require a great deal of human input. "It would be nice if you didn't need to be a genuine data scientist in order to pick the right algorithm," Olson says. "I would like to see advances that reduce the expertise required for the sensible use of these things: better programming tools, and advisory systems that could examine data sets and recommend engines." Olson envisions a kind of meta-machine-learning tool to help organizations deal with the complexities of machine learning. "If somebody could figure that out, it would be a huge service to the industry and humanity. And, by the way, if you were the guy who did it, you'd probably make a few bucks."

"It's not that we're starving," Olson concludes. "But we are slowed in our adoption of this technology because of those technical challenges."



A woman with short blonde hair is smiling while talking on a black corded telephone. She is in a data center or office environment, with computer monitors displaying data in the background. A semi-transparent bar chart is overlaid on the image. The chart has seven bars of varying heights. Two callout boxes are present: one pointing to the third bar from the left containing the text '65 %', and another pointing to the sixth bar from the left containing the text '35 %'.

65 %

35 %

# Research Approach and Demographics

03/07

02/07

This research report was based on a survey that TCS conducted from February through June 2016, case study interviews, and extensive secondary research over the first seven months of 2016.

To ensure that our research participants were working with a common definition of the three main terms that we use in the report – ‘cognitive technologies and/or systems’, ‘artificial intelligence’, and ‘machine learning’ – we defined our terminology this way:

AI or cognitive systems are technologies that can ...

- **Sense:** Collect data through a range of technologies that pore over text, images, video, numerical transactions, and so on
- **Think:** Make decisions based on digital data collected, based on the system’s rules and algorithms
- **Act:** Use technology to execute a formerly manual process (for example, using factory robots instead of workers to operate machines)
- **Learn:** Continually update the system’s sensing, thinking, and acting capabilities (through automated means and human intervention); the system keeps getting smarter and smarter

We gathered our data in three ways: an online survey of more than 800 executives in four regions of the world; three in-depth interviews with large companies; and extensive secondary research. Here’s more about each research stream.

## Online Survey

TCS designed a 20-question survey for companies in North America, Europe, Asia-Pacific, and Latin America. The questions were close-ended: multiple choice, Likert scale (five points, from 1 to 5), and others. The survey was fielded in February and March 2016 by the research panel firm, Research Now, to relevant senior executives in its panel.

More than 6,000 of these executives attempted to take the survey. The first set of surveys to be screened out (4,111 in all) were those who said they did not have moderate or extensive knowledge of their companies’ AI initiatives –that is, initiatives either in existence since 2010 or those planned over the next 10 years. Of the remaining 1,900 or so surveys, we screened out another nearly 1,000 surveys for one or more of the following reasons:

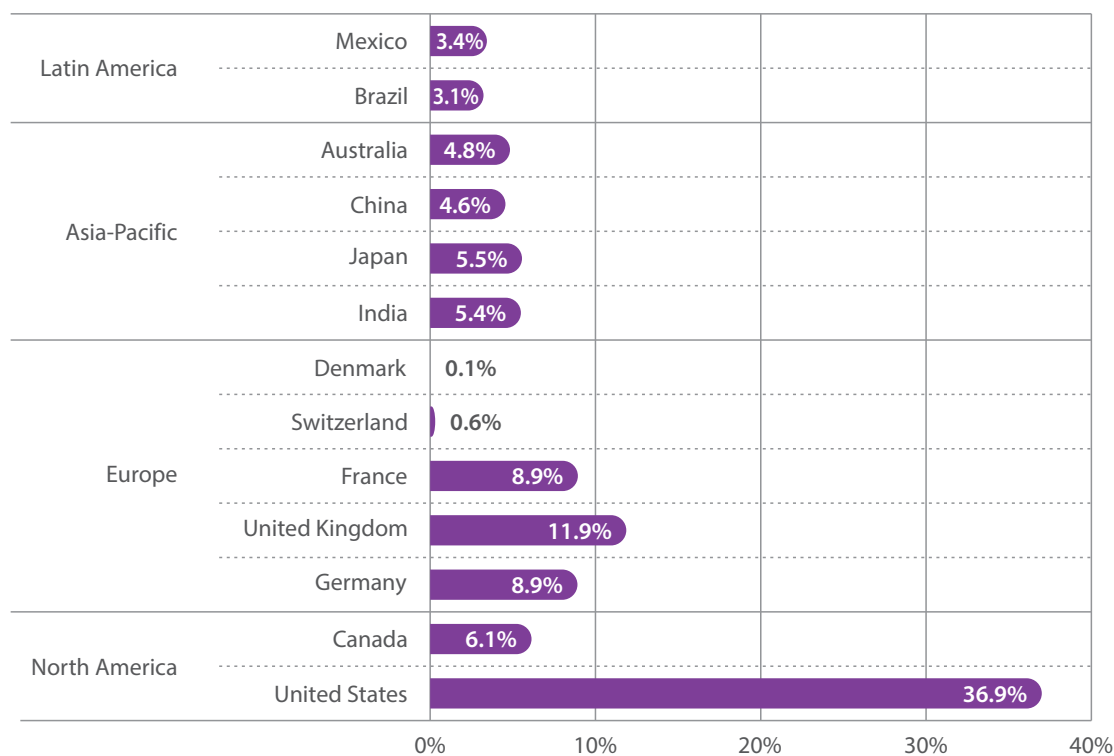
- They came from outside the countries we focused on
- They came from outside the 13 industries we focused on
- They had revenue of less than \$100 million (in North America and Europe)
- They worked in functions outside the 13 we focused on

In the management hierarchy, they were more than two levels below a functional head

That left us with 924 surveys, 84% of which said their companies were currently using cognitive technologies, and 16% of which said they were not. Of those 16%, 69% said they planned to implement the technologies by the year 2020. After factoring out incomplete or questionable surveys, we were left with 835 surveys.

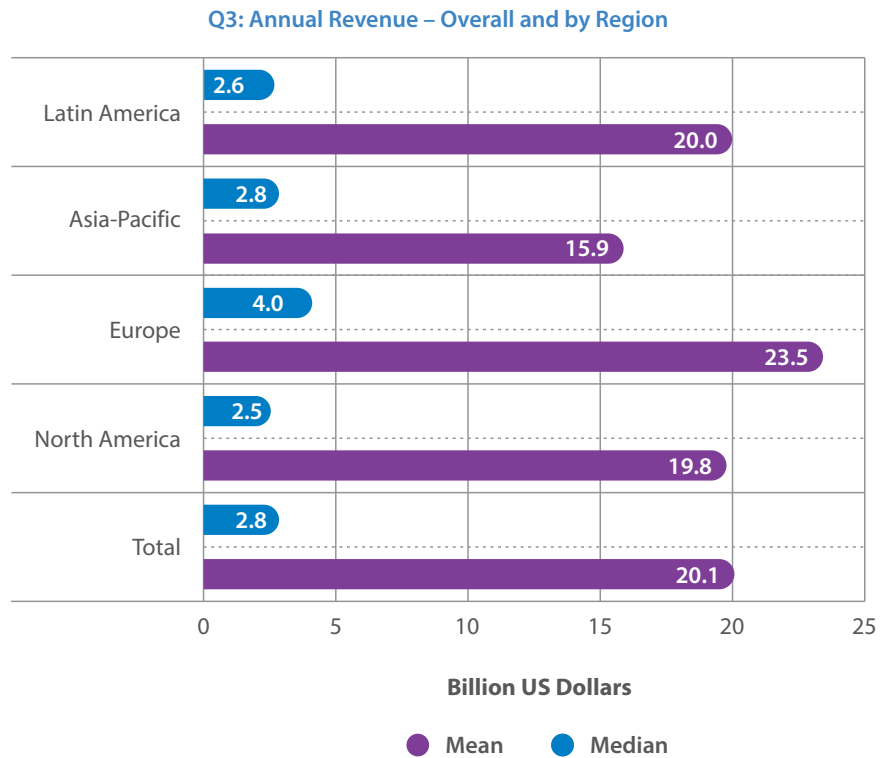
The largest group of survey participants (43%) were from North America, the second largest (30%) were from Europe. Asia-Pacific firms were 20% of the sample, and 7% were from Latin America (see Exhibit V-1).

**Q1 (Overall): Percentage of Survey Participants by Region and Country**



**Exhibit V-1: Surveys by Region and Country**

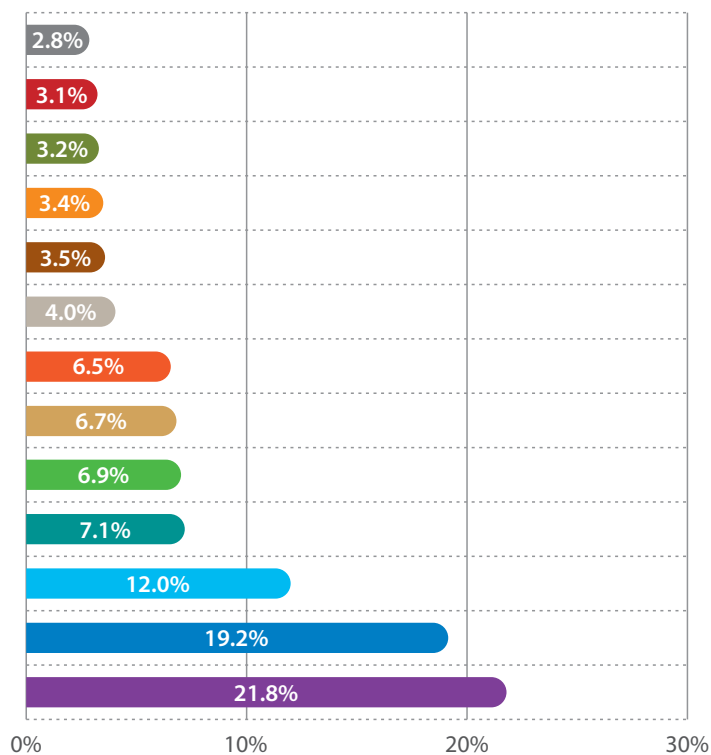
The mean revenue of the survey respondents across all four regions of the world was \$20 billion. The median revenue was much smaller: \$2.8 billion (see Exhibit V-2).



**Exhibit V-2: Mean and Median Revenue**

We surveyed executives from 13 global industries, with the largest responses coming from banking and financial services (22%), high tech (19%), and industrial manufacturing (12%) (see Exhibit V-3).

**Q2 (Overall): Percentage of Survey Respondents by Industry**

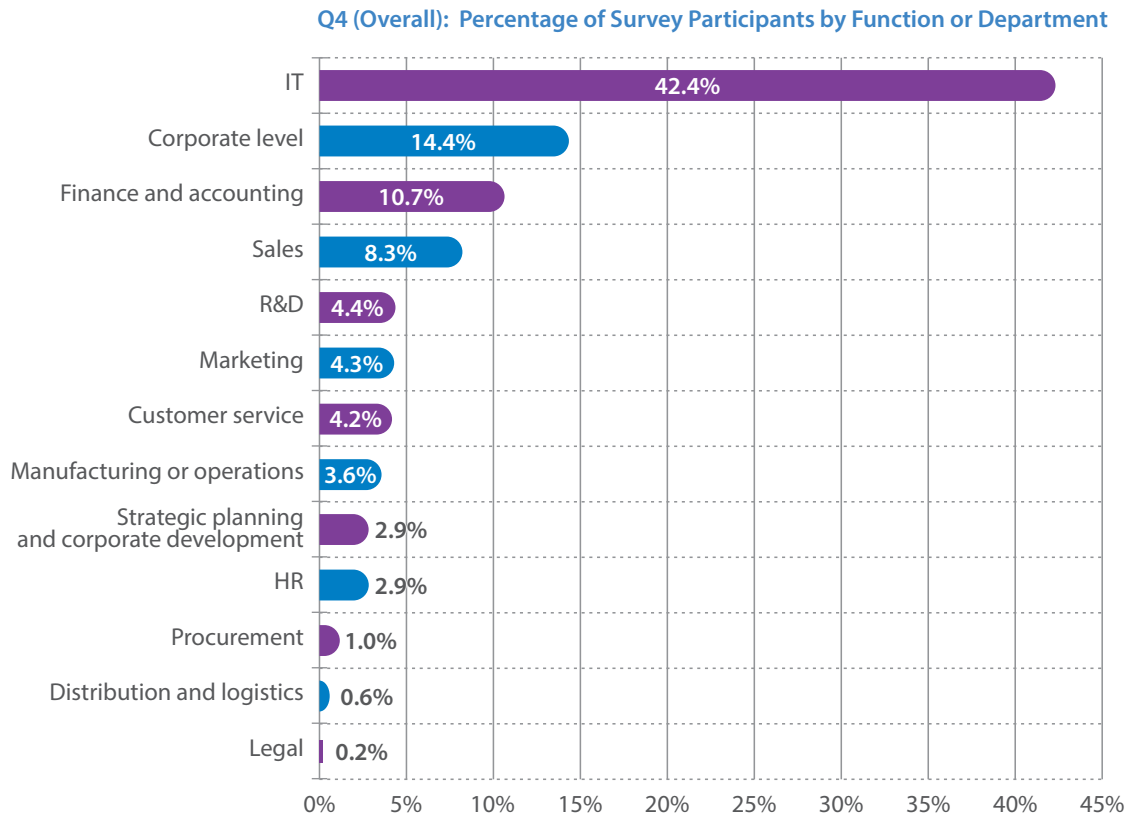


- Banking and financial services
- High-tech (hardware and software)
- Industrial manufacturing
- Telecommunications
- Retail
- Healthcare and life sciences
- Insurance
- Travel, transportation and hospitality
- Automotive
- Media, entertainment and information services
- Utilities (electric, gas, water)
- Consumer packaged goods
- Energy

### **Exhibit V-3: Surveys by Global Industries**



We wanted to get a broad range of views on cognitive technologies in these companies, but especially the views of the IT function, believing it would have the most informed view of any function on where the technology was being applied in the organization. As a result, 42% of the surveys were from the IT function. However, to understand how each business function was applying the technology, we also surveyed senior managers in those functions: corporate center, finance and accounting, sales, R&D, marketing, customer service, manufacturing (or the service industry equivalent of operations), strategic planning and/or corporate development, HR, procurement, distribution and logistics, and legal (see Exhibit V-4).



**Exhibit V-4: Surveys by Functional Role**

## Case Study Interviews

TCS, and its research partner Bloom Group, reached out to its networks of senior executives to conduct interviews on how their organizations viewed and used AI (if they did). Three companies participated in this exercise. Our researchers interviewed them for typically an hour or more by phone, probing them about:

- Why their companies had (or had not) invested in AI
- How they were using the technologies
- What business improvements they had gained to date
- The key factors in achieving those improvements

The case study interviews, which are presented in this first report on the study: Microsoft, the Associated Press and Cloudera, give us the opportunity to understand more deeply some of the key findings we had seen from the online survey.

## Secondary Research

We conducted extensive, ongoing literature searches over the first seven months of 2016 looking for articles written about, or written by, companies that were using AI. We collected articles from corporate websites, the media, conferences, publicly available analyst presentations, and other sources. The stories we found further gave us a rich set of qualitative data to round out our insights.

## About the TCS Global Trend Study Research Team

This is the seventh in a series of major global studies that TCS has conducted since 2011, exploring how large companies in 13 industries and four regions of the world (North America, Europe, Asia-Pacific, and Latin America) are capitalizing on AI. The following people played key roles in executing and publishing this study.

**Business Sponsors:** Study conceptualization, research design, trends analysis, best practice interview facilitation:

Dr Satya Ramaswamy, Vice President and Global Head, Digital Enterprise Group, Tata Consultancy Services

Dr Harrick Vin, Vice President and Global Head, Digitate, Tata Consultancy Services

**Program Manager:** Serge Perignon, Head of Marketing & Thought Leadership, Consulting, Tata Consultancy Services

### Best-Practice Interview Participants:

**The Associated Press:** Jim Kennedy, Senior Vice President of Strategy and Enterprise Development and Lisa Gibbs, Business Desk Editor

**Cloudera:** Mike Olson, Co-founder and Chief Strategy Officer

**Microsoft:** Joseph Sirosh, Corporate Vice President of Information Management and Machine Learning

### Research Design and Data Collection:

Bloom Group LLC

### Research Report Production and Publishing:

**Editing:** Jyothi Nair, Ami Malik, Sonalika Sharma, Shona Dias, Reema Pawa, Meirah Bhastekar

**Branding and Graphic Design:** Chandrahas Barde, Rahul Wakade

**Microsite:** Zubin Kutar, Akshay Mujumdar, Manish Khemani

## Previous TCS Global Trend Studies on Digital Technologies

Since 2011, TCS has been conducting in-depth primary research on how large companies around the world are using and benefiting from digital technologies such as AI, mobile devices, social media, Internet of Things, cloud computing, and Big Data and analytics.

Each of our six previous studies has an extensive microsite devoted to its findings:

[Internet of Things: The Complete Reimaginative Force \(2015\)](#)

[The Road to Reimagination: The State and High Stakes of Digital Initiatives \(2014\)](#)

[Mastering Digital Feedback: How the Best Consumer Companies Use Social Media \(2013\)](#)

[The Emerging Big Returns on Big Data \(2013\)](#)

[The New Digital Mobile Consumer: How Large Companies are Responding \(2012\)](#)

[The State of Cloud Application Adoption in Large Enterprises \(2011\)](#)

For more information about TCS' Global Trend Studies, please contact Serge Pérignon at [s.perignon@tcs.com](mailto:s.perignon@tcs.com).







## About Tata Consultancy Services Ltd. (TCS)

Tata Consultancy Services is an IT services, consulting, and business solutions organization that delivers real results to global business, ensuring a level of certainty no other firm can match. TCS offers a consulting-led, integrated portfolio of IT, BPS, infrastructure, engineering and assurance services. This is delivered through its unique Global Network Delivery Model™, recognized as the benchmark of excellence in software development. A part of the Tata group, India's largest industrial conglomerate, TCS has over 319,000 of the world's best-trained consultants in 46 countries. The company generated consolidated revenues of US \$15.5 billion for year ended March 31, 2015 and is listed on the National Stock Exchange and Bombay Stock Exchange in India.

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