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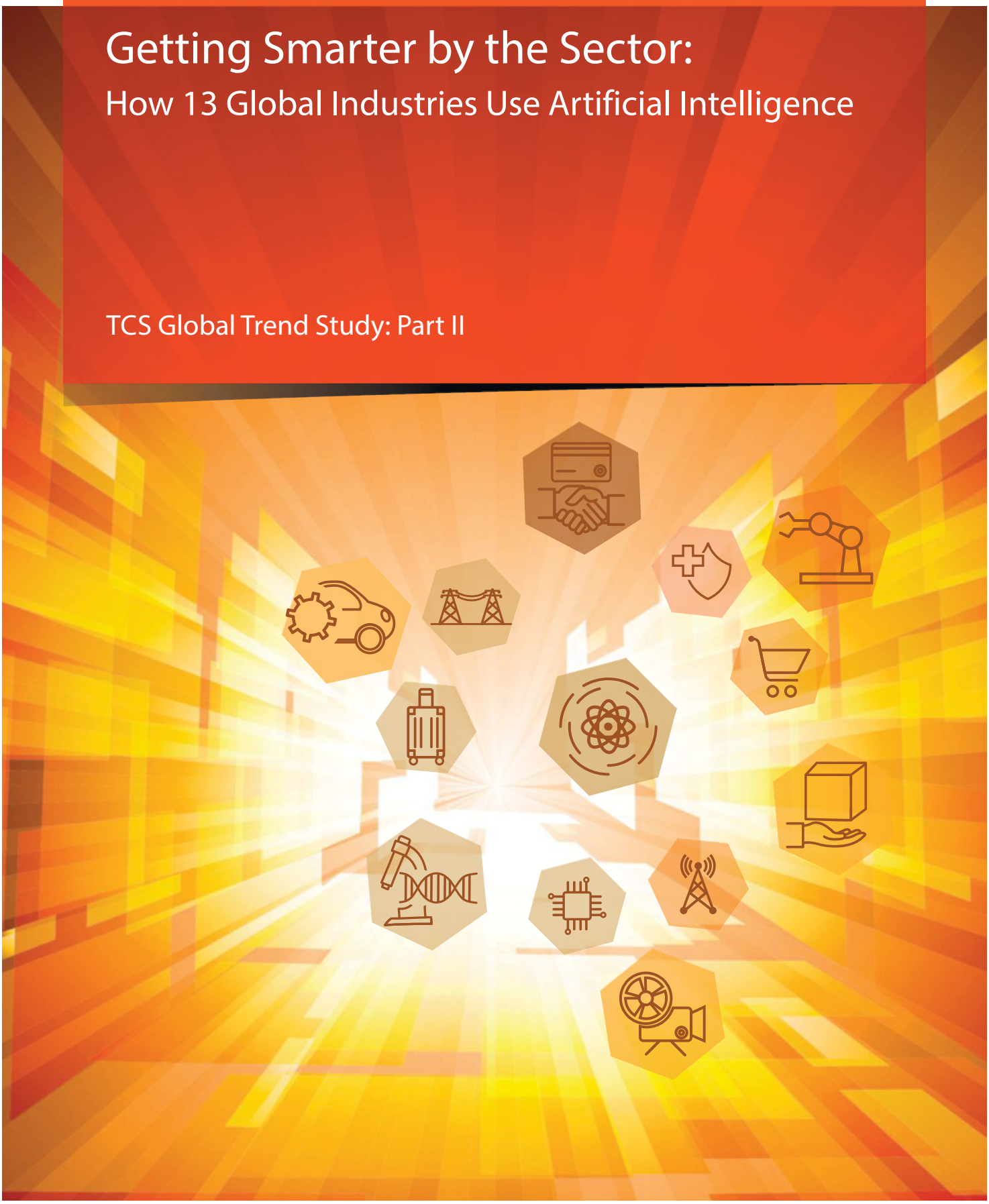
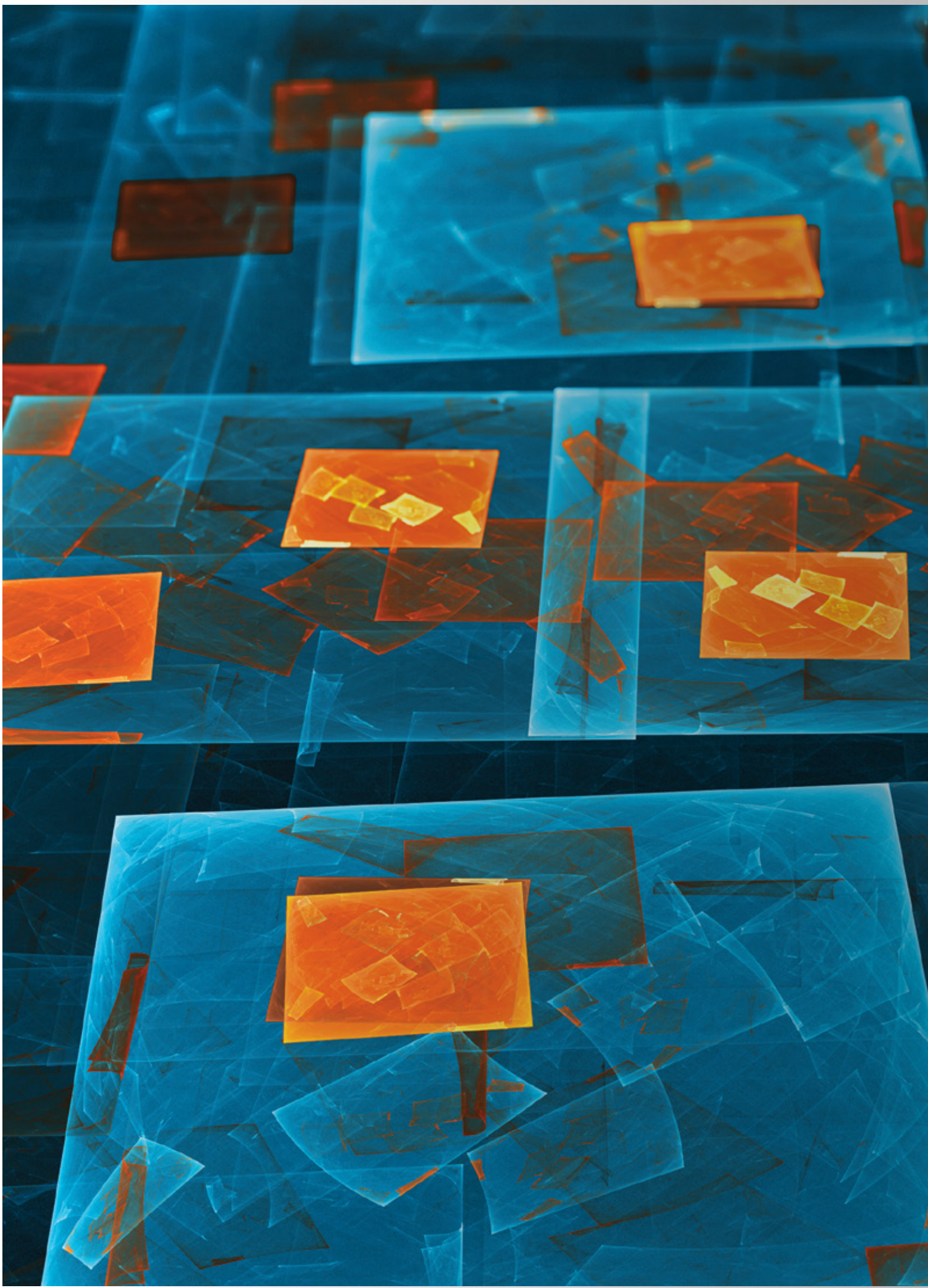
Getting Smarter by the Sector:

How 13 Global Industries Use Artificial Intelligence

TCS Global Trend Study: Part II





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Executive Summary and Key Findings

The AI Pursuits of 13 Industries

Will Artificial Intelligence (AI) help retailers improve merchandizing and inventory management? Can telecom operators use AI to offer more integrated services? How can banks use cognitive technologies to better predict and prevent fraud?

AI's footprint is rapidly expanding in industries across the world. Part II of TCS' Global Trend Study on artificial intelligence presents the results of our research in the 13 industries that we surveyed: 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. We published the first part earlier this year, and it covered the AI practices of 835 companies across and within four regions of the world: North America, Europe, Asia-Pacific, and Latin America. For more information on that study, click **here.**

For the purpose of our research, we define 'artificial intelligence' to mean technologies that can perform three core tasks:

- **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'
- **Recognize–** Being able to identify images, sound, voice, video, and other 'unstructured' data (as well as structured data that has appeared in computer databases for years) through training with a dataset.
- **Act –** Deciding what such digital data means, and determining what to do about insights after arriving at them

In both reports, we use the terms 'cognitive technologies' and 'artificial intelligence' interchangeably.

In this report, we compare and contrast AI practices – spending, usage, value, key success factors, and more – industry by industry. We also dive deeply into the results in each of the 13 sectors, presenting our views on them, starting with the key findings.

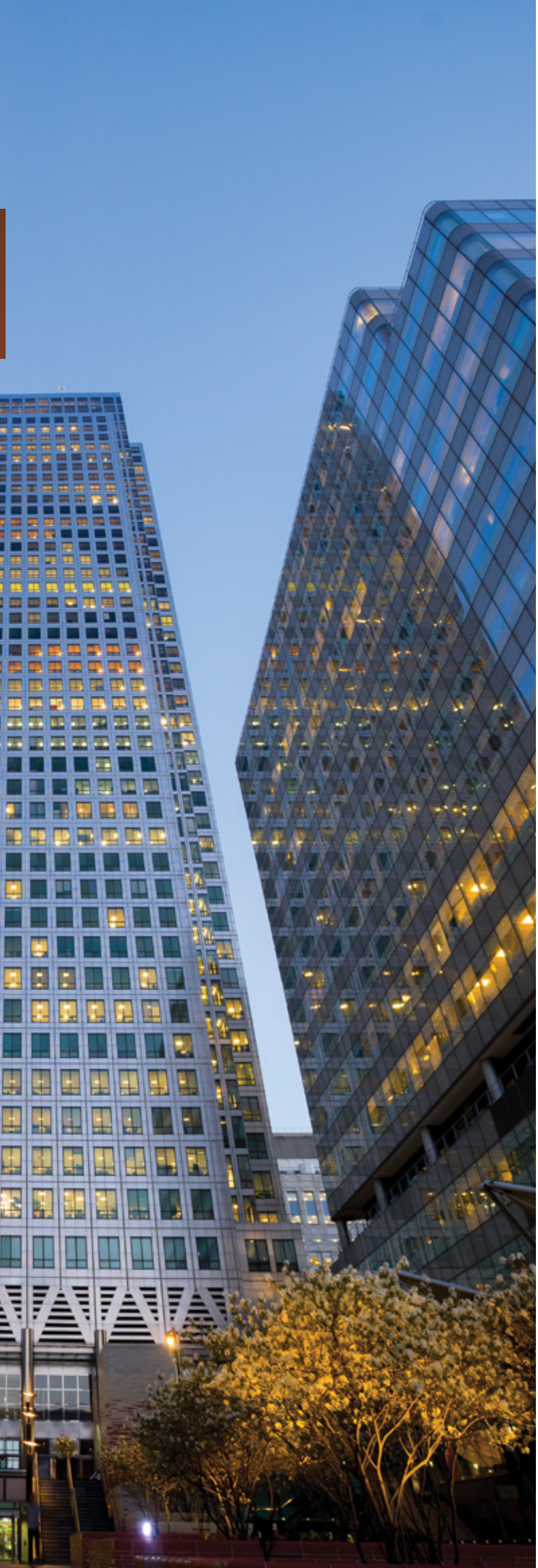
How 13 Industries are Using AI: 8 Key Industry Findings

1 **More than 90% of companies in five industries — energy, high tech, telecom, retail, and automotive — use AI today**. Across all 13 industries, more than 80% of companies use AI. 100% of energy companies use AI, the only industry in which every company is using it. Of the companies that don't use AI today, all expect to by 2020.

2 **Beyond the IT function, AI is most often used in customer service, sales, marketing, and finance**. In 12 of the 13 industries, the most frequent user of AI is the IT function (used in this department by at least 46% of companies), but in the consumer packaged goods (CPG) industry, the most common adopter is the sales function (by 52%). For customer service, CPG and insurance companies are the most frequent users, and for sales and marketing, CPG and retail companies. Banks are the most frequent users of AI in finance and accounting, and the automotive and industrial manufacturing sectors most frequently use AI for the manufacturing function.

3 **The most important goal for AI initiatives across industries is improving product and service quality, especially in the automotive and utilities industries.** Ranked second is helping customers get more value from the company's offerings (particularly in the insurance and utilities sectors). Cost reduction through automation — with a possible reduction in headcount — was the lowest-rated goal of AI initiatives in seven industries: insurance; high tech; energy; retail; CPG; industrial manufacturing; and travel, transportation, and hospitality.

4 **By 2020, business functions that will witness AI's greatest impact vary by industry, reflecting the technology's wide applicability and immense potential.** In the automotive and CPG industries, the manufacturing function will see the biggest impact, the sales function in retail and utilities, and the customer service function in insurance. In seven other industries, the IT function is seen as the greatest beneficiary of AI by 2020: banking and financial services; healthcare and life sciences; high tech; industrial manufacturing; media, entertainment, and information services; telecom; and travel, transportation, and hospitality.

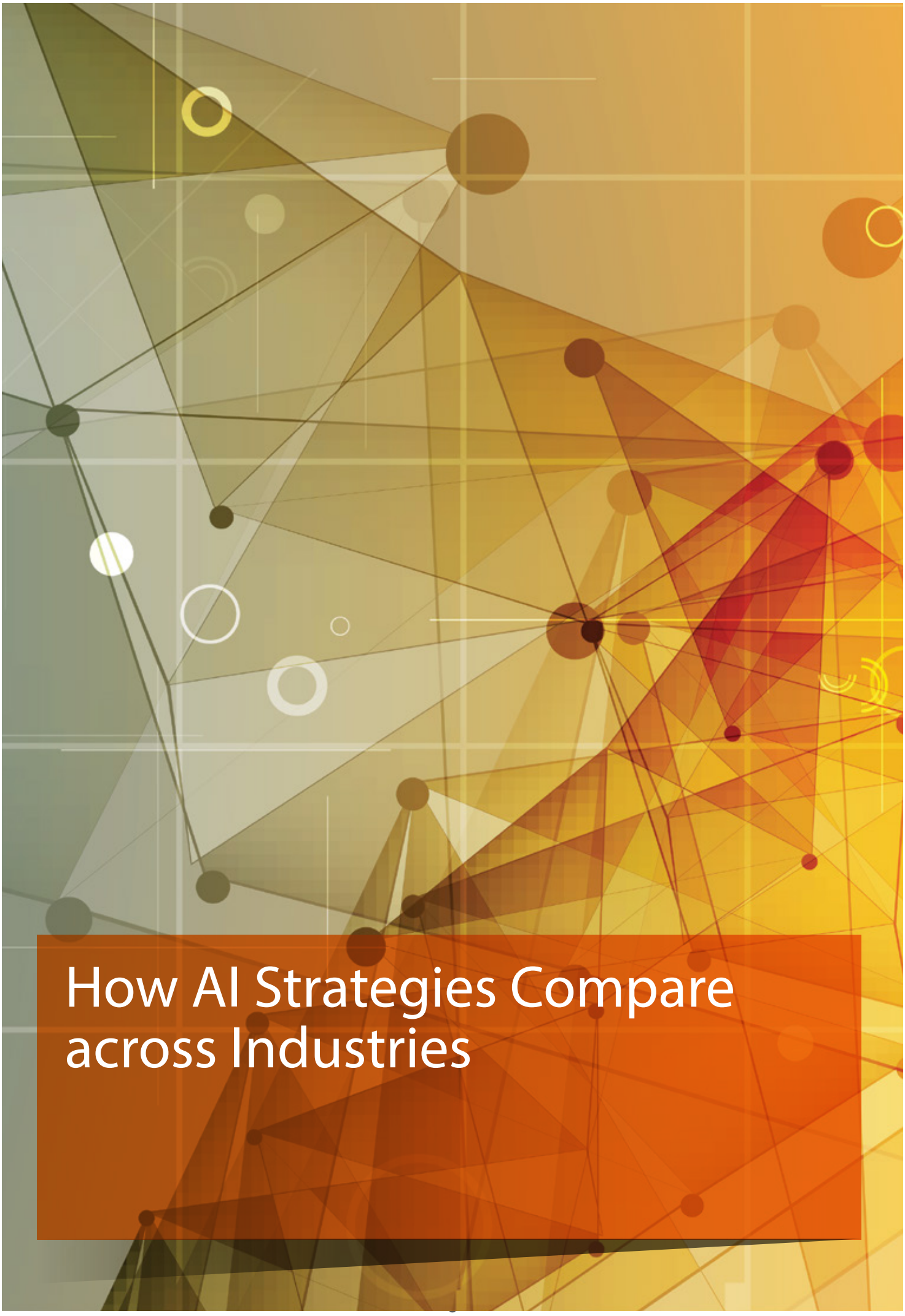


5 **Three industries outspent the others on AI in 2015: insurance, consumer packaged goods and high tech.** In 2015, the top industries by average spend per company were insurance ($124 million), consumer packaged goods ($95 million) and high tech ($95 million). But when adjusted for the size of the firms (average AI spend as a percentage of average company annual revenue in its industry), the biggest AI spenders were in consumer packaged goods (0.66% of revenue), utilities (0.53%), and insurance (0.52%).

6 **Telecom companies generated the most value from AI in 2015 in terms of cost reductions (average 20%) and revenue improvement (average 25%) in the areas of business in which they used the technology.** High tech and retail companies ranked second and third on these metrics. At the bottom of the list, utilities reported the lowest average revenue (9% revenue increase) and cost (7% cost cut) improvements.

7 **Industrial manufacturing, high tech, and travel, transportation and hospitality view AI as more important to competitiveness than the other 10.** Companies in all 13 industries view AI as more than moderately important to their competitiveness by the year 2020.

8 **To derive value from AI, the majority of industries say the No. 1 success factor is building AI systems that can't be hacked.** Companies in seven out of 13 industries rated keeping AI systems secure against hacking as the top success factor: automotive; banking and financial services; CPG; high tech; industrial manufacturing; telecommunications; and travel, transportation and hospitality.


How AI Strategies Compare
across Industries

We surveyed executives across 13 industries, from automotive to energy, in companies across North America, Europe, Asia-Pacific, and Latin America. (See Exhibit II-1.)

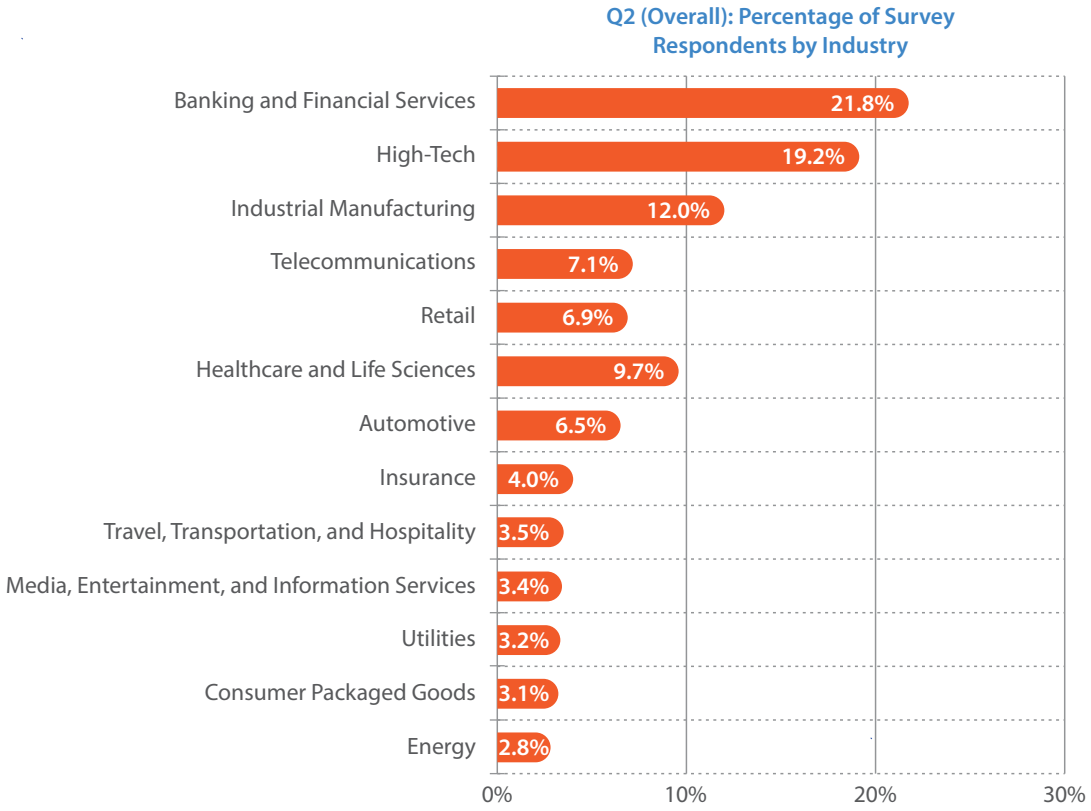


Exhibit II-1: Percentage of 835 Survey Participants by Industry

Industry by industry, we examined how many companies are using AI technologies; the areas of business where they're applying these technologies; investments in these technologies and investment plans by the year 2020; desired business benefits; and related issues.

First, let's compare how the 13 industries we surveyed are using AI today. (See Exhibit II-2.) In all these industries, at least four out of five companies were using AI. The highest percentage of companies using AI are in the energy industry, where 100% of executives surveyed say their firms use AI. In comparison, about four out of five consumer packaged goods use AI today, the lowest percentage among the industries surveyed. Across the board, among companies not using cognitive technologies today, all plan to do so by 2020.

Q6 (Industries): Percentage of Companies Using AI Today

Industry	% Using Cognitive Technologies Currently	% Not Using Cognitive Technologies But Plan to by 2020
Energy	100%	NA
High-Tech	96%	100%
Telecommunications	93%	100%
Retail	91%	100%
Automotive	90%	100%
Media, Entertainment, and Information Services	89%	100%
Banking and Financial Services	86%	100%
Healthcare and Life Sciences	86%	100%
Industrial Manufacturing	85%	100%
Insurance	85%	100%
Travel, Transportation, and Hospitality	85%	100%
Utilities	82%	100%
Consumer Packaged Goods	81%	100%

Exhibit II-2: Who's Using (and Not Using) AI?

Where Industries Are Using AI

But where exactly do companies in these industries use AI? In what parts of their business are they deploying the technology? We asked our survey participants to indicate the functions in which their company was using the technology. Here is how the industries compare.

IT: Where the Greatest Action Is Today

The most frequently mentioned function using the technology was, not surprisingly, the IT function. High tech and utilities companies are more frequently using cognitive technologies in the IT function than the 11 other industry sectors. Some 80% of high tech companies use cognitive technologies in the IT function today, as do 77% of utilities firms. (Across all industry sectors, an average 68% of companies do so.)

While companies across all industries rank security as a priority, respondents in the high tech and utilities sectors report the widest use of AI in IT. AI helps these companies detect and ward off attackers. In comparison, the industries that are least likely to be using cognitive technologies in the IT function are consumer packaged goods (43% are using AI today); travel, transportation, and hospitality (46%); and retail (55%).

Q8 (Industries): Where Companies Are Using AI

Business Function	Top Two Industries with the Highest % of Companies Using AI in This Function
IT	▪ High Tech (80%) ▪ Utilities (77%)
Customer Service	▪ Consumer Packaged Goods (48%) ▪ Insurance (46%)
Sales	▪ Consumer Packaged Goods (52%) ▪ Retail (49%)
Marketing	▪ Consumer Packaged Goods (48%) ▪ Retail (40%)
Finance and Accounting	▪ Banking & Financial Services (40%) ▪ Consumer Packaged Goods (38%)
R&D	▪ Automotive (35%) ▪ Industrial Manufacturing (34%)
Manufacturing and Production	▪ Automotive (58%) ▪ Industrial Manufacturing (51%)
Corporate Level	▪ Media, Entertainment & Information Services (28%) ▪ Industrial Manufacturing (26%)
Strategic Planning and Corporate Development	▪ Media, Entertainment & Information Services (36%) ▪ Energy (26%)
Human Resources	▪ Energy (26%) ▪ Consumer Packaged Goods (24%)
Distribution and Logistics	▪ Energy (39%) ▪ Retail (36%)
Procurement	▪ Automotive (23%) ▪ Media, Entertainment & Information Services (20%)
Legal	▪ Media, Entertainment & Information Services (16%) ▪ Healthcare & Life Sciences (8%) ▪ Retail (8%)

Exhibit II-3: Where Industries Are Applying AI

Customer Service: Popular Place for AI in CPG and Retail

A number of industries use AI in customer service as well. Nearly half (48%) the CPG and 46% of the insurance companies use AI to improve customer service (for example, in call centers).

Across all industries, an average of 32% of companies use AI in customer service. Trailing the pack, just 12% of automotive companies, 13% of energy companies, and 21% of industrial manufacturing companies do so.

Sales and Marketing: AI Used More Frequently in Some Sectors to Boost Demand

Several industries use AI in their sales function. But across the 13 industries surveyed, only 29% of companies were using AI in sales in 2016. In comparison, more than half the CPG companies (52%) and nearly half the retailers (49%) were using AI tools to improve sales. For CPG companies, cognitive technologies can help with account planning, for example, advising when, how, and who to contact in retail stores selling the companies' products.

In retail, AI is helping sales managers, salespeople, and website architects deal with millions of consumers. For example, AI can deliver product recommendations based on customer demographics, previous purchases, and interests. In fact, between 2% and 20% of revenue for an online retailer can come from AI-based product recommendations, according to Monetate.[1] In brick-and-mortar stores, robots can take up some tasks for employees. The $40-billion US-based consumer electronics retailer Best Buy Co. Inc. is testing the use of robots in New York stores to fetch products for customers, who make requests via touch screens.

Consumer packaged goods and retailers also lead the way in using AI in marketing. Some 48% of CPG and 40% of retail companies use AI in marketing, compared with only 29% of companies across all industries, according to our survey data. The CPG sector's embrace of AI is not a surprise, given the industry's huge investments in marketing. Procter & Gamble spent more than $7 billion on advertising in 2015, according to Statista.[2]

In contrast, the industries least likely to use AI in marketing are utilities (only 5% do so today) and energy (22%).

Finance and Accounting: Banks and CPG Most Often Use AI Here

AI has yet to make a big splash in the finance and accounting function, where just 27% of companies across all industry sectors use the technologies. However, two sectors stand apart here: 40% of banking and financial services and 38% of CPG companies are using AI in finance and accounting. At the other end of the spectrum, just 14% of utilities and 15% of telecommunications companies do so.

AI in R&D and the Factory: Automotive and Industrial Manufacturers Lead the Way

Within the realm of R&D, less than one quarter (23%) of companies say they're using AI technologies today in research, product design, development and engineering. The most likely industries to do so: automotive companies (35%) and industrial manufacturing (34%), both traditionally large spenders on R&D. In contrast, just 9% of telecommunications companies and 11% of travel, transportation, and hospitality companies were using AI in 2016 in R&D.

Within the manufacturing or operations function, 22% of companies across all industry sectors are using AI. Interestingly, more than twice as many automotive (58%) and industrial manufacturers (51%) are using AI in manufacturing (or its service industry equivalent of operations). Not surprisingly, only a small number of service sectors such as banking and financial services (7%), insurance (9%), and telecommunications (9%) are using AI in operations.

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1 Futurism. http://futurism.com/ibms-watson-powered-sales-associate-robots-to-be-rolled-out-into-u-s-retailers-by-june-2016/ accessed March 28, 2016

2 Statista. https://www.statista.com/statistics/262022/advertising-expenditure-of-procter-und-gamble-worldwide/ accessed Oct. 10, 2016.

AI in the C-Suite: Media and Industrial Manufacturing Companies Have Taken Notice

Are robots replacing senior managers on executive row? Not yet. Across all industries, less than one in five (19%) companies used AI in 2016 to guide executive decision-making (at the level of CEO, COO, or divisional head). The sectors most likely to use AI in this way are media, entertainment, and information services (28%) and industrial manufacturing (26%). In comparison, just 9% of utilities and 13% of energy companies do so.

Similarly, less than one in five companies surveyed (18%) use AI in strategic planning (for example, to determine new markets to enter) and corporate development (mergers and acquisitions, joint ventures, and the like). The only notable exceptions were the media, entertainment, and information services sector, where 36% of companies are using AI in strategy and corporate development, and the energy sector (26%).

Who's Using AI in HR, Distribution, and Procurement?

Across industries, less than one in five companies (18%) used AI in the human resources department in 2016. Even fewer — less than one in six (16%) — used AI in distribution and logistics. However, two industries — energy (39%) and retail (36%) — are more than twice as likely to be using AI in distribution and logistics. For retailers, this should not be surprising in the light of the complexities of bringing millions of products from warehouses to customers.

The procurement function is yet to adopt AI in a big way; only 10% of companies across industries were using it there in 2016. Two industries are notable exceptions: automotive (23% are using AI in procurement) and media, entertainment, and information services (20%).

Likewise, just 4% of companies across industries are using AI in their legal departments. However, media, entertainment, and information services companies were four times more likely than the average firm to do so (16%), followed by healthcare and life sciences, and retail (8% each).

Business Goals for Cognitive Technologies

In addition to wanting to know *where* each industry was using AI, we wanted to know *why* they were using it where they did. We asked executives to rate on a scale of 1-5 (5 being highly important) six common goals for AI initiatives:

- Improving product or service quality
- Helping customers use and get more value from their products and/or services
- Reducing key process cycle times
- Improving executive decisions
- Identifying new revenue opportunities (for example, from using AI to identify customer needs in transaction data)
- Reducing costs by automating manual work

On average, companies across all 13 industries gave each of the six goals a rating of between 3.80 and 4.03 on our scale of 1-5. Effectively, that meant they felt each goal was somewhere between "moderately important" and "important." Two goals were rated more important than the other four: improving product and or service quality, and helping customers use and get more value from them. Relatively speaking, cost reduction through automation was the lowest-rated goal. (See Exhibit II-4.)

Utilities and auto companies were ahead of the 11 other sectors in using AI to boost quality. Utilities and insurance companies placed more emphasis on using AI to help customers get more from their products and/or services.

Q9 (Overall and by Industry): How Industries Rate the Goals of Their AI Initiatives

Cross-Industry Rating of Goals	Industries Rating the Goals to be High in Importance
Improving the quality of products and/or services (4.03)	▪ Utilities (4.35) ▪ Automotive (4.16)
Helping customers use and get more value from products and/or services (4.03)	▪ Utilities (4.27) ▪ Insurance (4.20)
Reducing cycle times of key processes (3.95)	▪ Utilities (4.31) ▪ High Tech (4.02)
Improving executive decision-making (3.87)	▪ Energy (4.12) ▪ Retail and Industrial Manufacturing (tied at 3.91)
Identifying new revenue opportunities (3.84)	▪ Travel, Transportation and Hospitality (4.03) ▪ Energy and Retail (tied at 3.96)
Reducing costs by automating manual work (3.80)	▪ Utilities (4.04) ▪ High Tech (3.87)
(Scale of 1-5, 1 = not at all important, 5 = highly important)	

Exhibit II-4: What Industries Want from AI

Reducing key process cycle times ranked third among business goals, and utilities and high tech companies rated this goal highest. Rounding out the other business goals, companies ranked improving executive decision-making (3.87) and identifying new revenue opportunities (3.84) fourth and fifth. On the revenue goal, travel, transportation, and hospitality companies rated this goal highest, ahead of energy and retail companies. Notably, the goal of reducing costs by automating manual work came in last (at 3.80). Utilities and high tech companies rated it highest among the sectors.

Which Industries Are Spending the Most (and Least) on AI?

Perhaps the best measure of how important companies believe AI is to their competitiveness is what they're willing to spend on it. On that count, the data across and within industries is revealing.

Our survey examined spend plans starting with 2015 investments (Q10): Across all industries, companies reported spending an average of $70.4 million in 2015. Among the group, the highest average per-company spend on AI initiatives was from insurance ($124 million), consumer packaged goods ($95 million), high tech ($95 million), and telecom ($90 million). At the other end of the spectrum, travel, transportation, and hospitality ($4 million) and media, entertainment, and information services ($12 million) spent the least in 2015.

The spend comparisons become more interesting when AI spend is adjusted for company size (in this case, average company revenue in an industry). In terms of average AI investments as a percent of company revenue, three industries stood above the other 10: (See Exhibit II-5.)

- Consumer packaged goods: 2015 investments in AI initiatives were an average 0.66% of average company revenue in the sector
- Utilities: 0.53%
- Insurance: 0.52%

Q10 (Industries): 2015 Spending on AI Initiatives

Industry	2015 Average Per-Company AI Spend	AI Spend as a percentage of Average Company Revenue in its Industry
Consumer packaged goods	$95.1 million	0.66%
Utilities	$66.4 million	0.53%
Insurance	$124.4 million	0.52%
High tech	$94.7 million	0.46%
Telecommunications	$90.0 million	0.39%
All industries	$70.4 million	0.35%
Industrial manufacturing	$50.4 million	0.34%
Retail	$57.4 million	0.30%
Banking and financial services	$76.9 million	0.29%
Automotive	$54.9 million	0.26%
Healthcare and life sciences	$38.5 million	0.20%
Energy	$23.9 million	0.16%
Media, entertainment, and information services	$12.0 million	0.11%
Travel, transportation, and hospitality	$4.0 million	0.03%
Note: Average spend per company is based on the mean; average spend as a % of average industry revenue is also based on the mean, for spending and for company revenue		

Exhibit II-5: As a Percentage of Revenue, How Much Industries Spent on AI in 2015

The section that follows — in which we discuss each industry — will explain why these sectors are spending heavily (or not).

2016 AI Investments: Biggest Spenders are Insurance, Telecom and Banking Firms

We also surveyed companies on how much they had expected to spend on AI initiatives in 2016. The average ($67 million) was down slightly from 2015 – 4%. The biggest-spending industries on AI for 2016 (not adjusted for company size) were:

- Insurance: average $98 million per company
- Telecom: average $95 million per company
- Banking and financial services: average $85 million per company

Adjusted for company size, the top AI spenders in 2016 were CPG companies again (at 0.52% of revenue), industrial manufacturing (0.42%), insurance (0.41%), and telecom (0.41%).

We also asked our research participants to project how much their companies would spend on AI in the year 2020. The feeling was their companies would spend more on AI by then – in fact, a lot more. The average per-company spend across industries was $88 million, or 31% more than 2016's estimated spend. By 2020, the companies spending the most on AI are projected to be in these four sectors:

- Telecom ($131 million)
- High-tech ($119 million)
- Banking and financial services ($99 million)
- Insurance ($90 million)

AI Spend: To Improve or Transform the Business?

Another aspect of how big companies are using AI that we explored was whether they were using it to improve the way their businesses operated today – or to transform their business. But what exactly did we mean by 'improving' vs. 'transforming'? In our survey questionnaire, we defined:

'Improving their current business' as improving their current products and/or services and the ways in which they create demand and supply for those products and/or services.

'Transforming the business' as creating whole new products and/or services based on AI technologies, and whole new ways of creating demand and supply for both current and new products.

For example, AI systems that help bank lending officers better determine whom to lend money to are improvements to the current business. But an AI system from a bank that gave consumers on-the-spot financial advice about whether to make a certain purchase they have in mind is an example of how AI could transform a business (if that bank hadn't offered that kind of financial advice previously). That would be a whole new service, enabled by AI, for such a bank.

We asked managers to estimate what percent of their AI investments went in both areas: 'improving' vs. 'transforming', and for three different years: 2016, 2020 and 2025. So, how did companies answer the question with those definitions and time periods in mind? Which industries today are investing more of their AI spending on improving the current business vs. transforming the business (or vice versa)? And what about by 2020 and 2025? Exhibit II-6 shows the breakout successes.

The answer is that in all 13 industries, companies consider a great deal of their AI investments — more than 40% — to be of the transformational type.

Questions 11A, 11B, 11C (Industries): Percentage of AI Investments for Improving vs. Transforming the Business

Industry	2016		2020		2025	
	Improve Investments	Transform Investments	Improve Investments	Transform Investments	Improve Investments	Transform Investments
Automotive	52%	48%	51%	49%	47%	53%
Banking and financial services	54%	46%	55%	45%	54%	46%
Consumer packaged goods	53%	47%	50%	50%	49%	51%
Energy	58%	42%	55%	45%	56%	44%
Healthcare and life sciences	57%	43%	52%	48%	49%	51%
High tech	51%	49%	51%	49%	50%	50%
Industrial manufacturing	55%	45%	52%	48%	51%	49%
Insurance	57%	43%	55%	45%	57%	43%
Media, entertainment & information services	56%	44%	52%	48%	49%	51%
Retail	54%	46%	53%	47%	53%	47%
Telecommunications	52%	48%	49%	51%	53%	47%
Travel, transportation and hospitality	55%	45%	48%	52%	52%	48%
Utilities	54%	46%	51%	49%	51%	49%
All industries combined	54%	46%	52%	48%	52%	48%

Exhibit II-6: Percentage of AI Investments for 'Improvement' vs. 'Transformation'

In 2016, the industries allocating the biggest slice of the cognitive budget to transformational projects included high tech (49%), automotive (48%), and telecom (48%).

By 2020, the proportion of spending shifts by only 2%, with companies expecting to allocate 52% of cognitive spending to improve the way companies currently do business and 48% to transform the business.

By 2025, the allocation of spending stays steady across industries (52% improvement/48% transformational).

Two observations on this data:

- A high percentage of investments in AI in 2016 and through 2025 are for 'transformation' initiatives.
- While no industry is earmarked the majority of its AI investments in 2016 in transformational initiatives, four sectors (automotive; CPG; healthcare and life sciences; and media, entertainment and information services) project they will do so by the year 2025.

How Much are Industries Improving Costs and Revenue through AI?

In this report, we wanted to gain a clear understanding of whether AI was having a financial impact in the areas in which companies were using the technology. To gain clarity on that question, we asked executives whose companies had AI initiatives in place in 2015 to estimate the impacts of their investments on a) cost reduction, and b) revenue improvement over the previous year's costs and revenue. If there were no improvements in either area, they could indicate that. If, in fact, their costs *increased* and their revenue *went down* as a result of their AI initiatives, they could indicate that as well.

What we found: Companies reported that their AI initiatives had had a strong positive impact on both revenue improvement and cost reduction in the areas in which they invested. That could be a product line or a division, or a set of products, or a region of the world or country. These numbers are not reflective of company-wide revenue or cost improvements – only in the area of the business with the AI initiative.

Across all 13 industries, the average revenue increase was 17%; the average cost reduction was 12%. But that varied, often significantly, by industry. The industries reporting the largest revenue improvement in the area of their AI initiatives were telecom, high tech, retail, and banking and financial services. The lowest revenue increases – although still sizeable – were in utilities and media, entertainment, and information services. (See Exhibit II-7.)

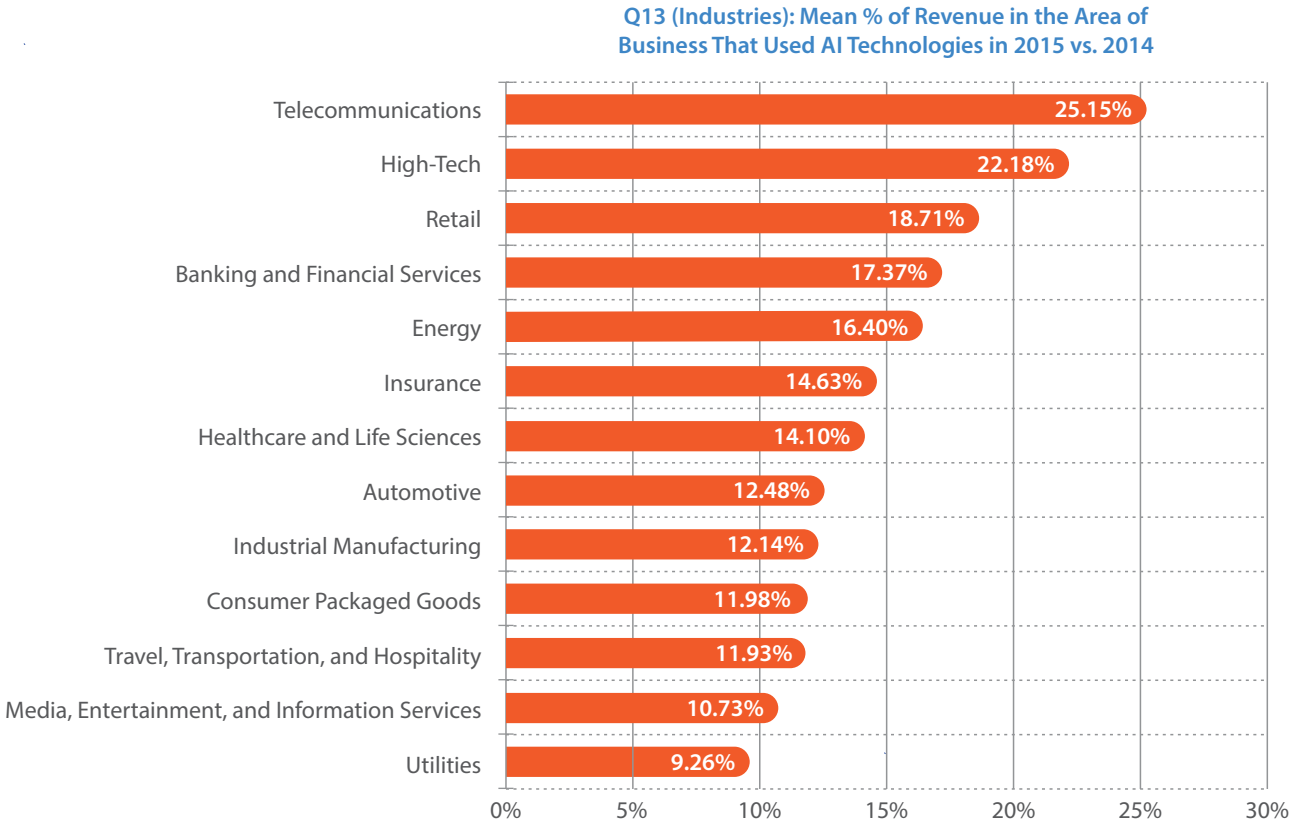

Exhibit II-7: Revenue Impact of AI Initiatives in the Business Functions That Staged Them

Industries whose companies reported the greatest cost reductions from AI in the area of the business that staged the initiative in 2015 were telecom, retail, high tech, and insurance. Each sector reported a 14% or greater average cost reduction in the area of the initiative. (See Exhibit II-8.)

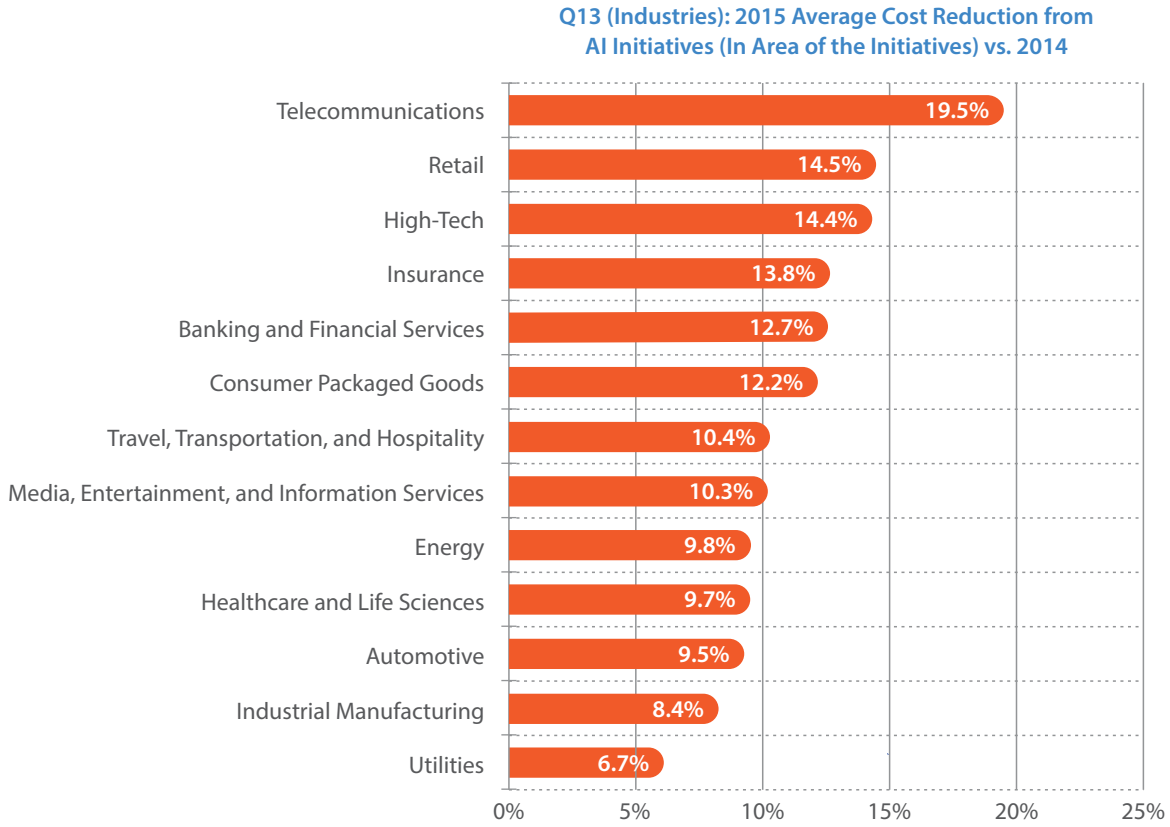

Exhibit II-8: Cost Impact of AI Initiatives in the Business Functions That Staged Them

Which Industries Lead the Pack in Deriving Value from AI?

Given that AI's adoption by big corporations is still in its relative infancy, companies should not be looking only at how their competitors are using AI; they should be examining the AI practices of leading companies in other industries as well.

But that raises a question: Which industries are ahead and behind in AI? It's a simple question without a simple answer. Merely investing more than other industries in AI doesn't make one sector a leader in getting business value from the technology. Neither does placing greater importance on AI as a competitive factor.

However, the data that we mentioned in the previous section on the cost and revenue improvements that companies generated from their AI initiatives in 2015 provides an indication of how these 13 sectors are faring in AI. We used that data in our first report to identify AI 'leaders' and 'followers':

Leaders were companies that reported a 16% or more increase in revenue in the area of their AI initiative, and reported a 16% or more cost decrease.

Followers were those that had no more than a 5% revenue increase and, at most, a 5% cost decrease. In some cases, these followers had a revenue decline or a cost increase, or both.

One way of assessing how industries compare in getting value from AI is to see how many such 'leaders' and 'followers' exist in each industry, as a percent of the total surveyed in each industry. The higher the percentage of AI leaders and the lower the percentage of AI followers in an industry, the more likely it would be that more companies in that industry are getting greater business value — and fewer are getting little value — from AI than other sectors.[3]

Using that data, three industries stood out among the 13 as having the greatest proportion of leaders and the smallest proportion of followers (See Exhibit II-9.):

- Telecommunications: 29% of the sample were leaders and 14% were followers
- High tech: 28% leaders, 10% followers
- Retail: 24% leaders, 12% followers

Two industries finished at the bottom of this ranking: healthcare and life sciences (7% of them were leaders but 29% were followers), and utilities (7% leaders, 26% followers).

3 Note: This data doesn't account for the fact that a higher average revenue or cost improvement in each industry may not mean a higher total revenue or cost improvement. For example, one industry may be reporting on very narrow AI initiatives, in which the revenue and cost improvements are small (even if the percentage improvements are high). Another industry may be reporting on broader AI initiatives that cover more revenue and cost in the business, but nonetheless result in lower percentage improvements in revenue and cost.

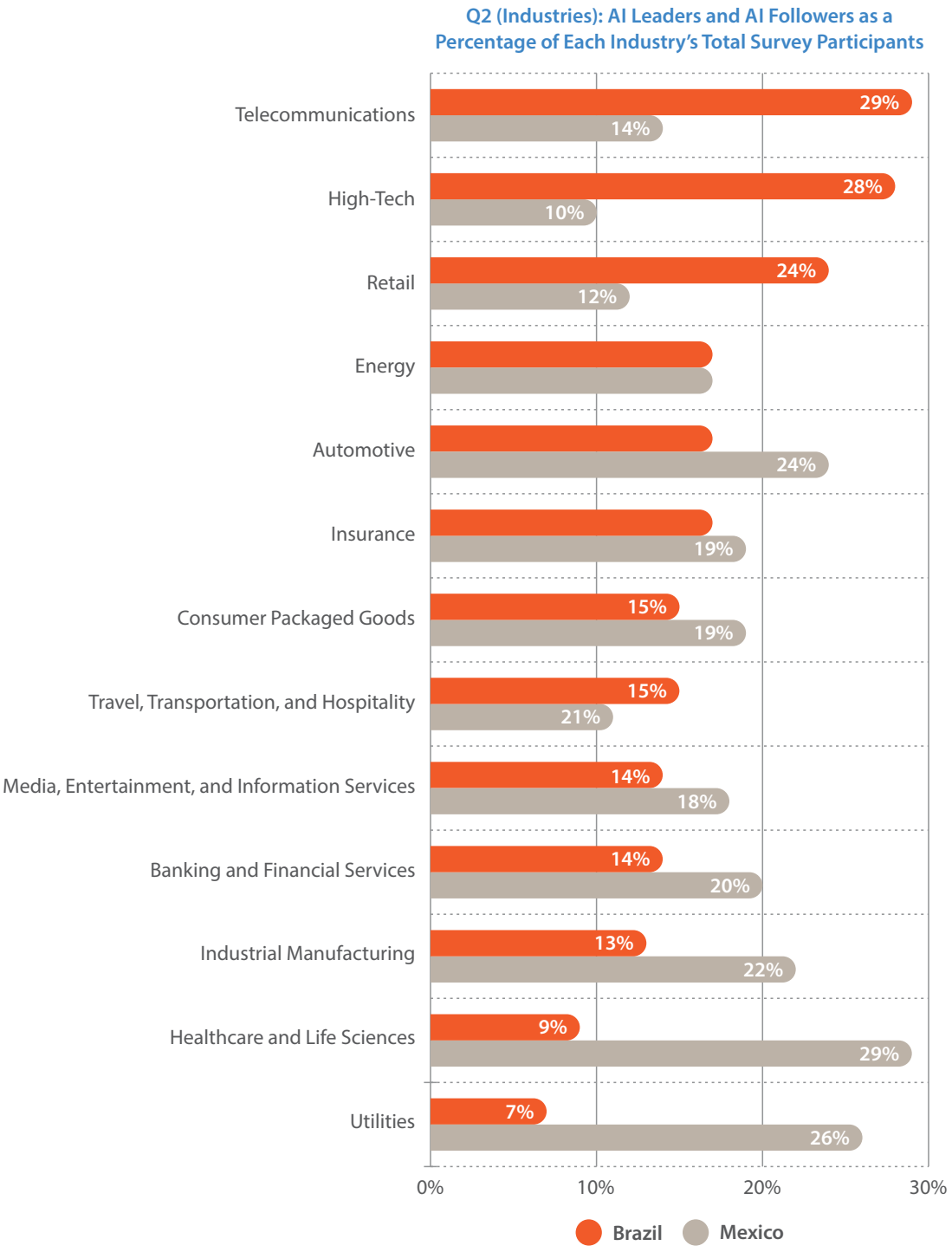

Exhibit II-9: Percentage of AI Leaders and Followers by Industry

Impact on Competitiveness by 2020

Will cognitive technology be crucial to a company's competitiveness by 2020? We asked respondents to rate the importance of cognitive technologies to the company's overall competitiveness by the year 2020 on a scale of 1-5. (See Exhibit II-10.) The average answer across industries: 3.73. Among the industries rating cognitive technology highest in importance to competitiveness: industrial manufacturing (3.86), high tech (3.84), and travel, transportation, and hospitality (3.82).

Industries rating AI the lowest on our 1-5 scale as a competitive tool by 2020 were media, entertainment, and information services, and CPG. Their rating – 3.50 – indicates that they still view AI as a moderately important to important technology for staying competitive.

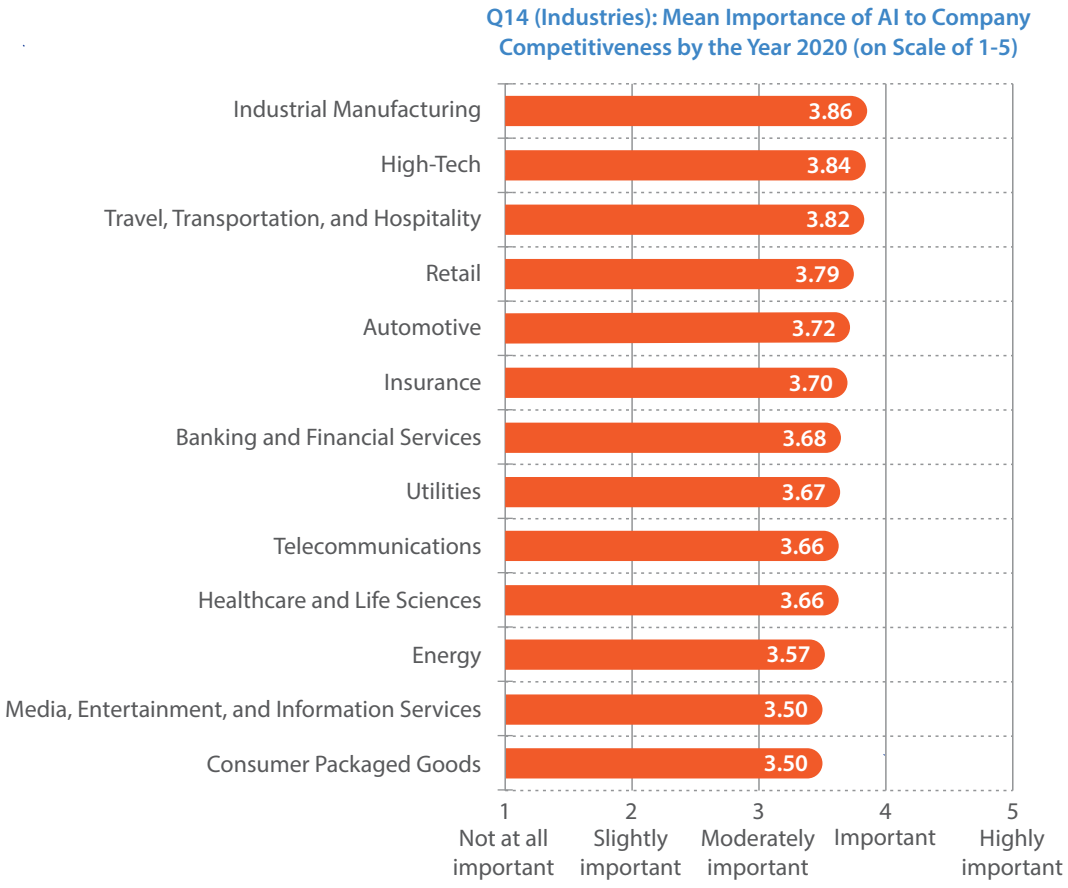

Exhibit II-10: AI's Impact on Company Competitiveness by 2020

These companies also weighed in on which business functions they believe will get the greatest benefits from cognitive tools by 2020. Overall, across industries, companies believe AI will have the biggest impact on the IT function (30% of respondents), sales (12%), and customer service (11%). Industry by industry, the IT function still leads, with 51% of high tech and 42% of telecom company respondents rating impact on IT as highest. (See Exhibit II-11.)

Q15 (Industries): Business Functions in Which AI Is Expected to Have the Greatest Beneficial Impact by 2020

Industry	Most Frequently Mentioned Function of Greatest Impact	2nd Most Frequently Mentioned Function of Greatest Impact
Automotive	Manufacturing (41%)	Information technology (17%)
Banking and financial services	Information technology (25%)	Finance and accounting (20%)
Consumer packaged goods	Manufacturing, sales and IT (tied at 19% each)	Marketing and R&D (tied at 12% each)
Energy	Finance and accounting (22%)	Information technology (17%)
Healthcare and life sciences	Information technology (29%)	Customer service (14%)
High tech	Information technology (51%)	Customer service (8%)
Industrial manufacturing	Information technology (21%)	Manufacturing (20%)
Insurance	Customer service (28%)	Information technology (20%)
Media, entertainment and information services	Information technology (32%)	Sales (14%)
Retail	Sales (31%)	Information technology (29%)
Telecommunications	Information technology (42%)	Sales (14%)
Travel, transportation and hospitality	Information technology (24%)	Marketing and customer service (tied at 18% each)
Utilities	Sales (19%)	Information technology (19%)

Note: Survey participants were asked to choose the one function of greatest impact by 2020. Percentages are % of all business functions surveyed in each sector.

Exhibit II-11: Where AI is Expected to Have the Greatest Impact

Two industries said AI's impact would be greatest in their manufacturing operations by 2020: automotive and consumer packaged goods companies. It ranked second among industrial manufacturers, a slightly higher percent of whom said the IT function would enjoy the greatest impact from AI by then.

In eight industries, the IT department was chosen as the function that would benefit the most from AI by the end of the decade, making it by far the most commonly chosen area of greatest impact.

The sales function was chosen by three industries – CPG, retail, and utilities – as the one on which AI would have the greatest impact by 2020. However, the function seen as being the greatest beneficiary of AI in the insurance industry by that year is customer service (28%). Energy sector respondents said AI's biggest impact by 2020 would be in the finance and accounting department. That's understandable in an industry with complex financial reporting regulations and tremendous cost pressures from slumping energy prices.

Results by Industry

Automotive: Using AI to Drive Vehicles – and the Business

Google's self-driving cars tend to dominate the headlines about AI and the automotive industry, but Google is far from the only company that has invested significantly in AI. Among the 13 industries that we surveyed, the automotive sector has made a clear commitment to harnessing the power of AI.

Our survey data on the industry comes from respondents from 29 automotive companies from around the world (11 in the US; 12 in Europe; five in Asia-Pacific; one in Latin America), with average revenue of $21.2 billion. Some 90% of our automotive survey participants said their companies used AI in 2016; the remaining 10% plan to do so by the year 2020.

The business area where auto companies apply AI technologies most frequently is IT, cited by 65% of automotive firms surveyed (See Exhibit III-1.). Next, companies cite the manufacturing function: 58% of automotive firms surveyed say they use AI here. That's more than 2.5 times the percentage of companies using AI in manufacturing across all 13 industries, and the highest among the industries we surveyed.

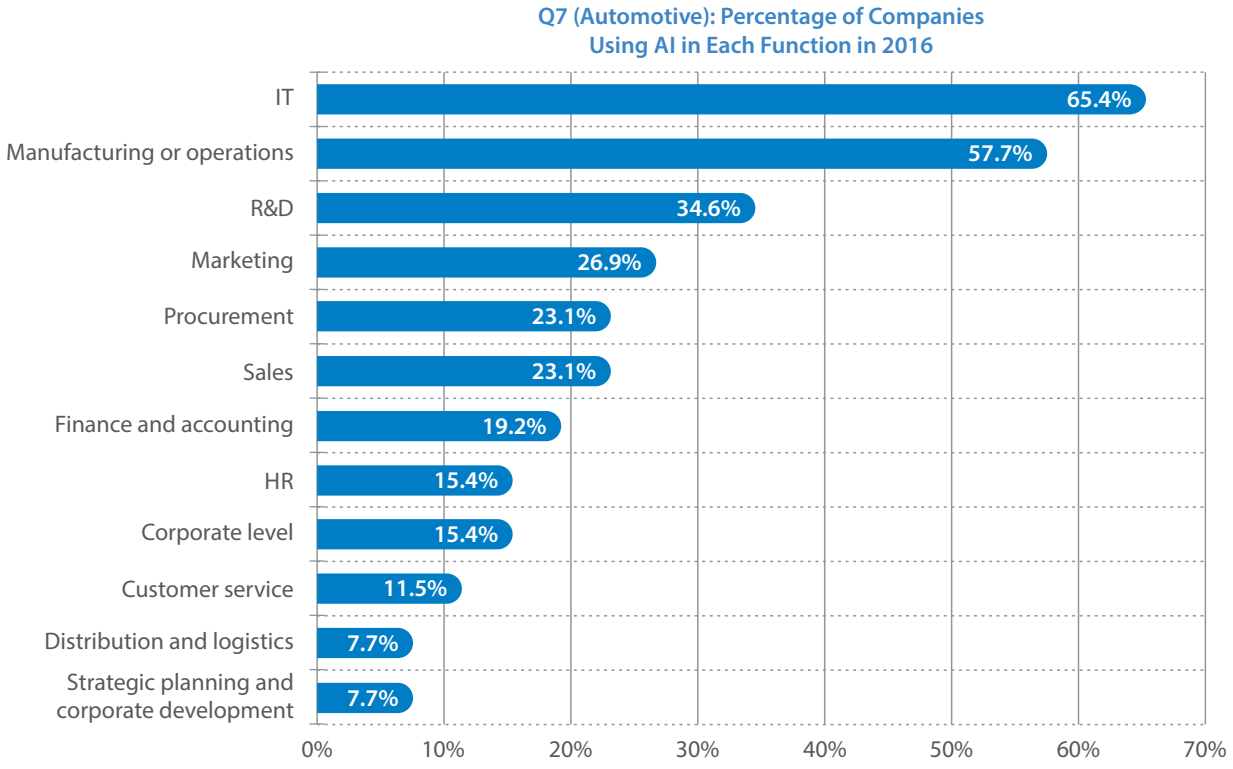

Exhibit III-1: Business Functions Where Automotive Companies Use AI

Robots have existed on factory floors in automotive plants for years. In fact, a 2014 survey by the Robotic Industry Association said 64% of orders for robots used in North American companies were for automotive and auto parts manufacturers – far more than for any other industry sector.[4] French carmaker Renault uses factory robots that are designed to work with people. At a French plant, robots put screws into car engines and check that parts are being used and fitted correctly. These robots are also equipped with camera, sonar, or other technologies that let them know where plant workers are.[5]

The third most frequent way automotive companies use cognitive technologies is for the R&D function (including product design, development, and engineering): 35% of the automotive firms we surveyed do so. For example, automotive giant Toyota is investing heavily in AI and driverless cars, and robots that could take care of the elderly. In September 2015, Toyota announced a $50-million investment in a robotics and AI research study with Stanford University and the Massachusetts Institute of Technology to develop intelligent cars – vehicles with technologies that make people better drivers (not cars that don't need people to drive them).[6]

Similarly, GM plans to install 500,000 Takata driver-monitoring devices in its new car models by 2020. The technology uses head and eye sensors to discern when drivers become distracted. GM's goal: Reduce accidents. Sensors monitor factors such as where the driver's pupils are directed, while an algorithm calculates how long the driver has or has not been focusing on items such as the road or rear-view mirrors. Along the same lines, tools for detecting fatigue are being tested on railroad and aviation workers.[7]

In March 2016, GM spent more than $1 billion on Cruise Automation, a start-up that will help GM enter the market for driverless cars. Cruise had raised only $20 million in venture funding when GM bought it for a price that was 50 times that funding amount.[8]

The fourth most frequent way automotive companies use cognitive technology is to improve the marketing function: 27% of automotive firms report doing so. For example, German automaker BMW in 2013 used iGenius — artificial intelligence technology — to respond to inquiries 24 hours a day from potential customers about its first electric cars, the i3 and the i8. The technology figured prominently in BMW's TV and print advertising campaigns. In the UK alone, thousands of potential customers sent text messages every month to the iGenius service, which responded with answers.[9] According to DigitalGenius, the company that developed the tool, iGenius held simultaneous 'conversations' with hundreds of prospects every second during peak times – far more than a call center could handle. The system also delivered an average response time of 1.2 seconds, and responded accurately more than 99.5% of the time. iGenius helped BMW book hundreds of test drives and telephone calls with interested prospects.[10]

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4 James R. Hagerty, "Meet the New Generation of Robots for Manufacturing," The Wall Street Journal, June 2, 2015. http://www.wsj.com/articles/meet-the-new-generation-of-robots-for-manufacturing-1433300884 accessed Mar. 29, 2016

5 Ibid, The Wall Street Journal, accessed Mar. 29, 2016

6 John Markoff, "Toyota to Finance $50 Million 'Intelligent' Car Project," The New York Times, Sept. 4, 2015. http://www.nytimes.com/2015/09/05/science/toyota-artificial-intelligence-car-stanford-mit.html?_r=0 accessed Mar. 29, 2016.

7 Harvard Business School citing a CBS News report, "GM and Seeing Minds," posted Nov. 21, 2015. https://digit.hbs.org/submission/gm-and-seeing-minds-creating-value-by-saving-lives/ accessed March 29, 2016.

8 Mark Bergen, "GM Spent Over $1 Billion on Self-Driving Startup to Keep Up With Google, Apple," Recode, Mar. 11, 2016. http://recode.net/2016/03/11/gm-spent-over-1-billion-on-self-driving-startup-cruise-the-largest-y-combinator-exit-ever/ accessed Mar. 29, 2016.

9 BMW press release, Aug. 23, 2013. https://www.press.bmwgroup.com/united-kingdom/article/detail/T0145091EN_GB/bmw-i-genius-launched accessed Mar. 29, 2016.

10 DigitalGenius case study, http://www.rocketspace.com/corporate-innovation/inside-the-future-of-customer-experience-with-ai accessed Nov. 27, 2016.

Sales organizations also make significant use of cognitive technologies: 23% of the automotive firms we surveyed pointed out the use of cognitive technology at the sales function.

Where else in the automotive businesses do cognitive tools find a role? Automotive companies are using cognitive technologies the realms of procurement (23%), finance and accounting (19%), human resources (15%), and corporate-level decision-making (15%).

Spending Plans and Business Benefits

Automakers have not shied away from investing in cognitive technologies. In 2015, the average auto company spent $55 million on AI initiatives (with a median of $3.8 million). Interestingly, one auto company we surveyed spent between $500 million and $750 million.

The projected average spend for 2016 was $32 million per auto company (median of $3.75 million). But by 2020, the projected figure more than doubles to $69 million.

Companies split their budgets fairly evenly between projects to improve the way they currently do business and those meant to transform the business. In 2016, companies allocated an estimated 52% to improvement projects and 48% to transformational ones. In 2020, automotive companies project that improvement initiatives will account for 51% of their AI budgets, with 49% going toward transformation initiatives. That ratio is projected to shift further toward transformation by 2025, with 53% of projected AI spending going toward those types of initiatives and 47% of investments going toward improving the way the company operates.

Cost and Revenue Improvements from AI

We asked automotive companies to estimate the impact of AI in the areas of their business in which they staged their initiatives, whether it was a specific product or product line, division, region of the world, continent or country, or any other facet of their business. Thus, the results – revenue and cost improvements in 2015 over 2014 – that we report are not for the company as a whole.

In revenue improvement, auto manufacturers reported a 12% average revenue increase in the area of their AI initiative.

Did AI help auto companies reduce costs in the areas in which they staged their initiatives in 2015? For sure. The average reported cost reduction was 10%.

Where AI Will Have the Greatest Impact by 2020

By 2020, the greatest business benefits will appear in the manufacturing and production realm, say 41% of automotive companies that we surveyed. (See Exhibit III-2.) Accordingly, the companies will likely continue to invest heavily in AI, robotics, and other factory automation initiatives aimed at manufacturing between 2016 and then.

The manufacturing projections really stand out. In fact, the next closest answer is IT, where 17% of the automotive companies surveyed say they expect big business benefits.

The third most-frequently-mentioned function of impact from AI was the corporate level (by 14%). It was followed by R&D (10%), marketing, and strategic planning (both mentioned by 7% of our automotive survey sample).

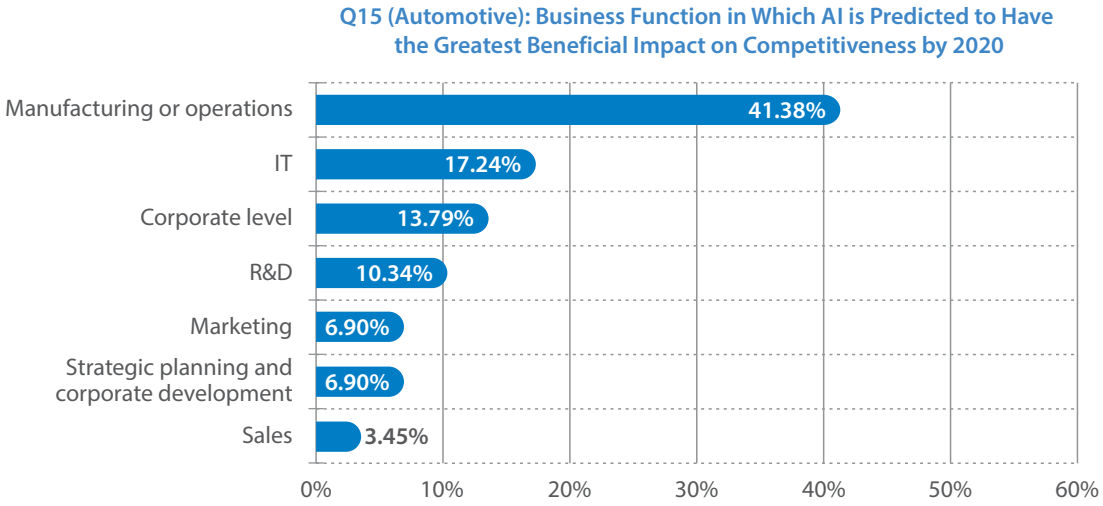

Exhibit III-2: Where Auto Companies See AI Having the Greatest Impact by 2020

Jobs and Competitiveness

How will AI affect employment in the global auto industry? Auto company respondents say AI could lead to a net job loss (where the jobs lost outnumber the new jobs created as a result of AI projects).

Here's the picture on what automotive companies could do. In 2016, automotive companies said the average function could cut 15% of its jobs by using AI. That figure rises to 21% of jobs by 2020 and 26% by 2025.

Surely, companies will have to add some new jobs in order to develop and manage cognitive technologies. On this front, our respondents say AI could increase the average number of jobs per function by 9% in 2016; 14% by 2020 and 16% by 2025. Our respondents say they envision 54% of these new jobs being filled by current employees and 46% by new employees.

Success Factors for AI Projects

Overall, automotive respondents believe in AI's potential to improve company competitiveness. Indeed, 59% called it 'important' or 'highly important' to improving competitiveness, and only 7% called it 'slightly important' or 'not at all important'.

What will separate the automotive leaders from followers in making AI pay off? It all starts with safety, our respondents say. (We asked respondents to rate 10 possible factors on a scale of one to five, five being 'highly important'.) Two success factors tied for first place: Making systems secure against hacking and developing a system that makes good, reliable, and safe decisions. (See Exhibit III-3.) This response makes sense, given public concerns regarding auto malware and driverless car safety.

Respondents cited two success factors in a tie for second place: Developing a system that continually learns and getting top management's approval for funding. (Any disruptive technology comes with funding challenges, and cognitive technology doesn't seem to be an exception.) Interestingly, our respondents rated addressing fears about job loss as the least important success factor. This may reflect a pragmatic attitude in an industry that has seen its workforce shrink for years.

Q17 (Automotive): Key Success Factors in Capitalizing on AI

1 (tied)	Making the systems secure against hacking	4.00
	Developing a system that makes good, reliable, and safe decisions	4.00
3 (tied)	Developing a system that continually learns, in order to make better decisions	3.90
	Getting top management's approval for funding	3.90
5	Determining where to use the technology in our company	3.72
6	Getting managers and employees to trust what our cognitive systems are advising them to do	3.69
7	Getting employees to learn and adopt the new processes and systems	3.66
8	Deciding whether to use the technology to assist people or replace them	3.62
9	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	3.55
10	Addressing people's fears about losing their jobs	3.38
	Factors rated on a scale of 1-5, 1= not at all important; 2=slightly important ; 3= moderately important, 4= important; 5= highly important	

Exhibit III-3: Key AI Success Factors in Automotive Companies

Banking and Financial Services: Banking on AI to Protect Internal Systems and Conduct Financial Trading

Judging a loan application or scrutinizing an investment now involves a new kind of science. AI tools bring new insights and efficiency to tasks at banking and financial services companies.

That's according to our survey respondents from 182 banks and financial services firms, with average revenue of $26 billion. Nearly half (47%) of the participants were from North America; 36% from Europe; 15% from Asia-Pacific; and 2% from Latin America.

What kinds of financial institutions did we survey? One quarter were retail banks; 20% were investment banks and brokerages; 16% were private wealth management firms; 15% were commercial banks; 14% were providers of other B2B banking and financial services; 5% were credit card companies; and 5% provided other consumer banking services.

A notable 86% of our banking respondents' companies currently use cognitive technologies, and the remaining 14% plan to use them by 2020.

Where They're Using AI

The function within this industry that is most likely to be using AI is the IT department, where 64% use AI. The finance and accounting department is next, followed by marketing, customer service, and sales. (See Exhibit III-4.)

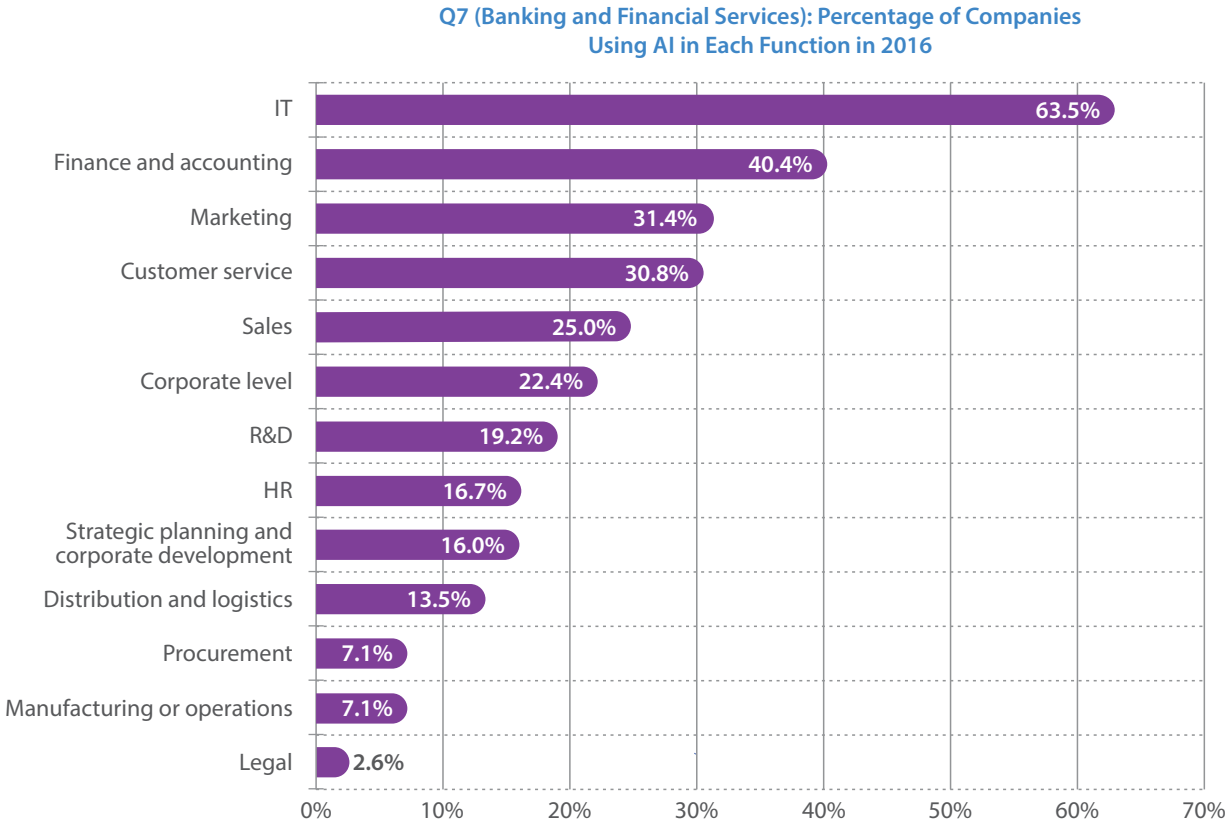

Exhibit III-4: Where Banks are Using AI

Of those using AI in IT, 70% are using the technology to detect and deter security intrusions. Some 57% are using it to troubleshoot their internal users' technology problems. And 54% are using AI to automate production management tasks. Another 57% are using AI to determine whether employees are using the technologies of approved tech vendors, and one quarter are using AI to do run-book automation.

Four out of five banks and financial services firms are using AI in their finance and accounting departments. Of this group, 72% are using AI in financial trading (for example, for high-frequency trading enabled by AI). As an example, Goldman Sachs invested in Kensho, a start-up that uses AI to decipher unstructured data — such as online articles — to spot trends.[11] Some 47% of the banks that use AI in the finance function use it to identify potential customer financial problems that might force the bank to withdraw credit.

Nearly a third of the banks that we surveyed were using AI in marketing and customer service. For example, UK-based Barclays PLC was developing an AI system similar to Apple's iPhone personal assistant, Siri, to let people talk to a device and get information.[12]

A quarter of our banking respondents use AI in the sales function, where cognitive tools can help them decide who to extend loans to, or where to invest, for example. Venture capital firm CircleUp (which focuses on consumer product-related companies, including food, restaurant, and cosmetics start-ups) uses AI and machine learning to determine which companies to fund. Its crowdfunding online platform – Classifier – has evaluated more than 10,000 potential deals done by the firm's analysts between 2011 and 2016. Since March 2014, the system has been helping the firm's investment analysts screen deals, dramatically increasing the number of possible deal evaluations. With Classifier, a team of less than 10 analysts can review 500 opportunities per month, versus the 500 evaluations per year done by the average private equity firm.[13]

About one in five banks uses cognitive tools to do corporate level (CEO, COO, or divisional head) decision-making work. Less than one in five use AI in product development, HR, strategic planning and corporate development distribution, procurement, or the legal department.

Some Banks are Very Big Spenders on AI

How much do banking and financial services companies invest in cognitive technology initiatives? Our banking respondents spent an average $77 million per company in 2015. The median spend was $5 million.

At the top end, seven of the banks and financial services firms that we surveyed spent $500 million or more each on AI in 2015, with four of those spending at least $1 billion. In 2016, the average per-company spend was expected to rise to $85 million (about a 10% increase over 2015), with 11 of those companies planning to spend $500 million or more.

Looking ahead to 2020, the banks we surveyed expect their investments in AI to increase to $99 million on average per company, notably increasing by 29% over 2015. In 2020, 11 of our respondent companies see themselves spending $500 million or more.

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11 Tracy Alloway and Arash Massoudi, "Goldman Sachs leads $15m financing of data service for investors," Financial Times, November 23, 2014, http://www.ft.com/cms/s/0/db9e08b2-71d7-11e4-9048-00144feabdc0.html#axzz44Oegxj7L, accessed March 30, 2016; "Goldman Invests In Kensho: Next Phase In Quant Analysis?," ValueWalk, November 24, 2014, http://www.valuewalk.com/2014/11/goldman-sachs-kensho/, accessed March 30, 2016

12 Arjun Kharpal, "Barclays wants a robot to do your banking," CNBC, June 16, 2015, http://www.cnbc.com/2015/06/15/barclays-thinks-artificial-intelligence-is-the-future-of-banking.html, accessed March 30, 2016.

13 Christopher Mims, "Software Is Disrupting Venture-Capital Sector," Wall Street Journal, March 7, 2016, http://www.wsj.com/articles/software-is-disrupting-venture-capital-sector-1457326861, accessed March 7, 2016.

These companies will evenly split the allocation of those investments between projects to improve the way they do business (54% of funding in 2016), and those meant to transform the business (46%). That ratio isn't predicted to change much by 2020 or 2025.

Impact of AI on Revenue and Costs: Higher than Most Industries

What did banks and financial services companies gain from their 2015 investments in AI? In the areas of business in which they used the technology in 2015, the average reported revenue increase was 17%. That was the fourth highest among our 13 industries. The average reported cost reduction was 13% — the fifth highest among the sectors we surveyed.

Where Will AI have the Greatest Impact by 2020? Little Agreement among Banks

There's no agreement among the banks and financial services executives we surveyed on where the biggest business benefits from AI will arise, our data shows. (See Exhibit III-5.) When asked to project where AI will have the greatest beneficial impact by 2020, the largest number of respondents (25%) said IT, while 20% said finance and accounting, and 15% said customer service. Just 9% cited sales, and even fewer pointed to marketing and R&D.

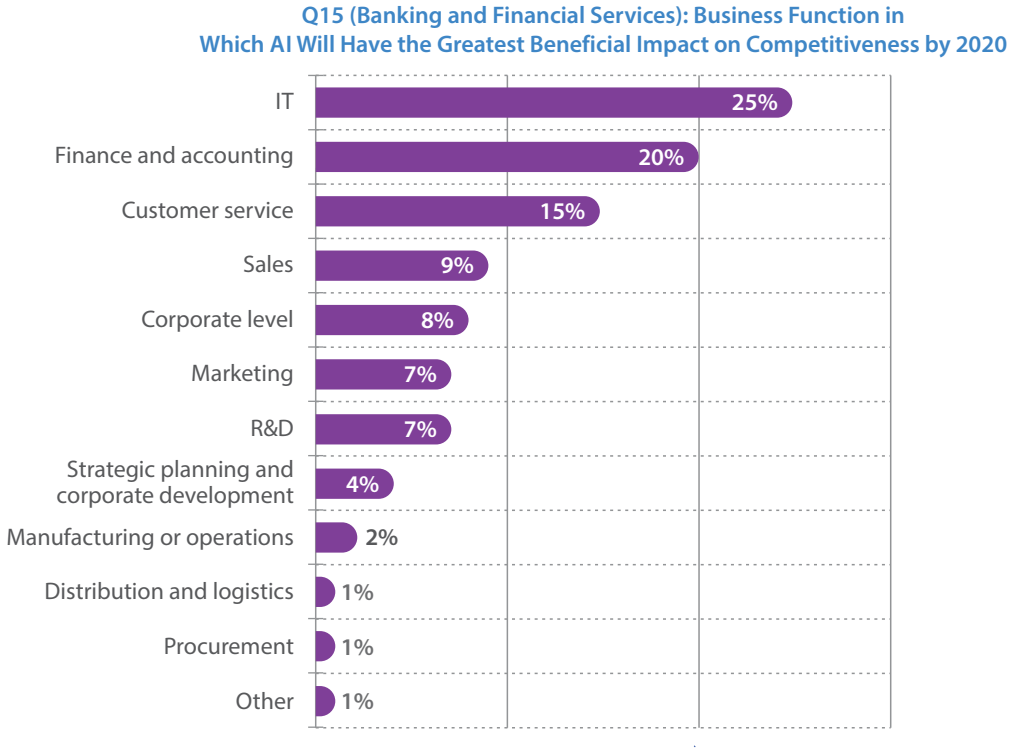


Exhibit III-5: Where AI is Predicted to Have the Biggest Impact by 2020[14]

14 Since no respondent selected 'HR', this category has been excluded from the graph.

The Jobs Impact of AI

As to AI's impact on banking sector jobs, respondents envision significant changes coming by 2025. In 2016, companies expected AI cut a functional average of 13% of jobs in the departments using AI. That number is predicted to increase to 18% in 2020 and 24% by 2025.

Those numbers won't be surprising for some. In March 2016, US banking powerhouse Citigroup Inc. released a report that predicted retail banking automation could result in a 30% reduction in jobs at US and European banks over the next 10 years – about 1.8 million jobs.

On the other hand, the banks we surveyed predicted a 10% rise in jobs in 2016, due to AI in the departments using the technology. They projected that number to increase to 13% new jobs on average by 2020, and 16% by 2025.[15]

Competitiveness and Keys to Success

Respondents from the banking and finance sector believe AI will be crucial to their ability to compete in the coming years. Some 59% said the technology was highly important or important to competitiveness (vs. 62% of our overall survey respondents). Only 12% said AI was slightly or not at all important to competitiveness.

Not surprisingly, banking and financial services respondents feel that among the success factors for AI projects, making systems secure against hacking is paramount. The second most commonly cited success factor is to develop systems that can improve themselves through continuous learning. (See Exhibit III-6.)

On a more human front, many of these respondents recognize the importance of getting people to trust what the technology advises, as shown by our No. 3 answer: getting managers and employees to trust what cognitive systems are advising them to do.

Q17 (Banking and Financial Services): Key Success Factors in Capitalizing on AI

1	Making the systems secure against hacking	4.14
2	Developing a system that continually learns, in order to make better decisions	4.02
3	Getting managers and employees to trust what cognitive systems are advising them to do	4.00
4	Developing a system that makes good, reliable, and safe decisions	3.98
5	Changing business processes in ways that capitalize on automated decisions, actions, and so on	3.97
6	Getting employees to learn and adopt the new processes and systems	3.90
7	Determining where to use the technology in the company	3.89
8	Getting top management's approval for funding	3.82
9	Deciding whether to use the technology to assist people or replace them	3.58
10	Addressing people's fears about losing their jobs	3.47
Factors rated on a scale of 1-5, where 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = highly important		

Exhibit III-6: Key AI Success Factors for Banks and Financial Services Firms

15 Telis Demos, "Citi: Technology Could Cost Two Million Bank Employees Their Jobs," The Wall Street Journal, March 30, 2016, http://blogs.wsj.com/moneybeat/2016/03/30/citi-technology-could-cost-two-million-bank-employees-their-jobs/, accessed September 5, 2016.

Consumer Packaged Goods: Big Believers in AI

Our consumer packaged goods (CPG) survey respondents come from 26 companies (17 food and beverage companies and nine durable consumer goods manufacturers) with an average revenue of $14 billion. Half the companies are in North America, eight are in Europe, four are in Asia-Pacific, and one is in Latin America. Among these companies, 81% currently use AI; of the 19% that don't, all plan to do so by 2020.

Most frequently, the CPG companies surveyed said they're using AI in the customer-facing functions of sales, marketing, and customer service, and in their manufacturing operations. (See Exhibit III-7.)

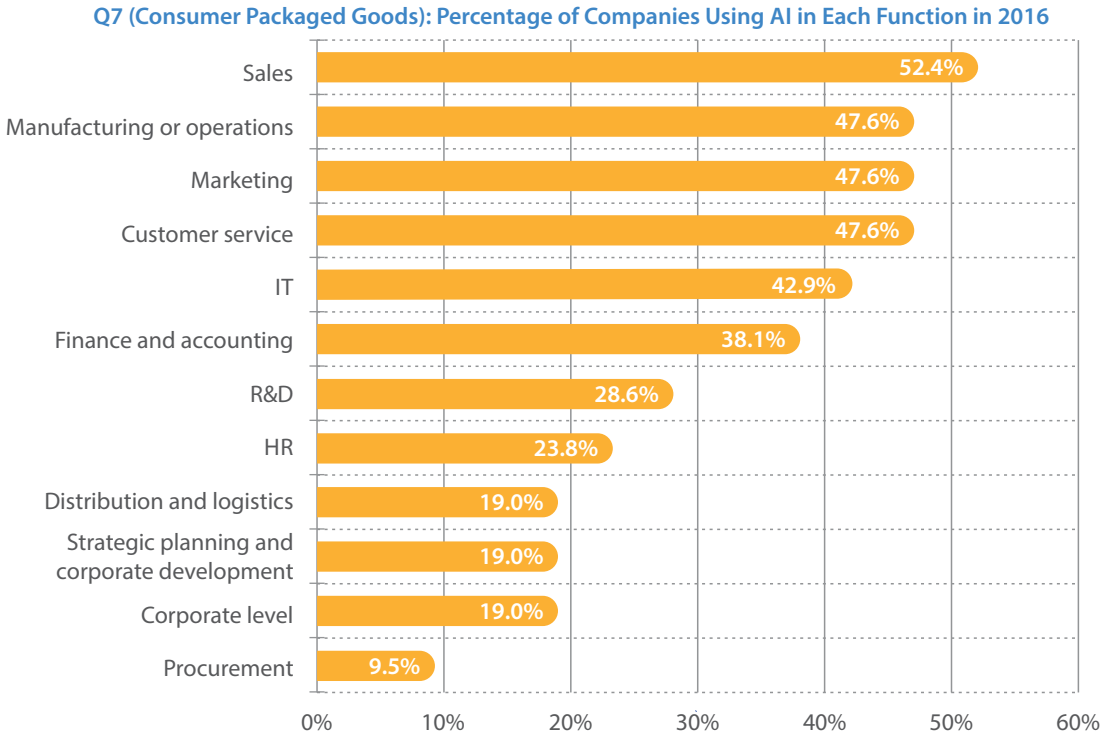


Exhibit III-7: Where CPG Companies are Using AI[16]

16 Since no respondent selected 'legal', this category has been excluded from the graph.

A little over half the CPG companies surveyed are using AI in sales. For example, food companies like Kraft have developed mobile apps that use AI to make meal recommendations to grocery shoppers. Kraft Foods (an $18-billion company within parent Kraft Heinz[17]) developed an iPhone app to deliver recipes and personalized advice to consumers. Updated in 2014, the Kraft iFood Assistant app[18] offers more than 7,000 recipes, and uses AI to learn more about the shopper with each use. That lets the app suggest recipes the user might like, such as recipes using ingredients the person has chosen before. The app also directs shoppers to nearby grocery stores.[19]

Nearly half the CPG executives surveyed said their companies were using AI in manufacturing, marketing, and customer service (48% in each case). Some 43% were using AI in the IT function, while nearly two out of five were using the technology in finance and accounting.

CPG Companies are Spending Heavily on AI

As we mentioned at the beginning of the report, CPG companies were the heaviest spenders on AI in 2015 as a percent of revenue out of the 13 sectors we surveyed. CPG firms spent an average 0.66% of revenue on AI in 2015, or $95 million on average per company. And while they said they planned to spend less in 2016 ($75 million per company), as a percent of revenue they would still be No. 1 among our 13 industries (spending 0.52% of revenue on AI). By 2020, they project spending an average $80 million per company on AI, which would be 0.56% of their annual revenue in 2016.

But are those investments largely to improve the way they do business today, or transform it? CPG companies favor using IT to improve current business operations (an estimated 53% of AI funding in 2016) vs. projects to transform the business (47%). That ratio is expected to be 50–50 by 2020, and then tilt slightly toward transformation by 2025, when 49% of investments are seen as 'improving' the business 'as is,' and 51% are seen as transformational.

How AI Helped CPG Companies Improve Revenue and Cost

CPG companies are already reaping the financial benefits of cognitive technology, our survey respondents say. We asked respondents to quantify the revenue increase in 2015 (as compared to 2014) for the business unit, product, or product line related to the cognitive initiative (not the revenue of the whole company). On average, our respondents cite a 12% revenue increase. At the same time, they note an average 12% savings in costs related to cognitive initiatives. So these companies have gained the best of both worlds: higher revenue and lower costs.

17 Dana Cimilluca, Dana Mattioli, and Chelsey Dulaney, "Kraft, Heinz to Merge, Forming Food Giant," The Wall Street Journal, March 25, 2015, http://www.wsj.com/articles/kraft-foods-h-j-heinz-to-merge-1427278332, accessed March 31, 2016.

18 Emily Bryson York, "Kraft Hits on Killer App for iPhone Marketing," Advertising Age, January 19, 2009, http://adage.com/article/digital/kraft-hits-killer-app-iphone-marketing/133869/, accessed March 31, 2016.

19 Domenick Celentano, "Kraft Foods iPhone Assistant Appeals to Time Starved Consumers," About.com, October 16, 2015, http://foodbeverage.about.com/od/Whats_Hot/a/Kraft-Foods-Iphone-Assistant-Appeals-To-Time-Starved-Consumers.htm, accessed March 31, 2016.

Where AI Will Have the Most Impact by 2020: The Picture is Cloudy

Where do CPG respondents envision the biggest business benefits from their AI projects to be by 2020? We found little agreement here. Of the functions we surveyed, no one function received more than 19% of the votes. Sales, manufacturing, and IT each were cited by 19% respondents. Only 12% cited marketing or R&D. Just 8% said customer service. (See Exhibit III-8.)

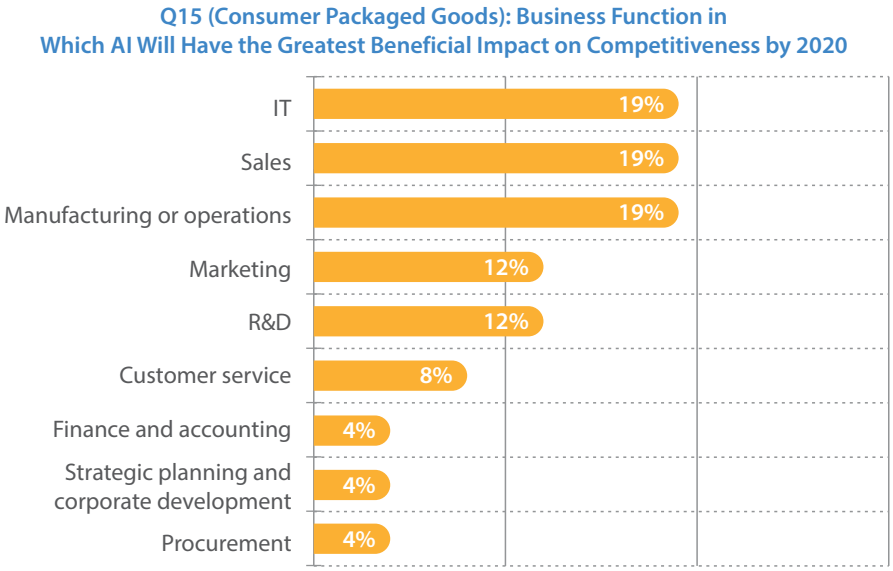


Exhibit III-8: Where AI is Seen as Having the Greatest Impact by 2020[20]

The Jobs Impact of AI in CPG

In terms of AI's employment impact, CPG companies had not envisioned a lot of changes for 2016. We asked how many jobs related to cognitive projects could be eliminated and created within the respondent's department (not the whole company): CPG respondents expected a functional average 8% of jobs to be cut in 2016. This estimate rises to 13% by 2020 and 17% by 2025.

On the other hand, respondents expected 4% new jobs to be created in 2016 because of the technology. CPG survey participants said they could see AI leading to a 7% average functional increase in new jobs by 2020, and an 8% increase by 2025. Between now and 2025, companies expect to fill 54% of those new jobs with current employees, and 46% with people from outside the company.

What importance do CPG companies place on AI in remaining competitive by 2020? Nearly half (46%) said the technology was either highly important or important to staying competitive. Less than one in four (23%) see AI as only slightly important or not at all important, with 31% saying

20 Since no respondent selected 'corporate level', 'distribution and logistics', 'HR', and 'other', these categories have been excluded from the graph.

it would be moderately important.

Making Systems Hack-Proof Tops the List of Key AI Success Factors in CPG

What are the keys to success with cognitive projects at CPG companies? Of our list of 10 success factors, making the system secure tops the list. (See Exhibit III-9.)

CPG companies rated getting employees to trust the cognitive system's advice as second in importance. Rated third was developing AI systems that continually learned on their own, in order to keep making better decisions.

Almost at the bottom of the list was getting top management's approval for funding. That is not surprising, given that the average CPG company spent $95 million on the technology in 2015, and the most as a percent of company revenue.

Q17 (Consumer Packaged Goods): Key Success Factors in Capitalizing on AI

1	Making the systems secure against hacking	4.08
2	Getting managers and employees to trust what cognitive systems are advising them to do	4.00
3	Developing a system that continually learns, in order to make better decisions	3.88
4 (tied)	Changing business processes in ways that capitalize on automated decisions, actions, and so on	3.85
	Deciding whether to use the technology to assist people or replace them	3.85
6	Getting employees to learn and adopt the new processes and systems	3.81
7 (tied)	Developing a system that makes good, reliable, and safe decisions	3.73
	Determining where to use the technology in the company	3.73
9	Getting top management's approval for funding	3.58
10	Addressing people's fears about losing their jobs	3.46
Factors rated on a scale of 1-5, where 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = highly important		

Exhibit III-9: Key AI Success Factors for CPG Companies

Energy: Using AI to Control Costs

Every energy company we surveyed was using AI in 2016. In the world of oil drilling, AI can rewrite the rules of efficiency. That picture emerges from our survey respondents in the energy sector, from 23 companies (in oil and gas production, energy distribution, and energy retailing). Eight of the companies are in North America, seven in Europe, five in Asia-Pacific, and three in Latin America. Average revenue of the 23 energy companies was $15 billion.

The most cited functional area for AI projects is IT (mentioned by 74%), followed by distribution and logistics (39%). Also notable was the fact that 35% are using AI in sales and manufacturing or production, and 30% are using AI in finance and accounting. (See Exhibit III-10.)

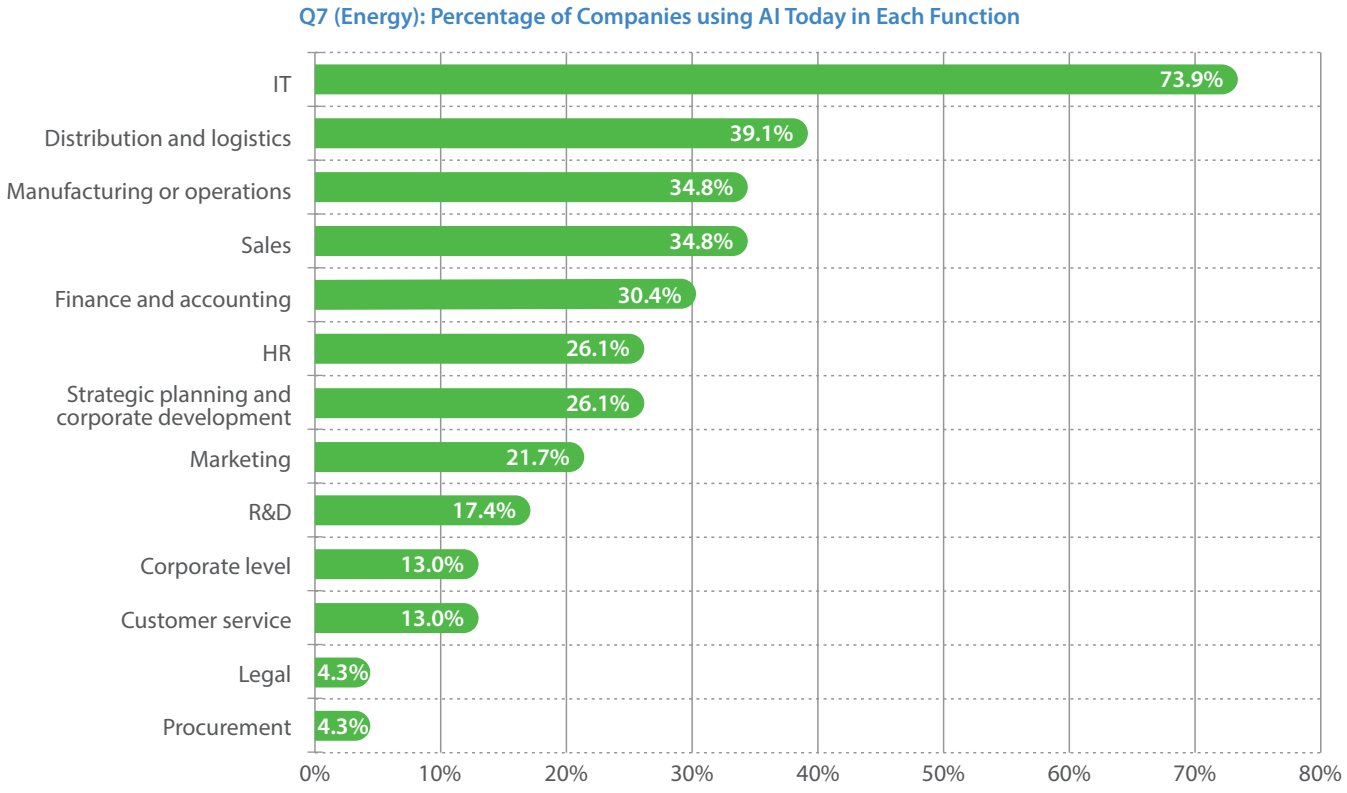


Exhibit III-10: Where Energy Companies are Using AI

Less frequently, our energy respondents point AI at tasks in HR (26%), strategic planning and corporate development (26%), marketing (22%), and R&D (17%). Just 13% use it at the corporate decision-making level, and 13% do so in customer service. Only 4% are using AI in their procurement and legal functions.

In energy, like other industries, AI can help companies address backroom efficiency problems. In 2015, Royal Dutch Shell PLC (with $431 billion in 2014 revenue, the world's second largest publicly held petroleum refining company) and Baker Hughes (the third largest oil and gas equipment company, with revenue of $24 billion) tested an AI system to be used in accounts payable. The system, called Amelia, was programmed at Baker Hughes to answer suppliers' questions about invoices. Considering that the firm has thousands of vendors, such activity at Baker Hughes traditionally has required people in accounts payable to spend thousands of person hours annually.[21]

In the production realm, oil drilling supplier National Oilwell Varco (a $21-billion company based in Houston) has technology that uses artificial intelligence to automate the drilling process. Digital sensors collect well conditions in real time, and the firm's software adjusts drilling techniques accordingly – 40% faster than oil field engineers could do it, the company says.[22]

Along more analytical lines, Woodside Petroleum (the largest operator of oil and gas production in Australia) is using AI to analyze 30 years of engineering data, aiming to improve decision-making, business processes, and operational performance.[23]

Spending and ROI

On their AI projects, energy companies spent an average of $24 million per company in 2015 — a figure they expected to rise to $39 million in 2016 (a 60% increase). By 2020, energy companies predicted their average spend on AI would decrease to $27 million. Likely, the forecasted flattening demand for oil globally is influencing these companies to be conservative with spending. Also, these firms have one-time upfront costs in IT projects, including AI ones.

In using AI, energy companies are focused on improving the way they currently do business, allocating 58% of their current AI budget to improvement projects vs. 42% for transformational projects. That ratio is expected to change only slightly by 2020 (55%-45% in favor of improvement investments) and 2025 (56%-44% in favor of improvement projects).

Early RoI on cognitive projects looks promising for energy companies, based on our survey data. We asked respondents to quantify revenue benefits generated in 2015 vs. 2014. Our respondents report an average revenue increase of 16% in the area of the AI initiative. Additionally, they cite an average cost decrease of 10% related to their AI work. So, these companies are adding revenue, while cutting costs.

21 Karen Boman, "Cognitive Worker Amelia Could Transform Oil, Gas Operations," Rigzone, August 7, 2015, http://www.rigzone.com/news/oil_gas/a/140030/Cognitive_Worker_Amelia_Could_Transform_Oil_Gas_Operations/?all=HG2, accessed March 31, 2016.

22 Christopher Helman, "The Robot Roughnecks: Out of the Oil Bust Comes a Golden Age of Drilling Technology," Forbes, August 19, 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/#598ffa3e2b88, accessed March 31, 2016.

23 Paul Smith, "Woodside Petroleum searches for data value with IBM's Watson cognitive computing," Financial Review, May 26, 2015, http://www.afr.com/technology/woodside-petroleum-searches-for-data-value-with-ibms-watson-cognitive-computing-20150521-gh6un7, accessed August 26, 2016.

Where AI is Expected to Have the Biggest Impact by 2020

Which area in the business will AI projects have the most beneficial impact by 2020? There was little agreement on this among energy companies. The most common answer is finance and accounting (but only 22% of respondents cite it). Seventeen percent of respondents say IT, and 13% cite production. No other business function topped 10% of votes. (See Exhibit III-11.)

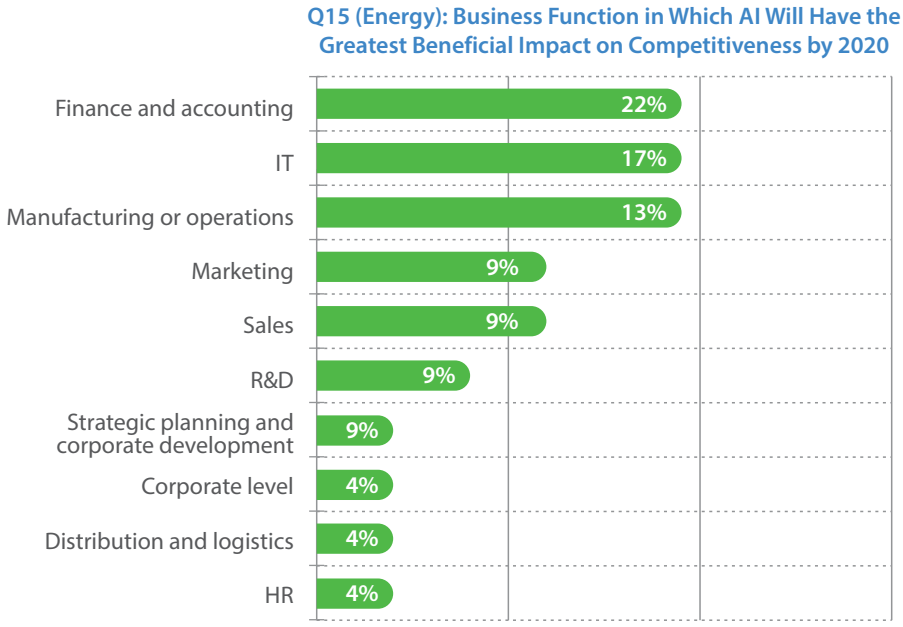


Exhibit III-11: Where Energy Companies See AI Having the Greatest Impact by 2020[24]

AI and Jobs

As to the jobs impact of cognitive work, energy respondents envisioned significant changes in 2016, and right through 2025. Our respondents expected 21% average cut in jobs in each function where AI is used, in 2016 with the figure rising to 22% in 2020, and 33% by 2025 (one of the highest estimates among our 13 industries).

On the other hand, our respondents also predict a significant number of new jobs will be created in the functions that use AI: an average 18% increase in those functions in 2016, a 22% increase in 2020, and a 25% increase in 2025. Companies will fill these new jobs in a fairly even split between new hires (52%) and current employees (48%), our respondents say.

Energy respondents have gotten on board with the value of AI projects, perhaps due to the early RoI wins. When asked to rate the overall importance of AI technologies to the company's competitiveness by 2020, 13% say it's highly important, and 48% say important. Some 22% say moderately important, 17% say slightly important, and none say not at all important.

24 Since no respondent selected 'customer service', 'procurement', and 'other', these categories have been excluded from the graph.

Key Success Factors with AI

When it comes to executing AI projects successfully, energy respondents seem keenly focused on change management and security (the latter being a common focus among all industries).

The top key to success cited by energy respondents: getting employees to learn and adopt the new processes and systems. Also important was ensuring strong security, and getting teams to trust the advice from cognitive systems. Winning funding approval came in at No. 4, which seems logical since these respondents are seeking investments from companies at a time of softening oil demand. (See Exhibit III-12.)

Q17 (Energy): Key Success Factors in Capitalizing on AI

1	Getting employees to learn and adopt the new processes and systems	4.13
2	Making the systems secure against hacking	4.04
3	Getting managers and employees to trust what cognitive systems are advising them to do	4.00
4	Getting top management's approval for funding	3.91
5	Developing a system that continually learns, in order to make better decisions	3.83
6 (tied)	Changing business processes in ways that capitalize on automated decisions, actions, and so on	3.78
	Determining where to use the technology in the company	3.78
8 (tied)	Developing a system that makes good, reliable, and safe decisions	3.74
	Addressing people's fears about losing their jobs	3.74
10	Deciding whether to use the technology to assist people or replace them	3.65
Factors rated on a scale of 1-5, where 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = highly important		

Exhibit III-12: Key AI Success Factors

Healthcare and Life Sciences: The AI Action Goes Beyond R&D

Healthcare and IT companies that use artificial intelligence to identify ways to treat (and possibly cure) diseases have received enormous press attention in recent years. However, our survey of healthcare and life sciences companies shows that R&D isn't the most frequent area they are investing in AI.

We surveyed 56 healthcare and life sciences companies, of which 19 are healthcare service providers such as hospitals and clinics, 24 are pharmaceutical or biotech firms, 10 are medical device or medical product companies, and three provide other healthcare services or products. Regionally, 26 respondents were from North America, 19 from Europe, eight from Asia-Pacific, and three were from Latin America. Average revenue for our respondent companies was $19 billion.

Some 86% are currently using cognitive technologies; of the 14% that don't, all plan to do so by 2020.

So, if R&D isn't their favorite place to invest in AI, what is? These 56 companies more often than not are using AI in IT, marketing, finance, and customer service. (See Exhibit III-13.) The top area they're using these technologies in is the IT function, which was mentioned by 69% of respondents. Some 31% marketing, while 25% say customer service and finance and accounting. A little less than one quarter cite strategic planning and corporate development.

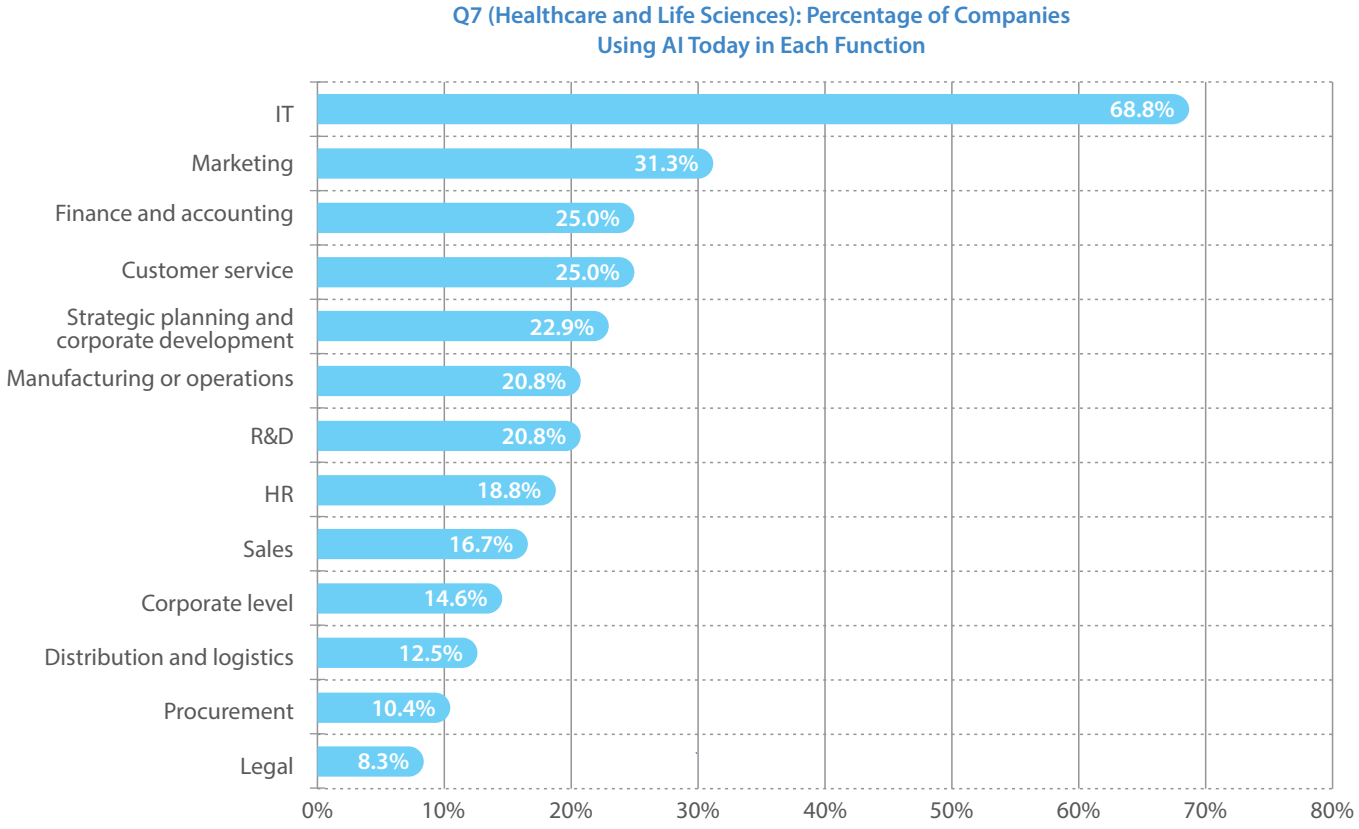


Exhibit III-13: Where Healthcare Companies Use AI

Among our respondents, 21% cite R&D — a lower percentage than you might expect. In one R&D example, Berg Health (a Massachusetts biotech firm) uses AI to research prostate and pancreatic cancers. The company says it has created more than 14 trillion data points from a single tissue sample, and that AI is helping its researchers comb through the data. Niven Narain, president of Berg, told *Fortune* in 2015, "AI is actually able to take all the information from the patient's biology, clinical samples, and demographics and really categorize which ones are similar and which ones are different, and then stratify those in a way that helps us understand the difference between the healthy and diseased."[25]

Five years ago, pharmaceutical giant Merck awarded a $22,000 prize to anyone who could create a software program that could predict new drug candidates. A student of the University of Toronto, who had been working on speech recognition technology using a deep-learning neural network, approached Merck regarding the challenge. The computer scientist, George Dahl, and his colleagues used their deep-learning system to go through Merck's database of more than 30,000 molecules, projecting how each one acted on 15 target molecules. They won the competition, bettering Merck's record by 15%, according to Dahl.[26] Dahl now works as a research scientist at Google.

Moderate Spending but Strong Results

While chasing big ideas like these, some healthcare companies are spending generously on AI projects. Although the average spend is $38 million in both 2015 and 2016, two companies spent more than $100 million on AI in 2015. The average spend is expected to rise a strong 42% to $54 million in 2020.

Is this money largely being used for improving the business as is, or for transforming it? Today, companies point 57% of their AI budget at projects meant to improve current business operations, and 43% at transformational projects. By 2025, that ratio is expected to flip to 51% allocated to transformational projects.

What kind of early results have our respondents' companies seen from AI? We asked them to quantify additional revenue generated in 2015 (compared to 2014) in the area of the business related to the cognitive project (not the whole company): our respondents cite an average revenue increase of 14%. At the same time, they report an average 10% reduction in costs in areas affected by their AI projects.

Our respondents have varied expectations as to where AI will have the most beneficial impact on their companies by 2020. Some 29% say it will be in the IT function (the top answer), while just 11% say it will be in R&D – which is surprisingly low, given R&D's importance to these companies. A higher percentage (14%) cite customer service, while 11% cite marketing and sales. (See Exhibit III-14.)

25 Cyrus Sanati, "How one company is using artificial intelligence to develop a cure for cancer," Fortune, April 16, 2015, http://fortune.com/2015/04/16/cancer-cure-artificial-intelligence/, accessed March. 31, 2016.

26 Nicola Jones, "Computer science: The learning Machines," Nature, January 8, 2014, http://www.nature.com/news/computer-science-the-learning-machines-1.14481, accessed March 31, 2016.

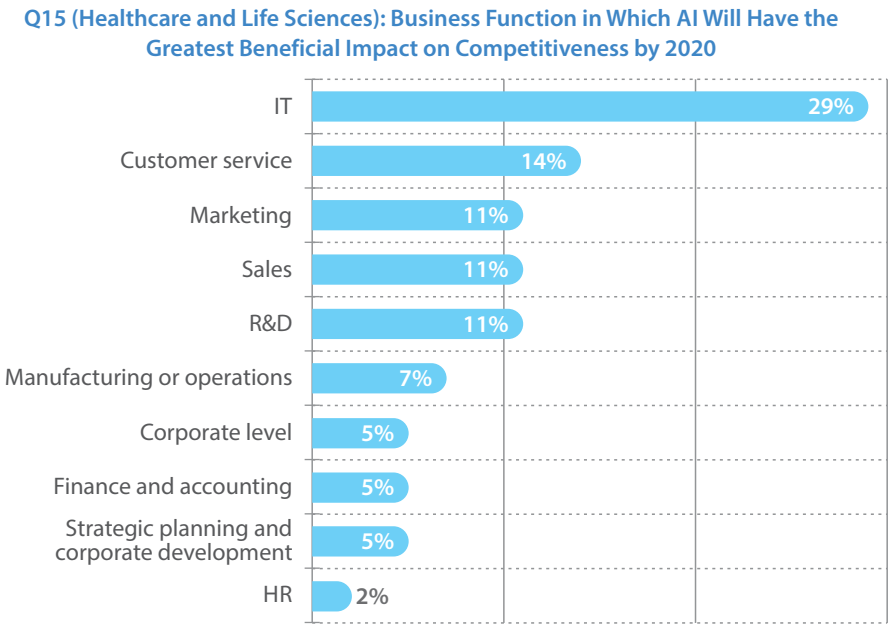


Exhibit III-14: Where Healthcare Companies Expect AI to Have the Most Impact by 2020[27]

Jobs Outlook

Healthcare respondents expected cognitive tools to have a moderate impact on employment levels at their companies in 2016, with bigger changes ahead. In 2016, they expected AI to reduce jobs by an average 11% in the functions using the technology. By 2020, they could see AI eliminating 17% jobs in the functions using the technology, and 23% by 2025.

On the other hand, respondents envisioned new jobs from AI projects, with an average of 8% more jobs in 2016 in the functions using AI, 11% more such jobs in 2020, and 13% in 2025. For the new jobs, companies will fill 58% with current employees and 42% with new hires, respondents predict.

Healthcare respondents display strong belief in the overall importance of cognitive technologies to company competitiveness, with 14% calling it highly important and 41% calling it important. Some 41% say AI is moderately important to success, while only 4% say it is slightly important or not at all important.

Keys to AI Success: Getting Employees to Trust AI

What are the keys to success with AI projects in this industry? While most industry sectors cite security as the No. 1 or 2 factor, the top answer among healthcare and life sciences companies is cultural: getting managers and employees to trust the advice that AI is giving them. (See Exhibit III-15.)

Rated second in importance was getting employees to learn and adopt new processes and systems. This focus on cultural change and process change isn't surprising given the crucial nature of some healthcare work. Doctors and nurses save lives every day, and have gained valuable experience long before the advent of AI. Trusting computers to help make better medical decisions is not easy.

Winning funding approval doesn't keep these companies up at night; perhaps the early wins on revenue and cost improvements have helped here. Addressing workplace fears about losing jobs to AI also doesn't appear to be a big concern. It was rated least important among the 10 success factors that we surveyed.

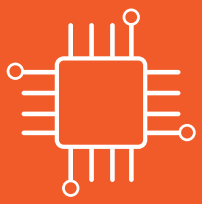
Q17 (Healthcare and Life Sciences): Key Success Factors in Capitalizing on AI

1	Getting managers and employees to trust what cognitive systems are advising them to do	4.02
2	Getting employees to learn and adopt the new processes and systems	3.96
3	Making the systems secure against hacking	3.95
4	Developing a system that continually learns, in order to make better decisions	3.91
5	Developing a system that makes good, reliable, and safe decisions	3.86
6	Changing business processes in ways that capitalize on automated decisions, actions, and so on	3.80
7	Getting top management's approval for funding	3.79
8	Deciding whether to use the technology to assist people or replace them	3.66
9	Determining where to use the technology in the company	3.64
10	Addressing people's fears about losing their jobs	3.39
Factors rated on a scale of 1-5, where 1 = not at all important; 2 = slightly important; 3 = moderately important; 4 = important; 5 = highly important		

Exhibit III-15: Key AI Success Factors

27 Since no respondent selected 'distribution and logistics', 'procurement', and 'other', these categories have been excluded from the graph.

High Tech: An Expected Big Affinity for AI



In the high tech sector, applications of AI involving robots and virtual reality games inspire the imagination. But AI tools also help these companies solve unglamorous business problems, like creating accurate sales forecasts. To that end, Microsoft uses AI to better predict its quarterly software license sales. "It turns out to be very, very accurate for that application," Joseph Sirosh, corporate VP, Data Platform, Microsoft, told one publication. "Our [CFO] is a big fan of this. She can sleep [better] knowing that a machine learning model predicted her quarter."[28]

Indeed, our survey respondents from 160 high tech companies, with average revenue of $21 billion, reveal a broad range of current applications for cognitive technologies. Among our group, 51% were hardware companies, 41% were software companies, 5% were communications equipment companies, and 3% were mobile device makers. (Regionally, 58 are in North America, 42 in Europe, 45 in Asia-Pacific, and 15 in Latin America.)

Today, 96% of these respondents' companies use cognitive technologies; of the remaining 4%, all plan to do so by 2020.

Where High Tech Companies are Using AI

Most commonly, high tech companies are using AI in the IT department (80% do so) for tasks such as detecting and deterring security threats, resolving users' tech problems, and assessing internal compliance issues. (See Exhibit III-16.) For example, Microsoft uses machine learning to anticipate network hackers. [24]

Customer service is the second most common application (cited by 35% of respondents).

Some 30% cite R&D or product development, design, and engineering. For example, in 2015, Qualcomm (a $25-billion semiconductor manufacturer based in San Diego) said it was using AI in its chips for Android smartphones to block malicious software. The company used neural networking technology that it had developed.[29]

28 Dina Bass, "Inside the New Microsoft, Where Lie Detection Is a Killer App," Bloomberg Business, February 22, 2016, http://www.bloomberg.com/news/articles/2016-02-22/inside-the-new-microsoft-where -lie-detection-is-a-killer-app, accessed March 7, 2016.

29 Stacey Higginbotham, "Qualcomm's latest smartphone chip has security AI built right in," Fortune, August 31, 2015, https://www.bloomberg.com/news/articles/2016-02-22/inside-the-new-microsoft-where-lie-detection-is-a-killer-app, accessed April 4, 2016.

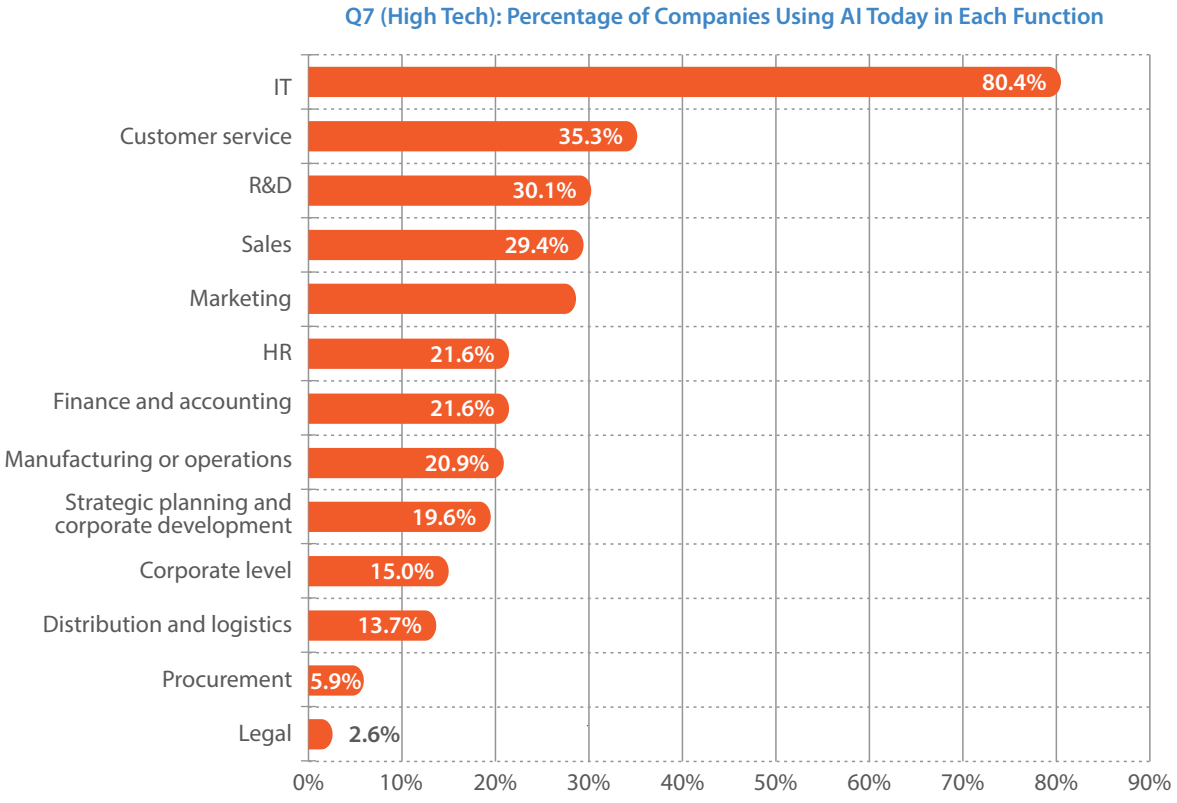


Exhibit III-16: Where High Tech Uses AI

About 29% of high tech companies use AI in their sales functions. For example, in 2013, Intel began a machine learning project to prioritize where to place sales efforts. The system uses a predictive algorithm and machine learning technologies to put 140,000 global customers into categories with similar purchasing patterns. Intel then uses those categories to determine where to focus sales initiatives and customize sales promotions. Intel expected the system to generate $20 million in additional revenue.[29]

Some 29% of high tech companies are using AI in marketing, and 22% in finance and accounting work, like the sales forecast example we mentioned earlier. About 21% are using AI in both manufacturing and HR.

High tech search and software innovator Google has a major effort in machine learning that is used by more than 600 internal teams, dubbed the Google Brain research group. The results have helped Google improve its search engine, make search results more relevant, place more relevant ads as a result of those search results, recommend videos to watch on Google's YouTube service, and more.[30]

Less frequently, high tech companies use AI for strategic planning and corporate development (20%) and corporate-level decision making (15%), for example, to gauge customer sentiment.

30 Derrick Harris, "Intel is Betting on Big Data to Add Tens of Millions to its Bottom Line," GigaOM, November 18, 2013, https://gigaom.com/2013/11/18/how-intel-is-betting-on-big-data-to-add-tens-of-millions-to-its-bottom-line/, accessed March 15, 2016.

31 Tom Simonite, "Machine Learning for Everyone," MIT Technology Review, March 28, 2016, https://www.technologyreview.com/s/600987/machine-learning-for-everyone/, accessed March 28, 2016.

Spending on AI is Strong

High tech companies spend generously to make AI projects succeed — an average $95 million per company in 2015. They expected to spend a lower $78 million on average in 2016, and a hefty $119 million in 2020, our survey respondents say. Companies planned to allocate 51% of that budget in 2016 to projects designed to improve business operations, and 49% to transformational projects. That ratio stays mostly steady through 2025.

In return for that spending, high tech companies have already reaped noticeable rewards. Our respondents report a revenue gain of 22% in 2015 (compared to 2014) in the business department in which they used AI (not the entire business). Across all of our industry segments, respondents report an average revenue increase of 17% in the area of the business that used AI.

High tech companies also realized better-than-typical cost savings related to cognitive work – an average 14% cost reduction where they used AI, vs. an average 12% cost reduction across all 13 industries.

By 2020, AI is Predicted to Have the Greatest Impact in the IT Function

Where in their businesses do high tech companies believe AI will deliver the greatest benefits by 2020? The most frequent answer is IT, cited by 51% of respondents. In contrast to the 12 other industries we surveyed, that was a high percentage. High tech companies appear to be sold on the importance of AI in protecting their computer networks and reducing the cost of IT.

No other business function received more than 8% of the votes. So, outside of IT, there's little agreement on this question. (See Exhibit III-17.)

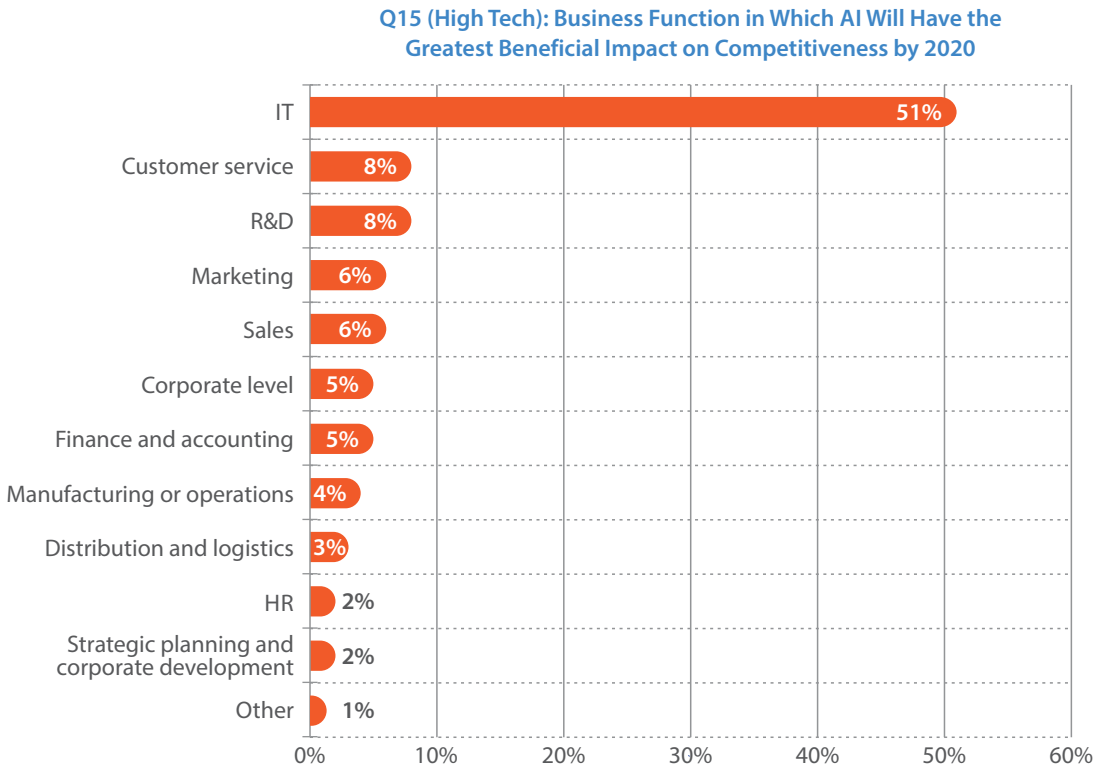


Exhibit III-17: Which Function Will Have the Strongest Impact from AI by 2020[31]

High tech companies also believe that AI will have a significant impact on employment in their firms. We asked respondents to quantify the number of jobs that AI could replace in the functions that use the technology. They expected an average 14% of jobs to be eliminated in 2016 in functions using AI and that 22% of jobs could be eliminated by 2020 in departments using the technology. That number rises to 28% by 2025.

What about new jobs created as a result of AI? Our respondents predicted AI leading to an average 13% more jobs in the functions using the technology in 2016, followed by 18% increase in 2020 and 23% by 2025. Companies will likely fill 57% of the new jobs with current employees and 43% with new hires, respondents say.

Overall, high tech respondents display strong belief in the importance of cognitive technologies to the company's competitiveness by 2020, with 27% calling AI highly important and 40% saying it will be important. About a quarter (24%) say AI will be moderately important to competitiveness. Only 9% believe AI is slightly important to competitiveness, and 1% said it was not at all important.

Success Factors for AI in High Tech

To make cognitive projects successful, these respondents rank two factors highest among keys to success: making systems secure from hacking, and developing systems that continually improve through learning. (See Exhibit III-18.) Given the importance that high tech companies attach to AI in improving the way they run IT internally, these factors are understandable.

But high tech companies also understand the need to get managers and staff to buy into AI. The third-ranking success factor was getting these employees to trust in the systems' advice.

Q17 (High Tech): Key Success Factors in Capitalizing on AI

1	Making the systems secure against hacking	4.04
2	Developing a system that continually learns, in order to make better decisions	4.01
3	Getting managers and employees to trust what cognitive systems are advising them to do	3.99
4	Developing a system that makes good, reliable, and safe decisions	3.98
5	Changing business processes in ways that capitalize on automated decisions, actions, and so on	3.87
6	Getting employees to learn and adopt the new processes and systems	3.97
8	Getting top management's approval for funding	3.83
7	Determining where to use the technology in the company	3.77
9	Deciding whether to use the technology to assist people or replace them	3.76
10	Addressing people's fears about losing their jobs	3.64
Factors rated on a scale of 1-5, where 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = highly important		

Exhibit III-18: Key AI Success Factors

31 Since no respondent selected 'procurement', this category has been excluded from the graph.

Industrial Manufacturing: AI Moves Outside the Factory

AI has already helped industrial manufacturers automate work on the factory floor and improve product quality. But there's more to come, according to our 100 survey respondents from the industrial manufacturing sector.

These companies make building materials (15%), construction equipment (13%), appliances (11%), paper products (5%), homes (4%), lawn and garden equipment (1%), and other types of industrial manufacturing gear (51%). Forty-two of the companies are based in North America, 26 are in Europe, 25 are in Asia-Pacific, and seven are in Latin America. The average revenue of all 100 companies is $15 billion.

Some industrial manufacturing companies are arriving a little late to the cognitive trend; 85% said their companies used cognitive technologies in 2016, compared to 96% of high tech companies, for example. However, the remaining 15% of industrial manufacturers plan to use AI tools by 2020.

Where Industrial Manufacturers Use AI: IT and Production Top the List

The top business functions where these companies use cognitive tools today is IT (mentioned by 71%). The second most frequently cited function using AI was manufacturing. Tied for the third place were R&D and sales. (See Exhibit III-19.)

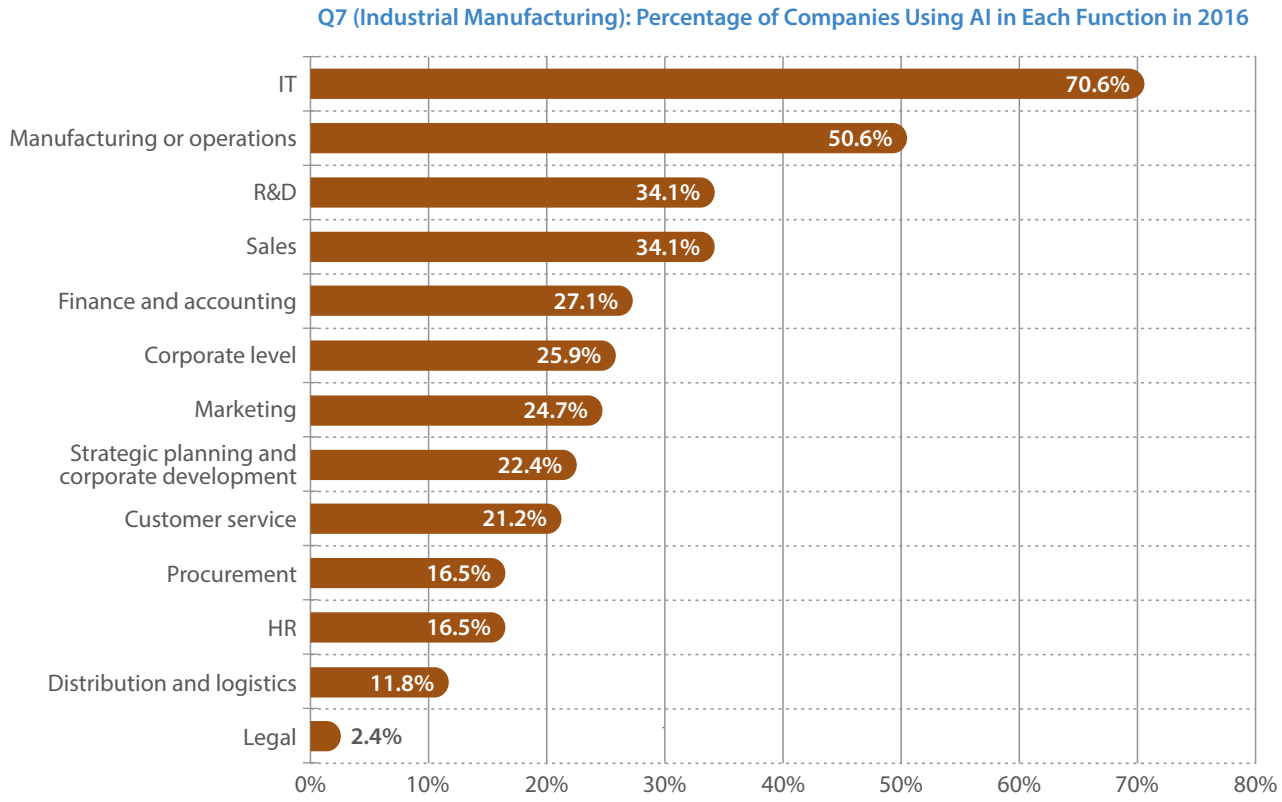


Exhibit III-19: Where Industrial Manufacturers are Using AI

So, what exactly are these companies doing with AI in the IT function? Of the companies using AI in IT, 71% are using the technology to automate production management. Some 61% are using AI to resolve users' technology problems, and another 61% are using it to detect and deter security intrusions in their computer networks.

Of all industrial manufacturers, more than half (51%) already use AI to improve manufacturing or production. What does that look like in practice? Of the group that uses AI in the manufacturing function, the most frequent applications of AI are automating labor scheduling (56%); performing load balancing manufacturing runs (56%); automating plant management (56%); finding and correcting assembly line problems (44%); and automating assembly line activities (44%).

For example, Donnelly Custom Manufacturing (a Minnesota-based maker of injection molding of thermoplastics for other manufacturers) is one of the many US manufacturers deploying robots on the factory floor. In the Minnesota plant, the robots do jobs like removing parts from a conveyor belt and stacking them, counting finished products, and packing products for shipment.[32]

Industrial manufacturers also use AI in sales (34% were doing so in 2016), and R&D, product design, product development, or product engineering (34%).

About a quarter of industrial manufacturing respondents use AI now in finance and accounting (27%), corporate-level decision-making (26%), marketing (25%), and strategic planning and corporate development (22%). Identifying payment problems and analyzing customer buying history to predict future purchases are examples of tasks the tools improve, respondents say. Some 21% use AI to improve customer service.

In October 2015, Aircraft maker Boeing and Carnegie Mellon University announced a $7.5-million research program to apply AI to improve the company's products. Boeing hopes AI will help its customers (airlines) improve their maintenance of planes. A typical 787 Dreamliner has thousands of onboard sensors, text issued by mechanics and pilots, and databases on the condition of the plane that all provide analyzable data for preventive maintenance. "The mass of data generated daily by the aerospace industry overwhelms human understanding, but recent advances in language technologies and machine learning give us every reason to expect that we can gain useful insights from that data," Jaime Carbonell, the Carnegie Mellon professor who will head the new Aerospace Data Analytics Lab, told a reporter.[33]

To a much smaller extent, industrial manufacturers use AI for HR tasks (17%), procurement (17%), and distribution and logistics (12%).

Modest Spending on AI

Currently, industrial manufacturers are not spending as much as some other sectors we studied, but bigger spending lies ahead. These respondents' companies spent an average of $50 million per firm in 2015. By comparison, across all 13 industries, the average spend was $70 million. Industrial manufacturers spent $87 million in 2015, and expected to spend $62 million in 2016.

In 2016, of that cognitive budget, 55% went to projects to improve current business practices and 45% to transformational projects. That ratio is expected to shift to 51% for improvement projects and 49% for transformational projects by 2025.

32 David Edwards, "Rethink Baxter's industrial robot 'simplifies complexity' for Donnelly," Robotics & Automation News, April 3, 2016, http://roboticsandautomationnews.com/2016/04/03/rethinks-baxter-industrial-robot-simplifies-complexity-for-donnelly/3821/, accessed April 5, 2016.

33 Dominic Basulto, "How artificial intelligence could lead to self-healing airplanes," Washington Post, October 6, 2015, https://www.washingtonpost.com/news/innovations/wp/2015/10/06/how-artificial-intelligence-could-lead-to-self-healing-airplanes/, accessed April 5, 2016.

What about revenue increases related to cognitive projects? We asked respondents to quantify revenue gains in 2015 (vs. 2014) in the AI project's business department. Industrial manufacturing respondents reported an average revenue increase of 12%. They also reported an average cost reduction of 8% in the area of the AI initiative. (It's worth noting that 21% of respondents reported a net cost increase. Up-front development costs, for example, may factor in here.)

Where AI is Expected to Have the Greatest Impact by 2020

Where in the business will AI deliver the most benefits in industrial manufacturing by 2020? On this issue, there is little unanimity. (See Exhibit III-20.)

Our respondents have varied predictions: 21% said IT; 20% said manufacturing or production operations (which seems low, given that these companies are manufacturers).

Only about one in nine (12%) said sales. R&D, marketing, and customer service were cited by no more than 10% of the sample as being the areas where AI would have the greatest impact by the end of the decade.

The message to us: industrial manufacturers know AI is important, but they don't agree about where its biggest impact will be by 2020.

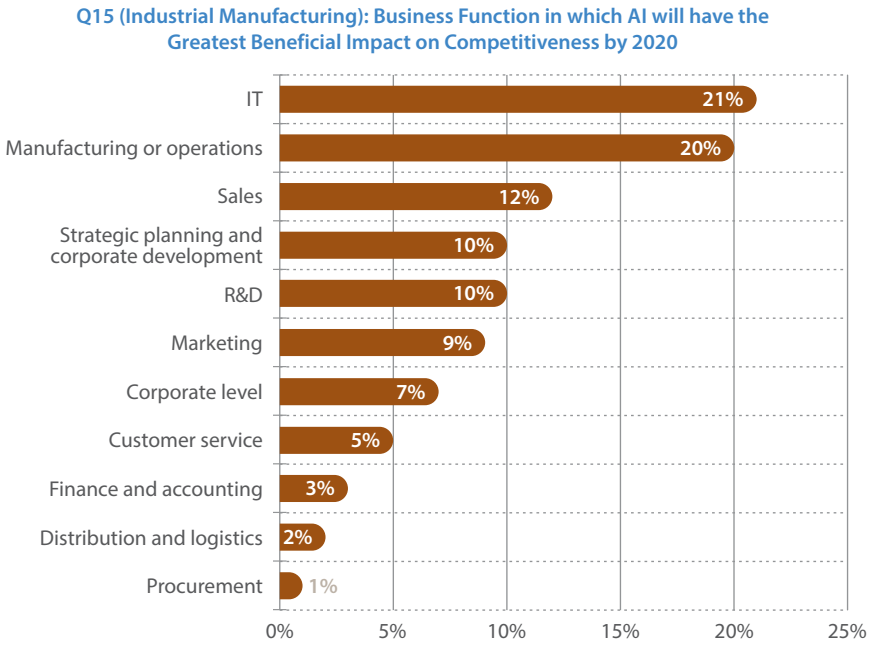


Exhibit III-20: Where Industrial Manufacturers Believe AI's Impact Will Be Greatest[34]

34 Since no respondent selected 'HR' and 'other', these categories have been excluded from the graph.

AI's Impact on Jobs and Competitiveness

US factory employment in roles such as assembly line work has been shrinking for years, and automation continues to influence that trend, according to our survey data. We asked industrial manufacturing respondents to estimate how many jobs in their functional area (not the entire company) could be eliminated due to AI. Respondents expected an average 14% cut in jobs in functions using AI in 2016. That rises to 20% by 2020 and 27% by 2025.

These companies also expect to create new jobs as a result of deploying AI. Our industrial manufacturing respondents estimated an average 10% increase in jobs in areas that used AI in 2016. They envision a gain of 13% in jobs in 2020 and 16% in 2025. With regard to the new jobs, companies believe they could fill 55% with current employees and 45% with new hires.

Industrial manufacturing respondents agree widely on the overall importance of AI technologies to company competitiveness by 2020. In this group, 24% of respondents call it highly important, and 45% say it is important. Some 24% say it's moderately important, while just 7% say slightly important. No industrial manufacturer that we surveyed believed AI was not at all important.

Key Factors in Getting Benefits from AI: Security Tops the List

Industrial manufacturing companies identify several key success factors for cognitive projects. First, making the system secure against hacking rates highest. Getting teams to adopt the technology ranks second in this sector (a bit higher than a fourth-place ranking across all industries combined). Funding is not a top concern for this group. (See Exhibit III-21.)

Q17 (Industrial Manufacturing): Key Success Factors in Capitalizing on AI

1	Making the systems secure against hacking	4.17
2	Getting employees to learn and adopt the new processes and systems	4.04
3	Developing a system that makes good, reliable, and safe decisions	3.98
4	Developing a system that continually learns, in order to make better decisions	3.97
5	Getting managers and employees to trust what cognitive systems are advising them to do	3.96
6	Determining where to use the technology in the company	3.92
7	Getting top management's approval for funding	3.90
8	Changing business processes in ways that capitalize on automated decisions, actions, and so on	3.88
9	Deciding whether to use the technology to assist people or replace them	3.79
10	Addressing people's fears about losing their jobs	3.62
Factors rated on a scale of 1-5, where 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = highly important		

Exhibit III-21: Key AI Success Factors

Insurance: AI Underwrites Better Customer Service

Insurance companies in the four regions of the world that we surveyed are high on AI. They're spending a lot on it already, and believe it has strategic importance for their customer service, IT, and other functions. In fact, they're outspending every other industry on AI today.

We surveyed 54 insurance companies. Of these, 26 companies were in North America (all but one were in the US); 19 were in Europe; eight were in Asia-Pacific, and one was in Latin America. Nearly half of the 54 (48%) were property and casualty insurers, 33% were life insurers, and 19% were health insurers. The average revenue of the insurers we surveyed was $24 billion.

AI is already delivering meaningful business benefits to the insurance industry. The majority of insurance providers—85%—currently use AI; the remaining 15% plan to do so by 2020.

Spending Plans and Business Benefits

Call it the Uber effect. Insurance company leaders have seen centuries-old industries suddenly disrupted by scrappy start-ups. And while the industry may not be considered an emerging technology early adopter, insurers are making significant investments in AI to disrupt themselves before they are disrupted.

The insurance industry is outspending all twelve other verticals we surveyed by a significant amount, having invested on average $124 million on artificial intelligence systems in 2015, compared to a cross-industry average of $70 million. Looking ahead, those numbers will remain significant, but decrease, suggesting insurance companies are on the leading edge of cognitive computing implementations. Insurance company respondents projected spending $98 million per company in 2016, and $90 million in 2020.

In 2016, 57% of that budget was expected to go to projects to improve current business operations, and 43% to transformational projects. By 2020, that transformational project slice will increase to 45%, respondents predict.

Insurance companies said they were most likely to invest in AI solutions for the IT function (59% could be doing so). However, they are applying AI in a wide range of functions, including customer service (46%), finance and accounting (33%), marketing (30%), sales (28%), strategic planning and corporate development (24%), and human resources (20%). (See Exhibit III-22.)

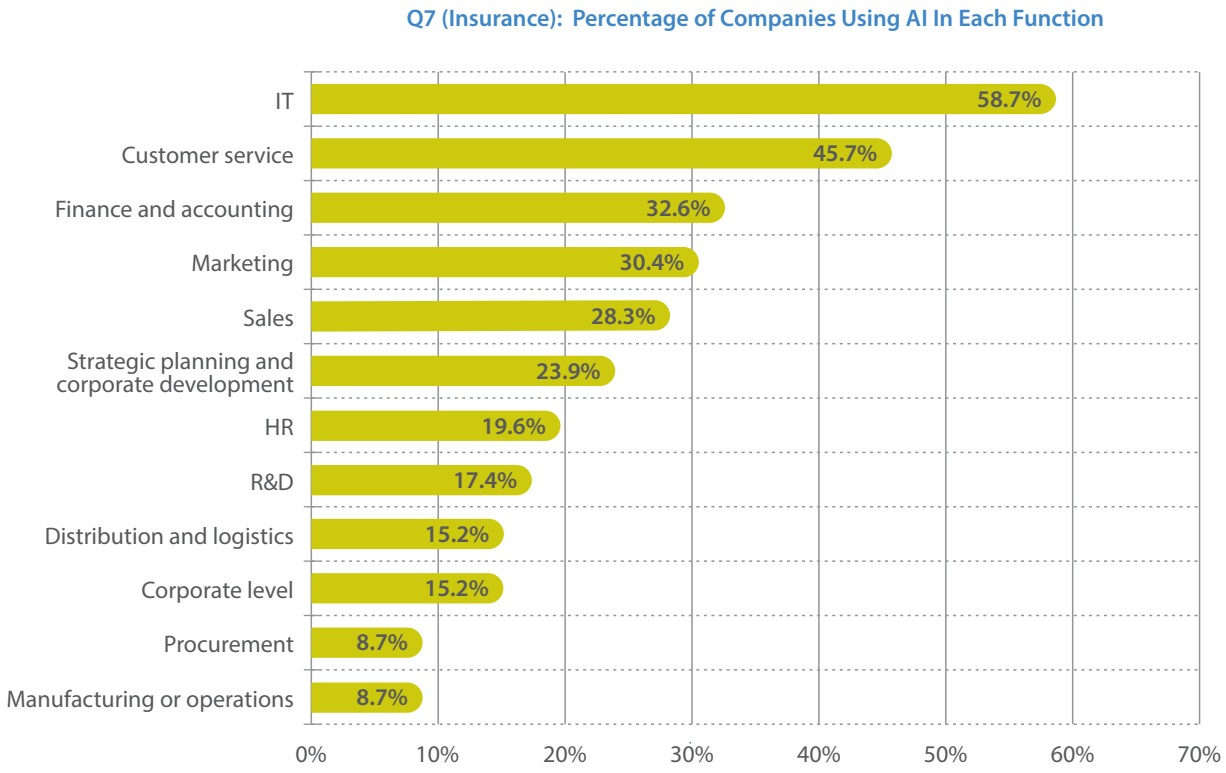


Exhibit III-22: Where Insurers are Using AI[36]

AI appears to play a big role in the strategies of some insurance companies. For example, in 2016 American International Group Inc. (AIG) announced that it was investing in an early stage start-up developing advanced analytics and wearable devices to improve employee safety. The $58 billion insurance company invested in a start-up called Human Condition Safety, which is using AI and data modeling to help employees, their managers, and worksite owners prevent injuries in some of the highest risk settings, such as manufacturing, energy, warehousing and distribution, and construction. The system correlates data from a worksite environment with historical data on workplace incidents and determines how best to prevent injuries *before* they happen.[37] Workplace accidents kill one person and injure 153 others every 15 seconds.[38] Instead of simply providing benefits to clients after these tragedies occur, AIG is looking to cognitive technology to reduce those risks.

While it's early days for these initiatives, cognitive computing efforts increased revenues within the department related to the project (not the whole company) by an average of 15% in 2015 vs. 2014. At the same time, insurance respondents report an average cost savings of 14% in the relevant business area. (However, 15% of respondents report a net cost increase from 2014 to 2015; upfront technology costs may play a role here.)

36 Since no respondent selected 'legal', this category has been excluded from the graph

37 AIG press release, "AIG Makes Strategic Investment in Human Condition Safety, a Workplace Wearables Startup," Jan. 6, 2016, http://www.businesswire.com/news/home/20160106005861/en/AIG-Strategic-Investment-Human-Condition-Safety-Workplace, accessed October 3, 2016.

38 AIG + Human Condition Safety Brochure, https://www-160.aig.com/content/dam/aig-mktg/america-canada/us/documents/landing-pages/disruptive-tech/aig-and-human-condition-safety-brochure.pdf, accessed October 8, 2016.

Jobs and Competitiveness

Insurance company respondents do not predict a huge net job loss as the result of the ongoing expansion of cognitive computing systems in the coming years. The insurance company managers surveyed felt AI could automate an average 10% of the jobs in their own departments in 2016. Looking further ahead, they anticipate that an average 14% of jobs on average could be cut in 2020 in functions using AI, and 18% of jobs could be automated in 2025 through AI in functions that use the technology.

However, that projected job loss looks to be mitigated by some of the new roles these AI-related systems will create. Insurance industry respondents predicted that AI could result in an average jobs increase of 8% in functions using the technology in 2016, and additional 10% more jobs in those functions in 2020, and 15% more by 2025. Respondents predicted that the majority of these new jobs (57%) will be filled in-house by existing employees, while 43% will go to new hires.

Not surprisingly, given their early embrace of cognitive computing, 59% of insurance industry respondents say that the technology is highly important or important to company competitiveness—with 22% indicting that AI is highly important. Just under one third (32%) said the adoption of AI was moderately important to competitiveness, while 7% said it was only slightly important, and just 2% said it wasn't important at all.

Where AI Will Have the Greatest Impact by 2020

So, where will AI have the greatest impact on insurance companies and their competitiveness by the end of the decade? Asked to choose one function, our insurance company respondents' answers were fragmented. The greatest percentage – 28% – chose customer service. Next was the IT function. The third most frequently cited function was sales, at 17%.

No other function was chosen by more than 7% of our sample. (See Exhibit III-23.)

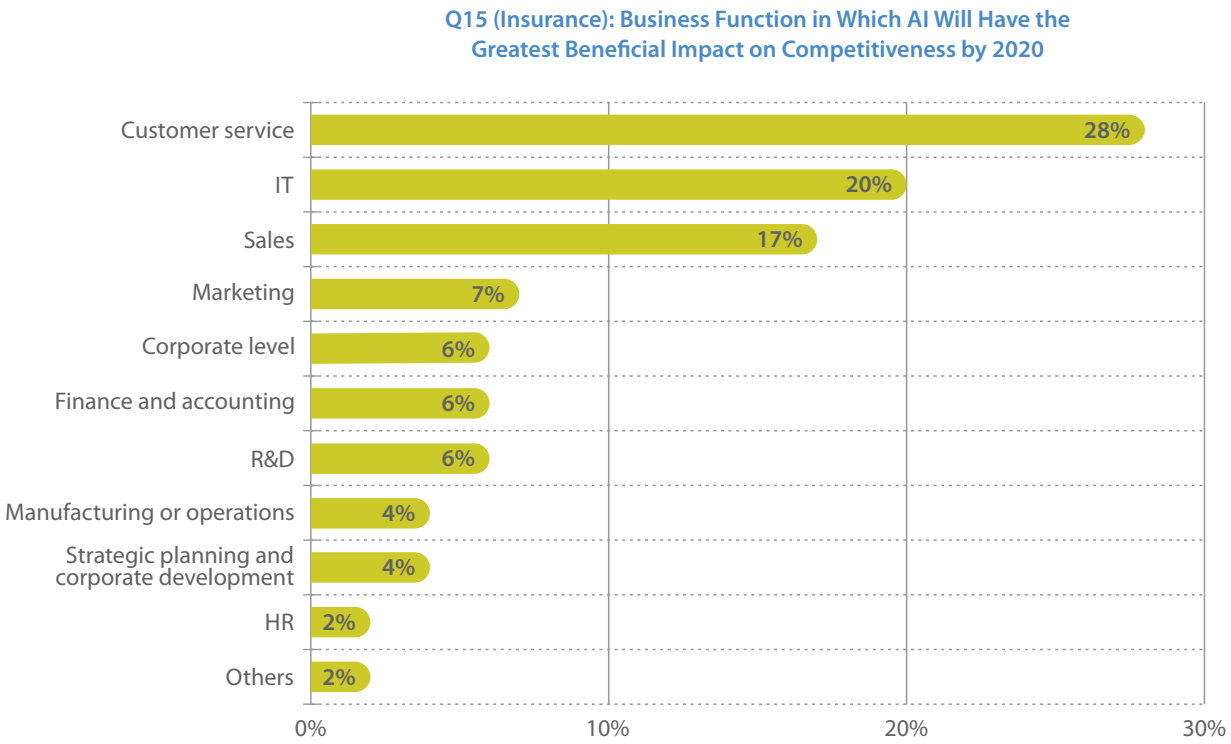


Exhibit III-23: Where AI is Predicted to Have the Greatest Impact by 2020[39]

39 Since no respondent selected 'distribution and logistics', 'legal', and 'procurement', these categories have been excluded from the graph.

Key AI Success Factors

What leads to success for AI projects at insurance companies? Convincing corporate leaders to invest in these systems is not a worrisome issue, respondents say. Rather, the keys to success in this risk-aware industry center around security. (See Exhibit III-24.)

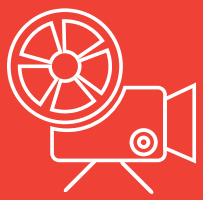
The leading success factors cited by insurance respondents: developing a system that makes good, reliable, and safe decisions, and securing the systems against hacking. Also high on the list are developing a system that continually learns in order to make better decisions, and getting managers and employees to trust advice from cognitive systems. Insurance companies also stress the need to change business processes in ways that capitalize on automated decisions and actions.

Q17 (Insurance): Key Success Factors in Capitalizing on AI

1	Developing a system that makes good, reliable, and safe decisions	4.07
2	Making the systems secure against hacking	4.02
3 (tied)	Developing a system that continually learns, in order to make better decisions	3.96
	Getting managers and employees to trust what our cognitive systems are advising them to do	3.96
5	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	3.94
6	Getting employees to learn and adopt the new processes and systems	3.93
7	Determining where to use the technology in our company	3.87
8	Addressing people's fears about losing their jobs	3.63
9	Getting top management's approval for funding	3.61
10	Deciding whether to use the technology to assist people or replace them	3.57
Factors rated on a scale of 1-5, 1 = not at all important; 2 = slightly important ; 3 = moderately important, 4 = important; 5 = highly important		

Exhibit III-24: Key AI Success Factors

Media, Entertainment, and Information Services: AI Provides New Tools and New Rules



Can artificial intelligence programs empower computers to write newspaper stories? For some media companies, AI has taken on such a supposedly human — or even superhuman — role.

Consider the venerable Associated Press (AP), a global news service that was launched in the 1800s. In 2014, the $600-million not-for-profit organization (which supplies content to global media companies like newspapers) began using AI to write corporate earnings stories on public companies. Given that there are more than 4,000 public companies in the US, AP's staff couldn't possibly write earnings reports on all of those companies every three months. In fact, they only covered the earnings announcements of about 300 companies. But by January 2015, AP produced more than 3,700 corporate earnings stories per quarter, largely because AI is doing the writing. AI helps the company do work that it couldn't afford to do in the past, when that work required exponentially more people. In 2015, AP applied the technology to collegiate sports stories.[40]

That's just one example of how the rules of the media, entertainment, and information services businesses are changing in the age of AI. Our survey respondents in this industry hail from 28 companies, with an average revenue of $10 billion. Some 18% of them are publishing companies (newspapers, books, magazines). Some 14% are internet media, with another 14% being broadcasters. Eighteen percent are information service providers, 7% are sports companies, and 29% are related businesses. Some 54% are based in North America, 25% in Europe, 18% in Asia-Pacific, and 4% in Latin America.

Among this group, 89% say their companies currently use cognitive technology; the remaining 11% plan to do so by 2020.

Where Companies are Using AI Today

The business function where the technology gets used most frequently: IT, mentioned by 72%. The second most often mentioned functions that are using AI today are marketing, finance and accounting, and strategic planning and corporate development (all used by 36%, respectively). On the sales front, 32% of these companies are using AI. (See Exhibit III-25.)

40 Based on articles by and about the Associated Press. All articles accessed on October 23, 2016. https://blog.ap.org/announcements/a-leap-forward-in-quarterly-earnings-stories, http://www.ap.org/Content/Press-Release/2015/AP-NCAA-to-grow-college-sports-coverage-with-automated-game-stories

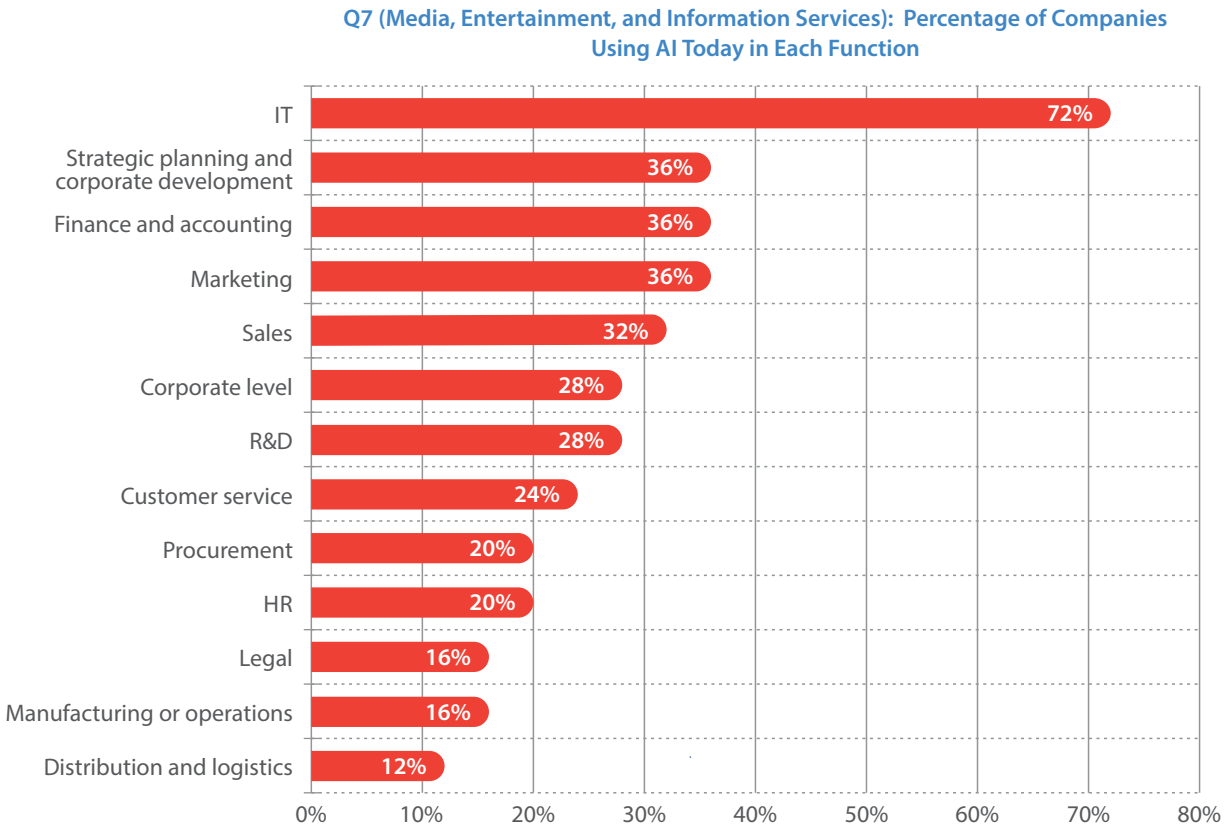


Exhibit III-25: Where the Industry is Using AI Today

At online music company Spotify (serving 30 million paid subscribers as of March 2016[41]), AI fuels recommendations for music listeners. The Swedish company says it's using deep learning technology to determine what acoustic elements of songs make them interesting to listeners.[42]

Only 16% of media respondents use AI in the 'production' function (the process of creating media content). AP is among them, as noted in our earlier example.

Netflix, the online movie giant with more than 75 million members in more than 190 countries, is using computer vision technology to figure out how to capture movie images for smaller screens such as mobile devices. In a company blog post, the firm describes how it's using algorithms to determine which part of a movie image to focus on for smaller viewing formats, where to put text, and so on.[43]

41 Micah Singleton, "Spotify hits 30 million subscribers," The Verge, March 21, 2016, http://www.theverge.com/2016/3/21/11220398/spotify-hits-30-million-subscribers, accessed October 5, 2016.

42 Sage Lazzaro, "Spotify's Head of Deep Learning Reveals How AI Is Changing the Music Industry," New York Observer, May 4, 2015, http://observer.com/2015/05/spotifys-head-of-deep-learning-reveals-how-ai-is-changing-the-music-industry/, accessed October 5, 2016.

43 "Performance Without Compromise," Netflix Tech Blog, March 23, 2016, http://techblog.netflix.com/2016/03/performance-without-compromise.html, accessed September 28, 2016.

Cautious Spending

These companies haven't put big financial bets on AI projects yet, spending an average of $12 million in 2015 – one of the lowest amounts across all 13 industries surveyed, where $70 million was the average. However, they expected to spend $22 million in 2016 and to double that number to $47 million in 2020.

In 2016, they planned to dedicate 56% of that spend to projects to improve current business operations and 44% to transformational projects. By 2025, that ratio will shift to 49% on improvement projects and 51% to transformational projects, respondents say.

We also asked media respondents to quantify revenue gains in 2015 (vs. 2014) in the area of the business that used AI. Companies realized an average revenue increase of 11% in that area of the business, respondents say. At the same time, respondents report an average cost reduction of 10% in those areas as a result of using AI. (Not everyone is succeeding here; 14% of respondents reported a net cost increase.)

Where AI's Impact is Predicted to be Greatest

Where will AI have the biggest beneficial impact in this industry by 2020? We saw little agreement on this question. In the top two answers, 32% of respondents cite IT and 14% say sales (see Exhibit III-26.)

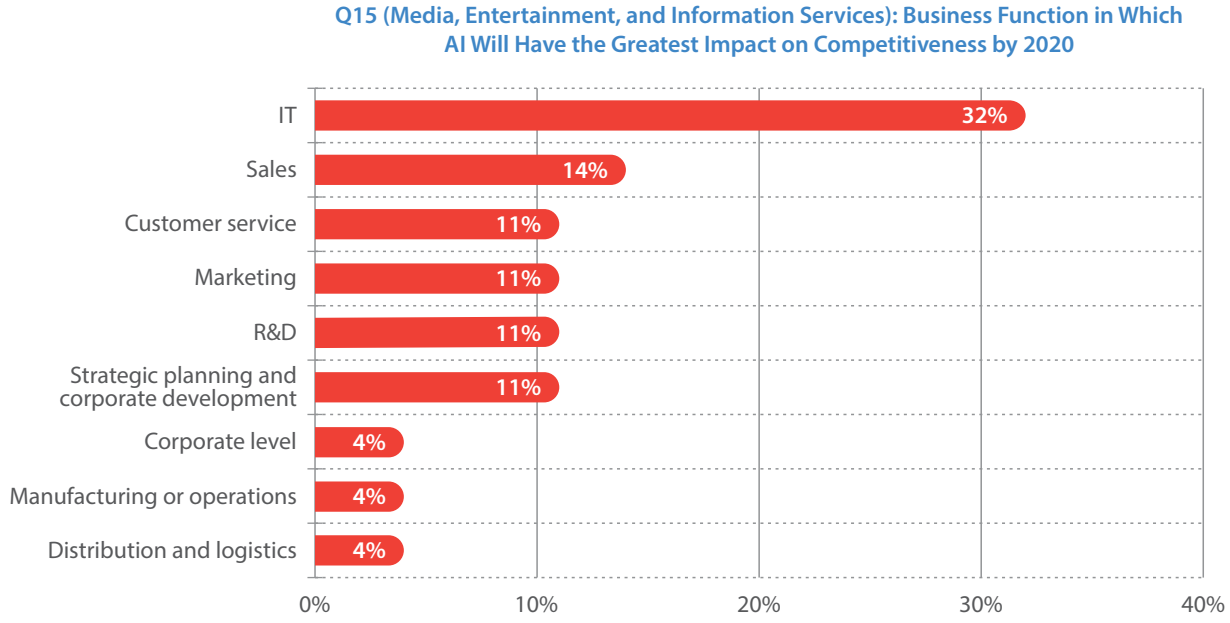


Exhibit III-26: Where AI is Predicted to Have the Greatest Impact by 2020[44]

44 Since no respondent selected 'finance and accounting', 'HR', 'legal', and 'procurement', these categories have been excluded from the graph.

Staffing Shifts

As with most industries we surveyed, media respondents envisioned significant possible jobs cuts due to cognitive tools in the years ahead. Our respondents expected 10% of jobs to be cut in the functional area where they work (not the whole company) due to AI tools in 2016. That figure rises to 17% of jobs in their departments by 2020, and 22% by 2025, respondents say.

As to new jobs created related to AI, our respondents expected 7% of department jobs to be added in 2016. That rises to 12% by 2020 and 16% by 2025. Companies will likely evenly split the new jobs between current employees and new hires, respondents say.

Media, entertainment, and information services companies haven't fully recognized AI's potential yet. Consider how they rated the overall importance of cognitive technology to their company's competitiveness by 2020. Just 14% say it's highly important, while 36% say important. Half say AI is either moderately important (36%) or slightly important to company success by 2020. None say AI is not at all important to their success.

Key Success Factors with AI

What will separate successful cognitive projects from unsuccessful ones in media companies? Our respondents cite two top success factors: developing systems that make good, reliable and safe decisions, and developing systems that continuously learn (see Exhibit III-27). These priorities fit with the type of work that AP, Netflix, and Spotify are doing with AI.

Q17 (Media, Entertainment, and Information Services): Key Success Factors in Capitalizing on AI		
1	Developing a system that makes good, reliable, and safe decisions	4.11
2	Developing a system that continually learns, in order to make better decisions	4.07
3 (tied)	Making the systems secure against hacking	4.04
	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	4.04
5	Determining where to use the technology in our company	4.00
6	Getting top management's approval for funding	3.96
7	Getting managers and employees to trust what our cognitive systems are advising them to do	3.93
8	Addressing people's fears about losing their jobs	3.89
9	Getting employees to learn and adopt the new processes and systems	3.82
10	Deciding whether to use the technology to assist people or replace them	3.61
Factors rated on a scale of 1-5, 1 = not at all important; 2 = slightly important; 3 = moderately important, 4 = important; 5 = highly important		

Exhibit III-27: Keys to Capitalizing on AI

Retail: Stocking Up on AI

Amazon's venture into drones – its PrimeAir service – shows the future of AI in retailing is not too far away.[45]

The initiative is emblematic of the retail industry's full embrace of AI technology. Among our survey's retail company respondents, 91% now use cognitive technology, with the rest planning to deploy it by 2020. Survey data includes responses from 58 retailers (25 in North America, 15 in Europe, 13 in Asia-Pacific, and five in Latin America), with an average revenue of $19 billion.

The survey respondents represent a range of retail sub-industries: apparel (10), department store chains (9), mass merchandisers (7), computer and electronics chains (5), grocery (4), and internet retailers (4). Another three were home furnishings chains, and three others were office supplies chains. In addition, 13 other retailers took our survey.

Where Retailers are Using AI Today

Retailers identified IT as the business function where they most frequently use cognitive tools, with 55% of companies saying they do so. (See Exhibit III-28.) Within the IT function, the most common applications of AI are to detect and deter security intrusions (71% of retailers using cognitive technology in the IT function do this); to resolve users' tech issues (63%); to automate production management work (63%); to do run-book automation (63%); and to gauge internal compliance in using approved technology suppliers (63%).

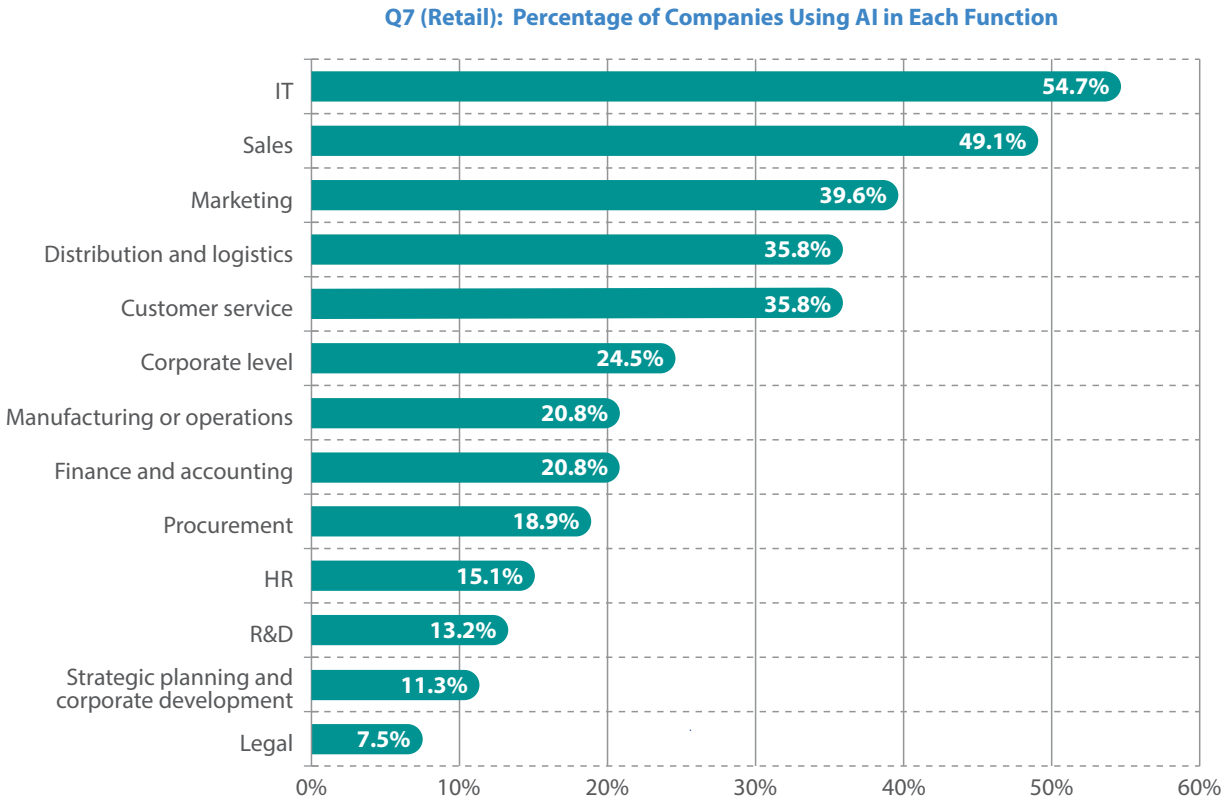


Exhibit III-28: Where Retailers Use AI

45 Amazon PrimeAir service information, www.amazon.com/primeair, accessed September 16, 2016.

After IT, the sales function is the second most active business function among retailers' current AI initiatives, with a 49% participation rate. That is followed by marketing (40% of retailers say they're using AI here), and customer service and logistics (36% for each function).

In using AI in marketing, apparel retailer The North Face personalizes the online shopping experience using artificial intelligence to help consumers find the right jacket. The system asks consumers questions about when and where they will wear a jacket and then offers options based on weather, activity level, and other factors.[46]

A look at two recent developments show how retailers are integrating cognitive capabilities into their services and products. Staples Inc., the $21-billion (revenue) office supplies retailer, came to market in March 2016 with Staples Easy System, an application that business customers can use from their mobile device or Wi-Fi-enabled red-button device to order merchandise through voice commands. The natural language processing application confirms the order by voicing it back to the customer. The system incorporates analytics so that it can recommend quantities and brands based on a customer's purchase history.[47] For example, if the customer says 'green tea,' the system knows from that customer's prior purchasing history the brand and type the customer wants.[48]

Amazon's Echo, released in late 2014, is a $180 device that executes tasks upon voice command – ordering a cab, groceries, music, or other items. It speaks back to users in a voice known as Alexa. The device offers voice recognition capabilities described as "more intuitive than those of many other vocal assistants" including Apple's Siri and Google Now, according to a *New York Times* columnist.[49] As of March 2016, Echo offered more than 300 capabilities, including operating the lights, thermostats, and other connected devices in a home. Amazon hasn't revealed sales numbers, but industry watchers predict it could be the firm's next billion-dollar offering.

The drive to enhance experiences applies to physical stores as well. Walgreens, the pharmacy and retail chain, has experimented with augmented reality screens attached to shopping carts, to guide consumers through a store and pinpoint items on sale based on their shopping histories. The spatially-aware applications supporting this feature connect to back-end inventory systems, supported by Google's Tango and Aisle411, a shopping location application maker.[50]

In the corporate decision-making realm, one quarter of retailers are using AI to support CEOs, COOs, and business unit general managers. Among this group, the most common applications of the technology are to determine broad economic trends (69%); to gauge customer sentiment (also 69%); and to look at historical sales transaction data to better understand why customers buy from them (62% do this). Additional functions where retailers have implemented AI include: finance and accounting (21%), operations (21%), procurement (19%), human resources (15%), product development (13%), strategic planning and corporate development (11%), and legal (8%).

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46 Sharon Gaudin, "A.I. and virtual reality may propel future of retail," Computerworld, February 4, 2016, http://www.computerworld.com/article/3029626/retail-it/ai-and-virtual-reality-may-propel-future-of-retail.html, accessed October 8, 2016.

47 Staples press release, "Staples Rebrands B-to-B Division; Launches "Staples Easy System" to Deliver More Value to Businesses", March 15, 2016, http://www.businesswire.com/news/home/20160315005489/en/Staples-Rebrands-B-to-B-Division-Launches-%E2%80%9CStaples-Easy, accessed March 16, 2016.

48 Kim Nash, "Natural Language Processing, Machine Learning Power Staples Ordering System," Wall Street Journal, March 16, 2016, http://blogs.wsj.com/cio/2016/03/16/natural-language-processing-machine-learning-powers-staples-ordering-system/, accessed September 20, 2016.

49 Farhad Manjoo, "The Echo from Amazon Brims with Groundbreaking Promise," New York Times, March 9, 2016, http://www.nytimes.com/2016/03/10/technology/the-echo-from-amazon-brims-with-groundbreaking-promise.html, accessed April 8, 2016.

50 Michael S. Goldberg, "Location-based apps' next frontier: Indoors," Computerworld, April 13, 2015, http://www.computerworld.com/article/2907173/location-based-apps-next-frontier-indoors.html?upd=1460143460357, accessed October 8, 2016.

While the vast majority of retailers are buying into AI, as a group, they are investing less than other industries. In 2015, retailers said they spent an average of $57 million per company, about 19% less than the average per-company investment across the 13 industries we studied. (However, two of our retail respondents reported spending $750 million or more on cognitive technology in 2015.)

In 2016, retailers expected to spend even less on these technologies — an average of $45 million per company — despite the National Retail Federation's optimistic forecast that 2016 retail industry sales would grow 3.1% in the US.[51] (part of the largest portion of our survey pool). Looking ahead, retailers said they expect to spend, on average, $70 million per company on AI in 2020. Three retailers each project spending $500 million or more on AI in 2020.

Retail firms expected to allocate 54% of their AI budgets in 2016 on projects meant to improve current business operations, and 46% on transformational projects. The ratio holds fairly through 2025, respondents say.

Is AI Paying Off?

When asked to quantify the benefits they have achieved, retailers in the survey cite an average 19% revenue increase in the business area where they implemented AI in 2015, compared to 2014. They also report an average cost reduction of 15% related to their AI work (although 9% of retailers reported having a net cost increase).

Looking forward, where in the business will AI have the most beneficial impact by 2020? Nearly a third of retailers (31%) say it will be in their sales function: the top answer, followed by IT (29%) and marketing (14%). (See Exhibit III-29.)

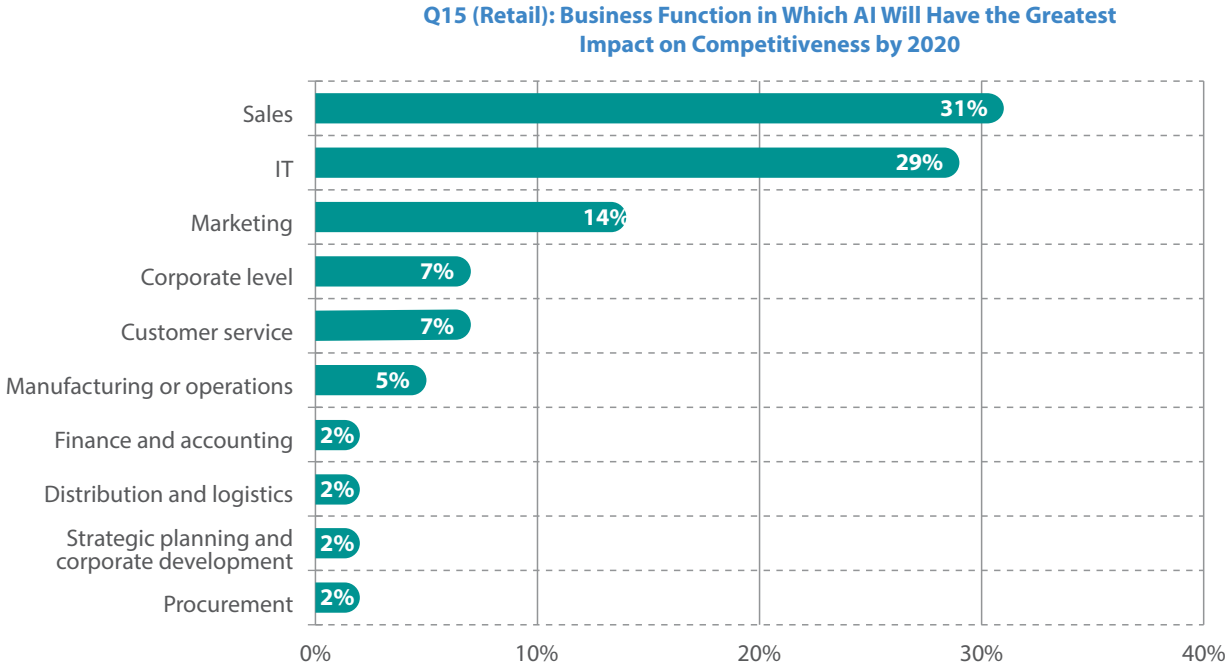

Exhibit III-29: Where AI is Predicted to Have the Most Impact by 2020[52]

51 National Retail Federation, "NRF Forecasts Retail Sales to Grow 3.1 Percent in 2016," February 10, 2016, https://nrf.com/news/nrf-forecasts-retail-sales-grow-31-percent-2016, accessed October 8, 2016.

52 Since no respondent selected 'legal', 'R&D', and 'HR', these categories have been excluded from the graph.

The Jobs Impact of AI in Retail

As in other industries, retail companies expect the automation enabled by AI will influence how their companies choose to fill jobs. Cognitive technology can free people to do new and different tasks.

The projects will also create some new jobs. In the retail industry, our respondents predicted an average 17% of jobs in their departments (not the whole company) could be eliminated in 2016 through AI. They envision additional job reductions of 22% by 2020 and 27% by 2025 as possible. On the flip side, respondents also predicted new job creation in their departments: 11% more in 2016 in areas using AI, followed by rises of 16% by 2020, and 20% by 2025. They expect most (54%) of these new jobs to be filled by current employees, with the rest coming from new hires.

A clear majority of retailers – 60% – see cognitive technologies as important or 'highly important' to their firms' competitiveness by the year 2020. Twenty-eight percent of respondents identify cognitive systems as 'moderately important' in terms of competitiveness, while only 12% describe these technologies as 'slightly important.' None said they are 'not at all important.'

Getting Value from AI: Key Success Factors

We asked retailers to rate their key success factors in harnessing the potential of AI. The most important factor they identified is building systems that continually learn on their own. Developing secure systems – those that are not easy to hack – ranked second. System adoption – getting managers and employees to use cognitive systems and to follow the advice – ranked as the third most important success factor. (See Exhibit III-30.)

Q17 (Retail): Key Success Factors in Capitalizing on AI		
1	Developing a system that continually learns, in order to make better decisions	4.22
2	Making the systems secure against hacking	4.17
3	Getting managers and employees to trust what our cognitive systems are advising them to do	4.12
4	Getting employees to learn and adopt the new processes and systems	4.10
5	Developing a system that makes good, reliable, and safe decisions	4.07
6	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	4.05
7	Getting top management's approval for funding	3.91
8	Deciding whether to use the technology to assist people or replace them	3.86
9	Determining where to use the technology in our company	3.84
10	Addressing people's fears about losing their jobs	3.71
Factors rated on a scale of 1-5, 1 = not at all important; 2 = slightly important ; 3 = moderately important, 4 = important; 5 = highly important		

Exhibit III-30: Key AI Success Factors for Retailers

Telecommunications: Dialing into the Power of AI

In December 2015, Japanese telco NTT Communications announced that it was developing a service based on artificial intelligence to 'talk' to customers in English and Japanese and accelerate phone-based customer service.[53] The service, which the bank began testing in February 2016, would respond to requests and execute customers' instructions, in order to issue invoices, mail documents, and send emails.

NTT and other telecommunications companies hope to improve customer service and more with AI tools. Our 59 survey respondents in the telecommunications industry include mobile service providers (61%), landline service providers (17%), and other related companies (22%). Regionally, 39% are in North America; 29% in Europe; 22% in Asia-Pacific; and 10% in Latin America. The average company revenue is $23 billion.

Among these respondents, 93% of companies currently use AI; the remaining 7% plan to do so by 2020.

By far, the largest use for the technology is in IT (where 69% of respondents use cognitive tools). In practice, that includes IT tasks such as resolving internal users' tech problems (64% of those using AI in IT are using it for this purpose); detecting and deterring security intrusions (61%); ensuring that all vendors are from approved vendor lists (50%); and automating IT production management work (46%).

Telecom companies also commonly use cognitive tools for customer service (44%), sales (26%), and marketing work (26%). To a lesser extent, these companies use cognitive tools for corporate-level decision-making (16%). (See Exhibit III-31.)

53 Linda Hardesty, "Artificial Intelligence Handles Phone Calls for NTT," SDX Central, Dec. 3, 2015, https://www.sdxcentral.com/articles/news/artificial-intelligence-handles-phone-calls-for-ntt/2015/12/, accessed Oct. 7, 2016.

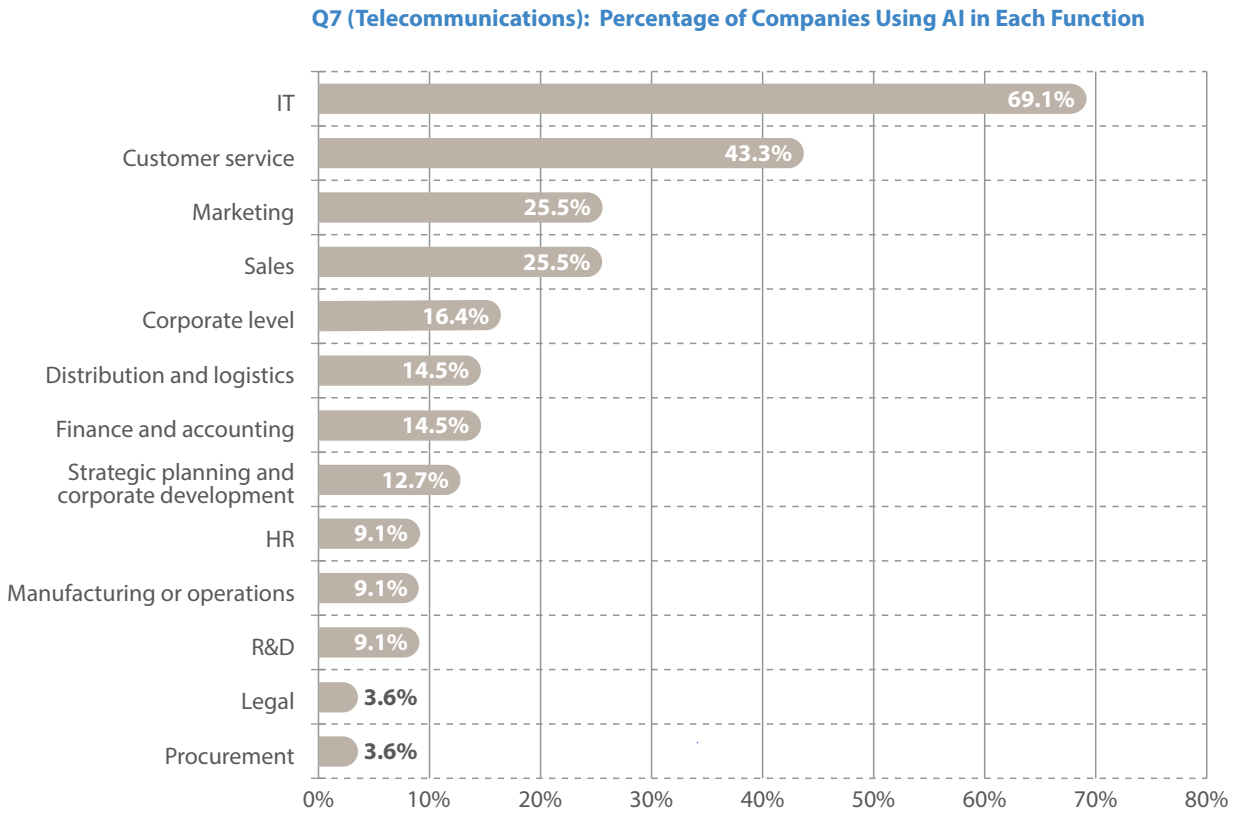

Exhibit III-31: Where Telcos Use AI

As one example of how a large telecommunications company is using AI in marketing and customer service, consider Spain's $54 billion telco, Telefónica. In February 2016, the company unveiled a new service that uses AI to zero in on the location of people in indoor settings such arenas, hospitals, convention centers, and other buildings.[54] Current GPS systems locate people (with digital devices) outdoors. The new Telefónica system, however, brings this capability indoors for smartphone users, utilizing the smartphone's sensors, Bluetooth, and other technologies. After sending these readings through a 4G network to a Telefónica cloud computing center, the system uses AI algorithms to choose the appropriate data to identify a person's indoor location.

Telefónica says the system will be especially helpful for large hospitals (for example, to help a patient find the place he needs to go), retail stores, and transportation centers (train stations, airports, and others). The company also says the system could help advertisers with geo-targeted advertisements – ads that are relevant to the smartphone user and his location (for example, a billboard message or advertising screen on a TV).

54 Telefónica press release, "Telefónica multi-sensory geolocation solution will provide users with the best indoor location," Feb. 24, 2016, https://www.telefonica.com/es/web/press-office/-/telefonica-multi-sensory-geolocation-solution-will-provide-users-with-the-best-indoor-location, accessed October 7, 2016.

Big Spending, Big Impacts

In 2015, our telecom survey respondents' companies spent an average of $90 million on AI projects – substantially more than the average of $70 million across all 13 industries surveyed. Three telecom companies spent at least $500 million each on AI in 2015.

Average annual spending on AI will rise to $95 million per telecom company in 2016, respondents predicted, and will increase nearly 40% to $131 million in 2020. During this time, five respondents project that their companies will spend at least $500 million each on the technology.

In 2016, companies expected to allocate 52% of that spending to projects to improve current business practices, and 48% to transformational projects, respondents say. That ratio stays fairly steady through 2025.

What will the companies reap in return? Plenty, respondents predict. We asked respondents to quantify revenue increases generated in 2015 (vs. 2014) in the business area related to the cognitive project (not the whole business). On average, these companies achieved a revenue increase of 25% — the highest of any of the 13 industries surveyed.

At the same time, the companies realized an average cost reduction of 19% in the area of their AI projects — the biggest savings among the industries surveyed.

What parts of the business will reap the most benefits from cognitive technology by 2020? Telecom respondents agree strongly here, saying IT (42%). That's followed by sales (14%), customer service (12%), and marketing (10%) (See Exhibit III-32.)

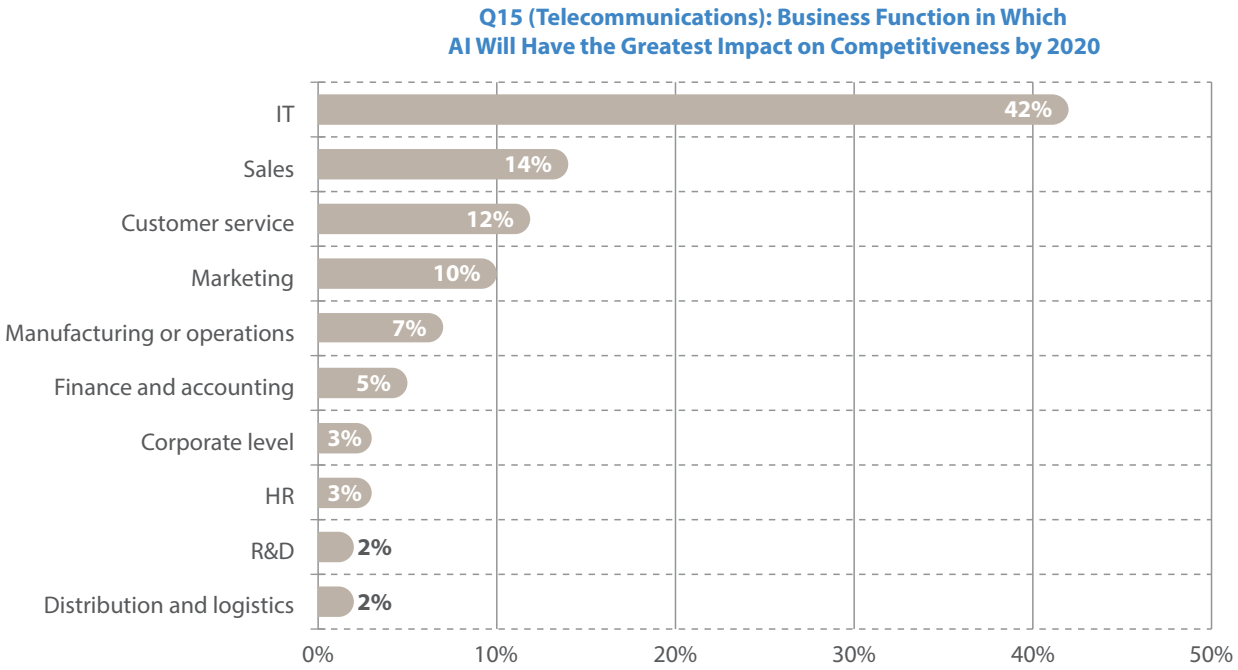

Exhibit III-32: Functions Where AI is Expected to Have the Greatest Impact in Telcos by 2020[55]

55 Since no respondent selected 'strategic planning and corporate development', 'legal', and 'procurement', these categories have been excluded from the graph.

Jobs Outlook: Changes Ahead

How will staffing change as a result of cognitive projects in these companies? We asked respondents to estimate the number of jobs in their functional department that could be eliminated if their function adopted AI technology. Telecom respondents expected cuts of 20% of jobs in their functions in 2016 — one of the highest responses across all 13 industries. They predict that 23% of jobs could be cut in 2020 and 30% by 2025, in the areas in which they used AI — also among the highest estimates across industries.

However, as to new jobs created related to cognitive projects (which undoubtedly will require some specialized developer skills, for example), these respondents expected 18% of jobs in their department to be added in 2016 as a result of adopting AI. Similarly, they predict a 20% addition of jobs in 2020 and 25% in 2025. Companies will fill 54% of these new jobs with current employees and 46% with new hires, respondents predict.

Telecom respondents agree broadly on the importance of AI to company competitiveness by 2020: 29% say it's 'highly important' and 44% say it's 'important' – adding up to strong support from 73% of respondents. Some 24% say 'moderately important'; 3% say 'slightly important'; and none say 'not at all important'.

Key AI Success Factors

For cognitive projects, success starts with security, telecom respondents say (a common response across many industries). The top two factors cited: Making systems secure against hacking and developing a system that makes reliable and safe decisions. Getting teams to trust advice from the systems ranked as the number three key to success (See Exhibit III-33.)

Telecom respondents appear to have some early insight into success factors, given the impressive revenue gains and cost savings they've already achieved with cognitive projects.

Q17 (Telecommunications): Key Success Factors in Capitalizing on AI

1 (tied)	Making the systems secure against hacking	4.05
	Developing a system that makes good, reliable, and safe decisions	4.05
3	Getting managers and employees to trust what our cognitive systems are advising them to do	4.03
4	Developing systems that continually learn and make better decisions	4.02
5	Determining where to use the technology in our company	3.98
6	Getting employees to learn and adopt the new processes and systems	3.93
7	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	3.90
8	Getting top management's approval for funding	3.88
9	Addressing people's fears about losing their jobs	3.78
10	Deciding whether to use the technology to assist people or replace them	3.76
Factors rated on a scale of 1-5, 1 = not at all important; 2 = slightly important; 3 = moderately important, 4 = important; 5 = highly important		

Exhibit III-33: Key AI Success Factors

Travel, Transportation, and Hospitality: Our Robots Are Increasingly at Your Service

At the YOTEL in New York City, guests do not hand luggage to be stored for the day to a bellman, but rather they hand them over to the Yobot. This robot uses a large 'arm' to store and retrieve luggage for guests, using a system of bins behind a glass wall.[56]

AI projects like this could change the face of customer service at travel, transportation, and hospitality companies, say our respondents from 33 companies in this industry. These companies include hotels, hospitality companies, and resorts, 39%; shipping, railroads, and other non-airline transportation, 36%; airlines, 9%; travel agencies 6%; and other related firms, 9%.

Regionally, 30% of the companies are in North America; 36% in Europe; 21% in Asia-Pacific; and 12% in Latin America. Average revenue per company is $12 billion.

Most travel, transportation, and hospitality companies — 85% of our survey participants — currently use cognitive technology; the remaining 15% all plan to do so by 2020.

Where Companies Are Using AI

So, where is this sector using AI? The top three business functions where they use these tools are IT (46%), sales (32%), and customer service (29%) (see Exhibit III-34.)

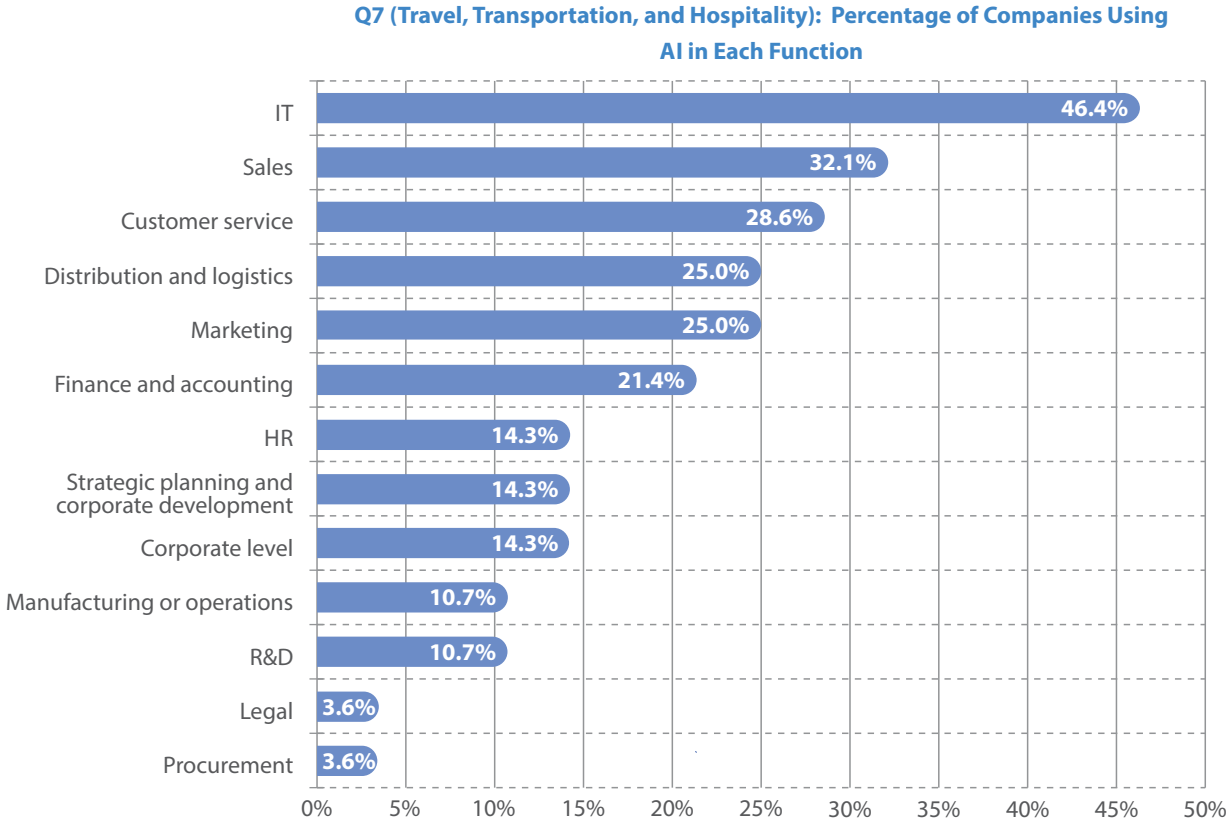

Exhibit III-34: Where Travel, Transportation, and Hospitality Companies Use AI

56 Katherine LaGrave, "Robots Will Now Bring You Snacks, Park Your Car," Condé Nast Traveler, Dec. 15, 2015. http://www.cntraveler.com/stories/2015-12-15/robots-will-now-bring-you-snacks-park-your-car, accessed April 7, 2016.

In the realm of customer service, robots don't stop at the hotel front lobby. In one example, Starwood Hotels began experimenting in 2014 with a robotic bellhop at its Aloft hotel chain. The three-foot-high robot brings items from the lobby desk to travelers' rooms in two California Aloft hotels.[57] Similarly, guests at the Crowne Plaza San Jose-Silicon Valley who ask for room delivery of snacks or toiletries get a phone call from a robot named Dash, announcing he stands outside the hotel room with the desired items.[58]

A sizable 25% of these companies use cognitive tools for marketing and distribution and/or logistics, respectively (though that latter figure is lower than you might expect, given the importance of distribution to many companies in this industry). In one distribution example, United Parcel Service Inc.'s ORION software (On-Road Integrated Optimization and Navigation) optimizes driver routes for efficiency. The company expects to fully deploy it in 2017 and save $300 million to $400 million a year in fuel and other costs. The software continually assesses a driver's route options, based on gathering and processing GPS and other data. The system has been under development since about 2003, costing $250 million[59] — all for the purpose of making UPS drivers (who make an average 120 stops daily) more efficient in their routes (the order of the stops, which roads to take, etc.) A team of 50 UPS engineers have been working on the optimal algorithm. By late 2014, more than 40% of the firm's 55,000 delivery routes in the US were using ORION.[60]

To a lesser extent, our respondent companies use cognitive tools for finance and accounting (21%). No other business function was cited by at least 15% of this industry's companies surveyed.

Low Spending

Companies in the travel, transportation, and hospitality industry spent an average of $4 million on cognitive projects in 2015 — by far, the lowest annual spend per company among our 13 industries, where the average annual spend across all sectors was $70 million. (This industry had some outliers; it's worth noting that two companies spent more than $20 million in 2015).

Our respondents predicted that the AI spending figure would rise to $5.9 million in 2016 (also the lowest spend among the 13 industries) but to $34 million by 2020.

In 2016, companies planned to allocate 55% of the cognitive spend on projects to improve current business operations and 45% to projects to transform the business. In 2020, that ratio will shift to 48% to improvement projects and 52% to transformational projects, respondents say.

In return for that spending on cognitive projects, our respondents report an average revenue increase of 12% in 2015 (vs. 2014) in the functional area of the AI effort (not the whole company). These companies also realized a 10% cost reduction related to the AI work, but 15% of the responding firms reported a net cost increase.

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57 John Markoff, "'Beep,' Says the Bellhop," The New York Times, Aug. 11, 2014, http://www.nytimes.com/2014/08/12/technology/hotel-to-begin-testing-botlr-a-robotic-bellhop.html?_r=1, accessed October 6, 2016.

58 Katherine LaGrave, "Robots Will Now Bring You Snacks, Park Your Car," Condé Nast Traveler, December 15, 2015, http://www.cntraveler.com/stories/2015-12-15/robots-will-now-bring-you-snacks-park-your-car, accessed October 7, 2016.

59 INFORMS press release, "World's Best Analytics Teams Selected for 2016 INFORMS Franz Edelman Award Competition," Dec. 14, 2015, https://www.informs.org/About-INFORMS/News-Room/Press-Releases/2016-Edelman-Finalist-Announcement, accessed October 6, 2015.

60 Steven Rosenbush and Laura Stevens, "At UPS, the Algorithm is the Driver," The Wall Street Journal, Feb. 16, 2015, http://www.wsj.com/articles/at-ups-the-algorithm-is-the-driver-1424136536?mod=LS1, accessed October 6, 2016.

Future Impact on Competitiveness – and Jobs

Where exactly in the business will cognitive technology have the greatest beneficial impact by 2020? There's little agreement on this in the industry. About a quarter say AI's impact will be greatest in IT (the top answer), 18% say marketing, and 18% say customer service (see Exhibit III-35).

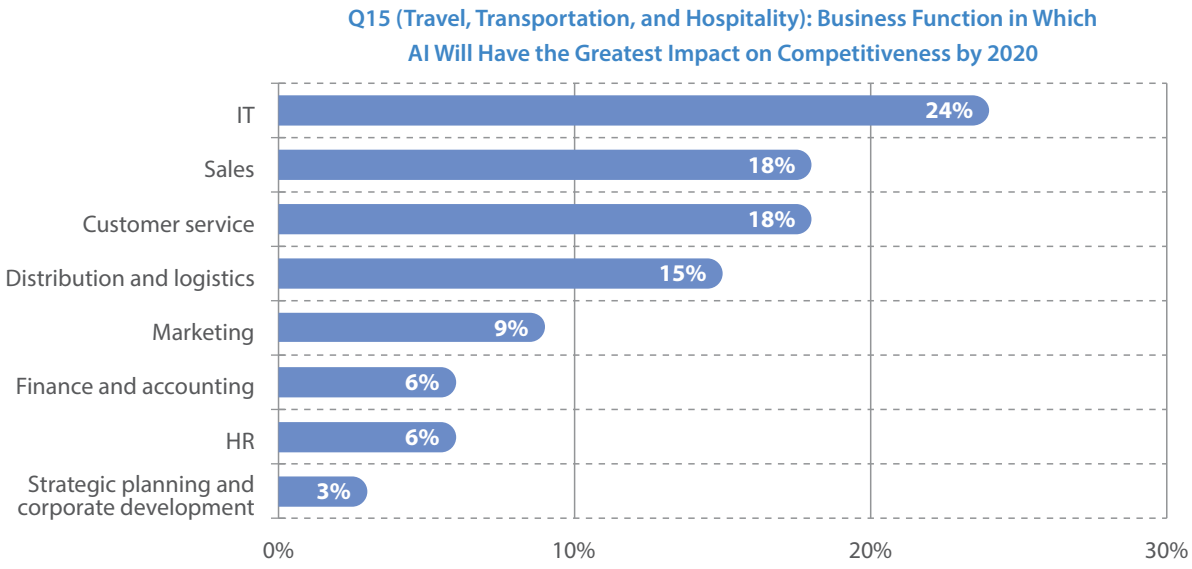


Exhibit III-35: Where AI's Impact Is Predicted to be Greatest by 2020[61]

Despite the robots hanging out at the front of the house in hotels, our travel, transportation, and hospitality industry survey participants don't appear more pessimistic than most industries with regard to possible job losses. We asked respondents to estimate the number of jobs in their department they think could be replaced by AI. They expected 11% of jobs to be eliminated in 2016. That rises to 13% in 2020 and 20% in 2025, they predict.

On the other hand, these companies believe AI will result in new jobs. Our respondents predicted that the companies could add 11% to current jobs in the places they use AI in 2016, 12% in 2020, and 17% by 2025. The executives we surveyed also believe that they could fill 52% of the new jobs with current employees and 48% with new hires.

Despite their frugal spending on AI, travel, transportation, and hospitality companies believe the technology is important to company competitiveness by 2020: 18% of respondents call it 'highly important,' 58% 'important', 12% 'moderately important', and 12% 'slightly important'. None say 'not at all important'.

61 Since no respondent selected 'HR', 'corporate level', 'R&D', 'legal', and 'procurement', these categories have been excluded from the graph.

Keys to AI Success

Like many industries, travel, transportation, and hospitality companies rate safety factors highest among the keys to success for cognitive projects. Securing the system against hacking and developing systems that make good, reliable, and safe decisions ranked as the top two factors cited by these respondents (see Exhibit III-36).

Two cultural factors ranked third and fourth: getting employees to learn and use the new systems and building trust among teams in the systems' advice. Robots, like many new technologies, come with their own people-related challenges.

Q17 (Travel, Transportation, and Hospitality): Key Success Factors in Capitalizing on AI

1	Making the systems secure against hacking	4.33
2	Developing a system that makes good, reliable, and safe decisions	4.15
3	Getting employees to learn and adopt the new processes and systems	4.09
4	Getting managers and employees to trust what our cognitive systems are advising them to do	4.00
5	Determining where to use the technology in our company	3.97
6	Developing a system that continually learns and makes better decisions	3.94
7 (tied)	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	3.88
	Getting top management's approval for funding	3.88
9	Deciding whether to use the technology to assist people or replace them	3.73
10	Addressing people's fears about losing their jobs	3.48
Factors rated on a scale of 1-5, 1 = not at all important; 2 = slightly important; 3 = moderately important; 4 = important; 5 = highly important		

Exhibit III-36: Key AI Success Factors

Utilities: Where AI Meets the Power Grid

Can AI and automation help utility companies manage the demands of an ever-changing and demanding power grid? That's one question utilities are pursuing with AI projects, based on our survey responses from 27 utility companies (including electric, gas, and water utilities) in four regions of the world. Regionally, 63% are located in North America, 15% in Europe, 11% in Asia-Pacific, and 11% Latin America. The average revenue of the companies surveyed is $13 billion.

Within this group, 82% currently use AI (slightly lower than the 89% average across the 13 industries). The remaining 18% plan to do so by 2020.

The most common place utility companies use AI is in the IT function (mentioned by 77%). But some also use AI in customer service (41%) and R&D (32%). Only 18% are using AI in their power generation operations. A tiny 9% apply the tools to sales; perhaps the fact that utilities have captive customers shapes this result. (See Exhibit III-37.)

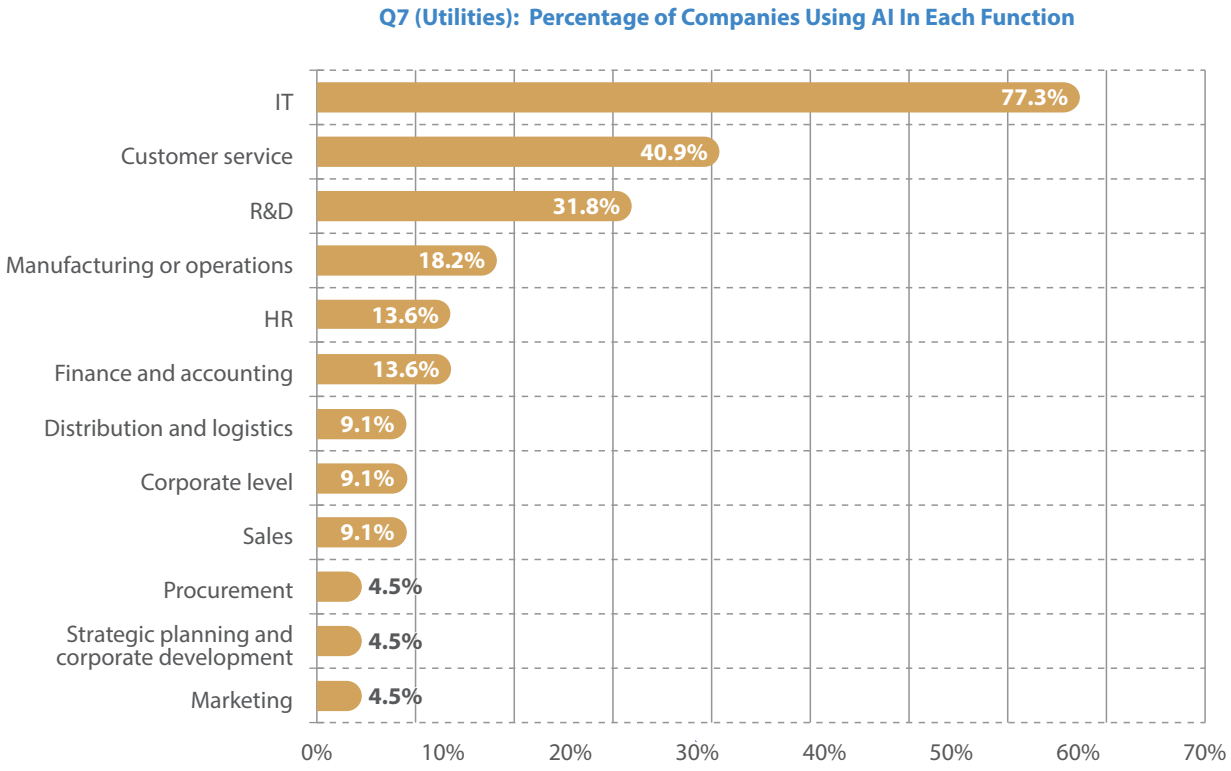


Exhibit III-37: Where Utilities Use AI[62]

US nuclear power plant operator Exelon Generation (the largest in the US) is working with General Electric to use AI to examine data from nuclear power suppliers. The project goals: Make better operational decisions, reduce costs and improve performance.[63] AI can also help utilities spot trouble. Enel SpA (a utility that provides power and gas to European and Latin American markets) uses machine learning technology to pinpoint faults in its grid more accurately.[64]

62 Since no respondent selected 'legal', this category has been excluded from the graph.

63 GE press release, "GE Hitachi and Exelon Generation Bring the Industrial Internet and Data Analytics to the Nuclear Industry," Sept. 29, 2015, http://www.genewsroom.com/press-releases/ge-hitachi-and-exelon-generation-bring-industrial-internet-and-data-analytics-nuclear, accessed October 7, 2016.

64 Enel Press release, "Enel increasingly digital and smart," November 11, 2015, https://www.enel.com/en/media/news/d201511-enel-increasingly-digital-and-smart.html, accessed October 7, 2016.

In another example, four companies in Switzerland (including Adaptricity, AEK Energie AG, and Alpiq) are experimenting with AI to optimize power utilization across the utility grid.[65] They began in the town of Riedholz, with about 40 homes and apartments. Over 18 months, they'll test how well a new software system controls heat pumps, boilers, batteries, and electric vehicle charging stations, as well as how well it measures photovoltaic systems that produce energy in homes and neighborhoods. The software constantly monitors grid loads, power consumption and generation, power prices, and weather forecasts. The AI components will learn how power customers use electricity, then optimize utilization to reduce peak loads in the power grid and balance loads.

Modest Spending

Utility companies take a cautious approach to funding cognitive projects, based on our survey responses. These companies spent an average of $66 million per company in 2015 (slightly less than the $70 million average across 13 industries). Our respondents predicted utility companies would spend just $48 million in 2016 (much less than the average of $67 million across industries) and $42 million in 2020 (less than half the cross-industry average).

Companies expected to allocate 54% of their 2016 AI budgets to projects that improve current business operations and 46% to transformational projects. That ratio shifts slightly in both 2020 and 2025, when companies will allocate 51% to improvement projects and 49% to transformational projects, respondents predict.

Now the chicken-and-egg question: It's hard to tell if utilities haven't seen much revenue gain from AI because they haven't invested much in the projects, or they haven't invested much in the projects because they haven't seen outstanding early revenue gains. We asked respondents to quantify revenue increases realized in 2015 (vs. 2014) in the areas of the business in which they staged their AI projects (not the entire company): They report an average revenue gain of 9% in these areas — the lowest increase among the 13 industries surveyed.

At the same time, these companies realized an average 7% cost reduction in the areas of their AI projects – the lowest savings among the 13 industries.

Where in the business will AI have the greatest impact by 2020? Utility companies display little agreement on this question (see Exhibit III-38). The most frequently mentioned functions are IT and sales – but each is cited by only 19% of respondents. Fifteen percent cite manufacturing or operations (power generation).

65 Landis + Gyr press release, "Artificial intelligence to control the power grid in Riedholz," Feb. 23, 2016, http://www.landisgyr.dk/artificial-intelligence-to-control-the-power-grid-in-riedholz/, accessed October 7, 2016.

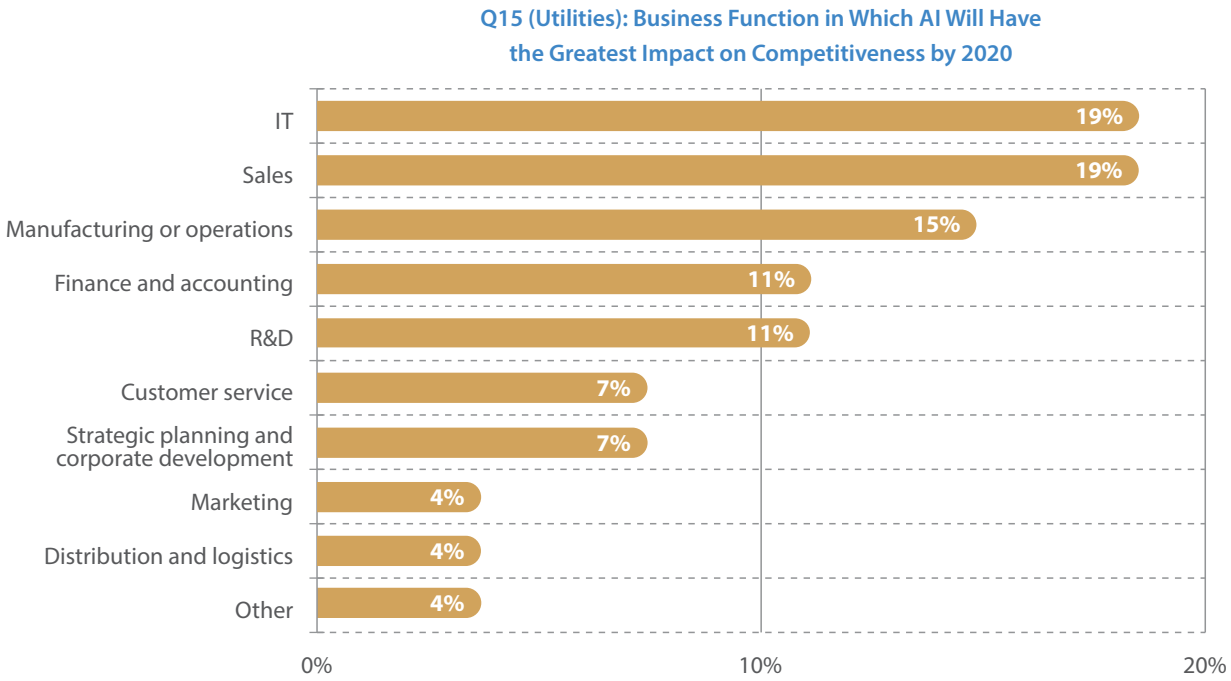


Exhibit III-38: Where AI is Seen Having the Greatest Impact by 2020[66]

Job Shifts Ahead

Some jobs will be cut and others will be created as a result of AI projects. Utilities envision AI to have a fair amount of impact on these jobs. We asked them to estimate the number of jobs in their functional department (not the whole company) that could be eliminated in 2016. Some 11% of jobs in their departments could be eliminated in 2016, respondents predicted. That figure rises to 16% by 2020 and 20% by 2025.

Regarding new jobs that could be created due to introducing AI, respondents predicted 10% of new jobs would be added in their departments in 2016. That figure rises to 12% by 2020, and 17% by 2025.

Utility respondents largely agree on the importance of AI to company competitiveness by the year 2020, with 19% calling it 'highly important' and 44% calling it 'important' — so 63% are well convinced of the significance. Some 22% call cognitive work 'moderately important', 15% say 'slightly important', and none say 'not at all important'.

66 Since no respondent selected 'HR', 'corporate level', 'legal', and 'procurement', these categories have been excluded from the graph.

Key AI Success Factors

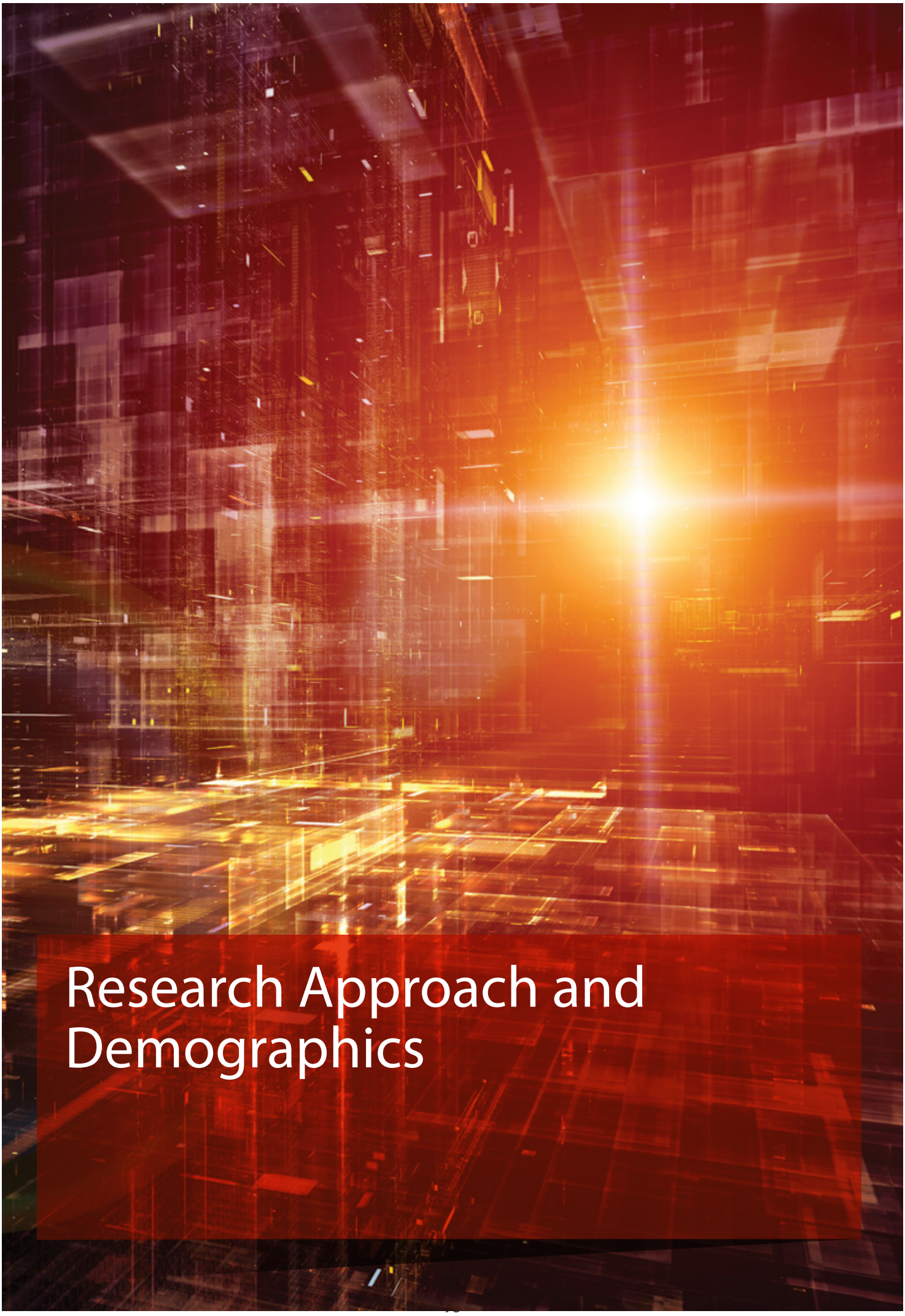
What ensures that AI projects succeed at utility companies? Three factors tied for first place: changing business processes to capitalize on automation; getting teams to learn and use the new processes and systems; and determining where to use the technology within the company (see Exhibit III-39).

These answers may reflect the fact that culture can be quite ingrained at utilities; they don't tend to innovate on business process as quickly as, say, high tech or retail companies. Thus, the change management challenges related to AI will be substantial for utility companies.

As is true across industries, utility companies also cite the importance of developing a system that makes reliable and safe decisions. Unlike some other industries, funding approval is mentioned as a top 5 success factor here – not surprising given the low spending levels discussed earlier.

Q17 (Utilities): Key Success Factors in Capitalizing on AI		
1 (tied)	Changing our business processes in ways that capitalize on automated decisions, actions, and so on	4.22
	Getting employees to learn and adopt the new processes and systems	4.22
	Determining where to use the technology in our company	4.22
4	Developing a system that makes good, reliable, and safe decisions	4.19
5	Getting top management's approval for funding	4.07
6	Making the systems secure against hacking	4.04
7	Getting managers and employees to trust what our cognitive systems are advising them to do	4.00
8	Developing a system that continually learns, in order to make better decisions	3.96
9	Deciding whether to use the technology to assist people or replace them	3.89
10	Addressing people's fears about losing their jobs	3.37
Factors rated on a scale of 1-5, 1 = not at all important; 2 =slightly important; 3 = moderately important; 4 = important; 5 = highly important		

Exhibit III-39: Key AI Success Factors at Utilities



Research Approach and Demographics

This research report was based on a survey that TCS conducted from February through June 2016, as well as 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 technology and/or systems', 'artificial intelligence', and 'machine learning' – we defined our terminology this way:

AI or cognitive systems are technologies that can…

- **Learn -** Continually update the system's sensing, thinking, and acting capabilities (through automated means and human intervention); the system keeps getting smarter and smarter
- **Recognize -** Identify and classify datasets ranging from text, images, video, and more through training
- **Act -** Make decisions based on digital data collected, based on the system's rules and algorithms to execute a formerly manual process (for example, using factory robots instead of workers to operate machines)

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 technology, and 16% of which said they were not. Of those 16%, 69% said they planned to implement the technology 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 IV-1).

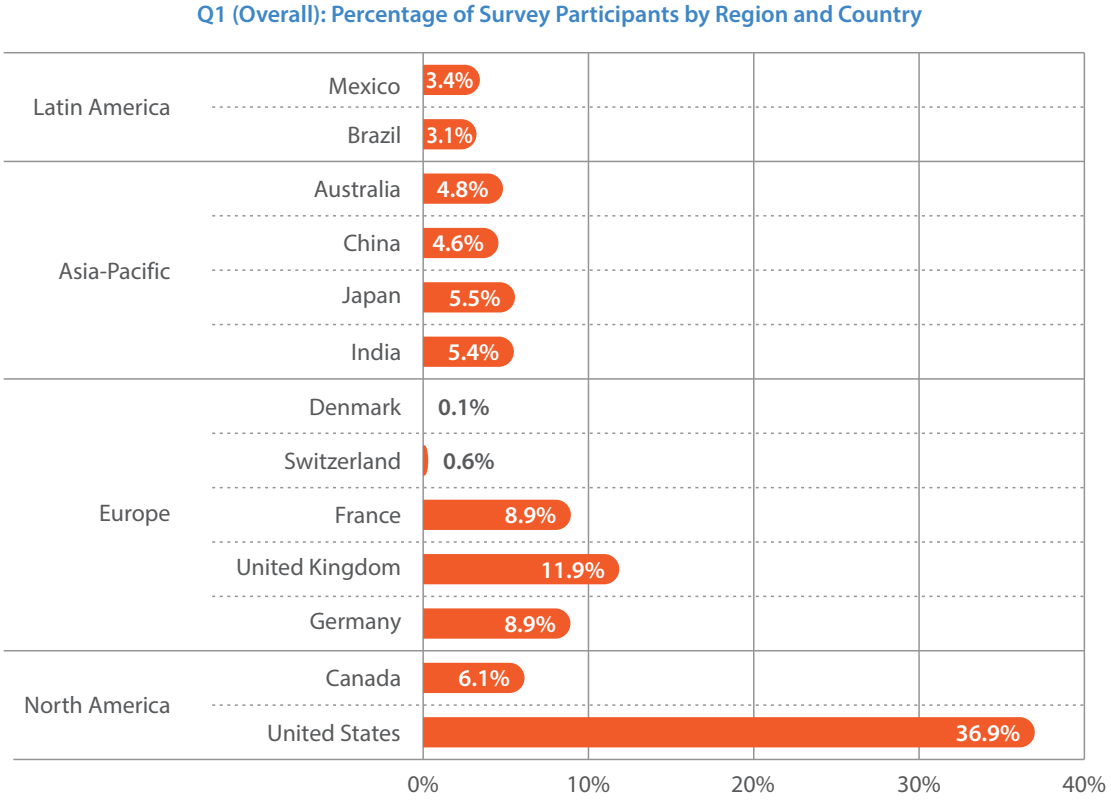


Exhibit IV-1: Survey Respondents by Region and Country

We wanted to get a broad range of views on cognitive technology 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 respondents were from the IT function. However, to understand how each business function was applying the technology, we also surveyed senior managers in these functions: corporate center, finance and accounting, sales, R&D, marketing, customer service, manufacturing (or the service industry equivalent of operations), strategic planning and corporate development, HR, procurement, distribution and logistics, and legal (see Exhibit IV-2).

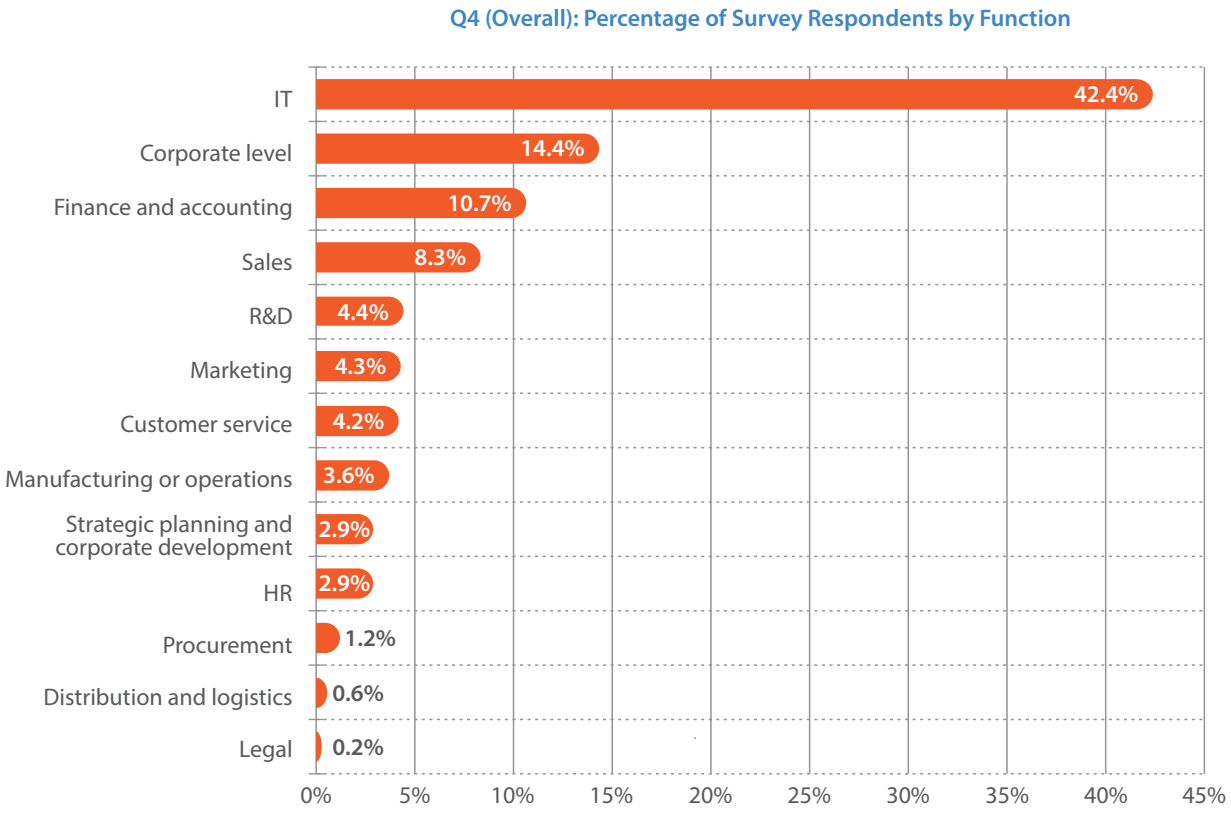


Exhibit IV-2: Survey Participants by Functional Role

Secondary Research

We conducted extensive, ongoing literature searches over the first seven months of 2016, looking for articles written about or 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 part two of 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.

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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.

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