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ARTIFICIAL INTELLIGENCE: WHAT'S NOW, WHAT'S NEW AND WHAT'S NEXT

Artificial intelligence (AI) is already becoming entrenched in many facets of everyday life, and is being tapped for a growing array of core business applications, including predicting market and customer behavior, automating repetitive tasks and providing alerts when things go awry. As technology becomes more sophisticated, the use of AI will continue to grow quickly in the coming years.



Dear eMarketer Reader,

eMarketer is pleased to make this report, **Artificial Intelligence: What's Now, What's New and What's Next**, available to our readers.

This report is a great example of eMarketer data and insight that detail the size, scope and growth of the AI market. This report also defines common AI terminology and highlights some noteworthy AI initiatives.

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We thank you for your interest in the report and **IBM** for making it possible for us to offer it to you today.

Best Regards,

A handwritten signature in black ink, appearing to read 'Crystal Gurin'.

Crystal Gurin
SVP President and Publisher



ARTIFICIAL INTELLIGENCE: WHAT'S NOW, WHAT'S NEW AND WHAT'S NEXT

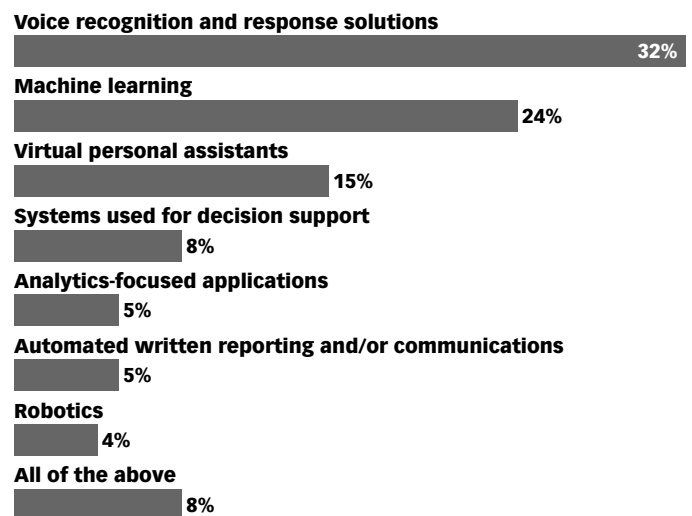
Artificial intelligence (AI) is already becoming entrenched in many facets of everyday life, and is being tapped for a growing array of core business applications, including predicting market and customer behavior, automating repetitive tasks and providing alerts when things go awry. As technology becomes more sophisticated, the use of AI will continue to grow quickly in the coming years.

- Forecasts of the size and value of the AI market vary widely. This is because research companies use different methodologies and definitions of AI. The situation is further complicated by confusing terminology and nomenclature. For example, many companies that use AI call the technology by a different name (e.g., machine learning or cognitive computing).
- AI development and adoption is growing quickly, propelled by faster and cheaper processing power, high-profile tech development, ubiquitous cloud computing and the urgent need to manage data overload. AI is frequently combined with big data.
- Large tech companies, including IBM, Google and Amazon, dominate the market and are jockeying for leadership positions. There are also hundreds of smaller startups focused on developing niche products that meet specific business needs.
- The use of AI is being explored in virtually every industry, across a wide spectrum of business functions. Companies are using a variety of different approaches to acquire the technology, including developing it in-house, licensing it and partnering with consultants or other organizations.

WHAT'S IN THIS REPORT? This report describes the size, scope and growth of the AI market, defines common AI terminology and highlights some noteworthy AI initiatives.

Most Widely Used Artificial Intelligence (AI) Technology at Their Company According to US Executives, May 2015

% of respondents



Note: among the 58% of respondents who already have AI-powered solutions deployed at their company; numbers may not add up to 100% due to rounding

Source: Narrative Science, "State of Artificial Intelligence & Big Data in the Enterprise," June 11, 2015

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KEY STAT: Businesses are already using AI to help improve their operations, streamline their communications and more efficiently process data. Voice recognition, voice response and machine learning are some of the most commonly used AI technologies.

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WHAT EXACTLY IS AI?

While most experts agree that AI involves the use of “intelligent” machines, there is much confusion and debate over what artificial intelligence really does, how big the market is and the future value it can deliver.

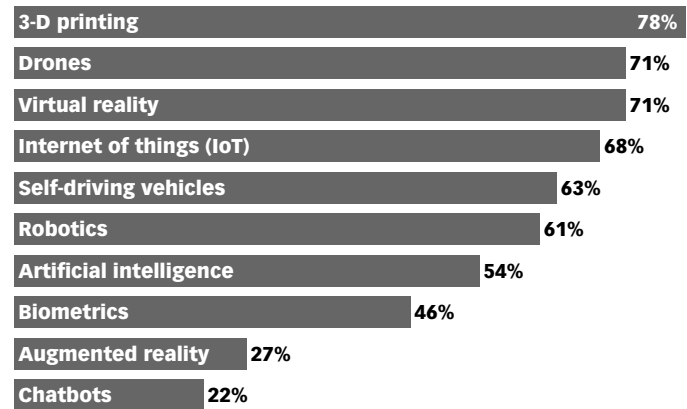
In its most widely understood definition, AI involves the ability of machines to emulate human thinking, reasoning and decision-making. A May 2015 survey of US business executives by Narrative Science found that 31% of respondents believed AI was “technology that thinks and acts like humans.” Other conceptions included “technology that can learn to do things better over time,” “technology that can understand language” and “technology that can answer questions for me.”

At a deeper level, however, there is confusion in the marketplace around AI technology and the terminology used to describe it. Similar-sounding terms—such as cognitive computing, machine intelligence, machine learning, deep learning and augmented intelligence—are used interchangeably, though there are subtle differences among them. Many companies that have been involved with AI for years don’t even call it AI, for various reasons. “In essence we call it machine learning, because I think AI sometimes can spook some folks,” said Mahesh Tyagarajan, chief product officer at ecommerce personalization platform RichRelevance.

Many people also don’t realize that AI powers some of today’s most buzzed-about technologies. For example, a June 2016 survey by CompTIA found surprisingly low awareness of AI among US business and IT executives: Just 54% said they were aware of AI, compared with 78% who were aware of 3-D printing and 71% who knew of drones and virtual reality. However, some of the higher-ranking technologies on the list—including virtual reality, self-driving vehicles and robotics—are underpinned by different types of AI, though they were not identified as such.

US Business/IT Executives Who Are Aware of Select Emerging Technologies, June 2016

% of respondents



Source: CompTIA, “Internet of Things Insights and Opportunities,” July 27, 2016

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According to Mark Torrance, chief technology officer at programmatic marketing company Rocket Fuel, this lack of awareness about AI stems from a historical tendency to give AI projects—such as path planning and search algorithms—other names once they become widely used. “Artificial intelligence as a name was reserved for mysterious stuff that was beyond the state of the art,” he said. “We take it for granted that we can talk to our phone and it sometimes understands what we say, and we can get driving directions that can avoid traffic. We don’t think of that necessarily as AI anymore because we are using it. But these things are absolutely powered by the same underlying technology that has been that field of AI all along.”

AI: TERMINOLOGY DEMYSTIFIED

The field of AI encompasses a collection of similar-sounding technical concepts. In general terms, AI terminology usually describes specific branches of computer science that deal with emulating human intelligence, or the more specific commercialized applications of this technology.

Some of the most common AI terms are explained below. It is important to understand that although discrete types of AI exist for classification purposes, many business solutions actually involve more than one type, new AI technologies may be hybrids of several types and many companies have different names for similar types of systems.

MAJOR AI TECHNOLOGIES

Machine learning. The branch of AI computing that involves training algorithms to perform tasks by learning from previous data and examples rather than explicit commands programmed by humans. Within machine learning, three of the most common algorithms are neural networks, induction algorithms and genetic algorithms. Many applications of AI, such as computer vision and natural language processing, rely heavily on machine learning. When companies talk about AI capabilities in their products and services, they are typically referring to machine learning.

Neural networks. Machine learning algorithms and computational models designed to function like neurons in the human brain. Neural networks are trained with specific sets of data points, which they use to guess at an answer to a query. The network's guess is then compared with the correct answer for each data point. If errors occur, the "neurons" are tweaked and the process repeats itself until the error levels decrease. This algorithmic approach, called backpropagation, is similar to statistical regression.

Genetic algorithms. Machine learning optimization algorithms that work by mimicking the evolutionary process using natural selection, recombination and mutation. They are particularly effective at optimizing problems with a large number of possible solutions.

Induction algorithms. Machine learning algorithms that learn by example and attempt to find patterns in data and create rules that explain what is happening. Unlike the process of deduction, which involves a preset collection of rules, these algorithms create rules to explain things that are happening on the fly.

Deep learning. A branch of machine learning concerned with building and training neural networks with multiple layers. Each layer of a network can find patterns in the output of the layer above it. Deep networks shine at sorting and classifying data and identifying anomalies in data patterns.

Expert systems. Also known as knowledge representation systems or decision support systems. Expert systems are an older form of AI technology that was originally designed to solve complex problems by making decisions based on a knowledge base and rules for applying that knowledge. Given their more sophisticated, data-driven and statistical approaches, newer machine learning models can now make more effective decisions than expert systems.

Knowledge representation. A branch of AI that involves the representation of different types of information in ways that computer systems can use to perform complex tasks or solve problems.

COMMON APPLICATIONS OF AI

Many of today's commercial applications are built on:

Computer vision. Also called machine vision. The branch of AI that deals with how computers emulate the human visual system and their ability to view and interpret digital images from the real world. It also incorporates image processing, pattern recognition and image understanding (turning images into descriptions that can be used in other applications).

Machine translation. A form of automated translation by which computer software is used to translate text or speech from one natural language to another (e.g., from Russian to English). In addition to merely substituting one word for another, it can incorporate statistical techniques that increase the likelihood of correctly identifying phrases, idioms, proper names and other anomalies.



Natural language processing. A branch of AI that deals with a machine's ability to understand spoken or printed words in human (natural) languages, as opposed to computer programming languages. These technologies are heavily used by search engines, for spam filtering and for their ability to extract information from large and complex documents. Natural language processing can also identify anomalies within text.

Natural language generation. A subset of natural language processing in which a computer makes decisions about how to make sense of a specific concept and put it into words. The technology is often used to automate manual processes related to data analysis, such as personalized form letters and other types of communication at scale. It can also dynamically create communications—including basic news articles and real estate listings—that meet specific goals.

Computational linguistics. An interdisciplinary field that concerns itself with statistical and rule-based modeling of natural language data by computers. It includes speech/voice recognition, the process by which machines can identify and recognize spoken words and phrases and translate or convert them to machine-readable text.

Chatbot. A computer program that uses a set of rules to conduct a speech- or text-based conversation with a human over an online chat interface. Chatbots are increasingly powered by AI and use machine learning to detect and mimic human conversation. They are commonly developed to provide specific content or automated service or utility to users.

Virtual digital assistant. A more sophisticated version of a chatbot, also known as an intelligent agent, virtual personal assistant, virtual intelligent assistant, automated assistant or virtual agent. Such assistants can organize, store and output information based on the user's location and can answer voice or text-based queries from the user with information from a multitude of online sources (e.g., weather forecasts, maps, stock prices or transportation schedules). Examples include Apple's Siri, Google Now, Amazon's Alexa and Microsoft's Cortana.

Recommender systems. Also known as recommendation engines. An AI-driven information filtering system that can automatically predict user preferences and responses to queries based on past behavior, one user's relationship to other users, similarity among items being compared and context. High-profile examples of recommender systems include Amazon's "frequently bought together" feature and Netflix's CineMatch algorithm. Similar algorithms are also used by social networks such as Facebook, LinkedIn and Ancestry.com to find connections among people and data and to identify targets for marketing campaigns.

Predictive analytics. Programs that use a combination of techniques from data science, statistics and artificial intelligence to analyze sets of structured and unstructured data, uncover patterns and relationships, and use them to make predictions about probable future outcomes and events. Predictive analytics models are closely related to prescriptive analytics models, which incorporate a predictive model but go a step further to produce actionable data and use and a feedback system that tracks outcomes.

OTHER NAMES FOR AI

There are also several other terms that are often used in place of or interchangeably with "artificial intelligence" or "machine learning." These are not official branches of computer science but instead have been created by marketers to help describe and commercialize different types of AI technology.

Cognitive computing. This is a catchall term popularized by IBM to describe the process by which machines can mine data, recognize patterns and process natural language to interact and emulate human intelligence. At its most basic, the term refers to computers that can simulate human thought processes. IBM and other organizations often use this term instead of the broader term "artificial intelligence."



Augmented intelligence. Also known as cognitive augmentation or intelligence amplification. Another catchall, it refers to technology designed to use the combined strengths of human and machine intelligence. Some of the large players in the field of AI prefer this term to describe their offerings to minimize perceptions that machines will eventually take over human work. “At IBM, we are creating ‘augmented intelligence,’ not ‘artificial intelligence,’” said Nish Parekh, program director of Watson client services at IBM. “It’s the important difference between systems that enhance and scale human expertise and those that attempt to replicate human intelligence.”

Man-machine learning. Conceptually similar to augmented intelligence, this is often used to describe AI that combines human guidance with machine analysis of large volumes of data. The term was developed in part to reassure audiences that human effort is still needed to provide reinforcement and feedback to the machine, which then refines its algorithm to achieve the desired results.

MARKET FORECASTS DIFFER, BUT THEY ALL INCLUDE GROWTH

Forecasts for the AI market vary widely, and the situation is complicated by the varying nomenclature and an inconsistently defined market scope. Still, most prognosticators agree that the AI market will experience robust growth. Some recent market forecasts:

- Market intelligence firm Tractica estimated that annual worldwide AI revenue would reach \$36.8 billion by 2025, up from \$643.7 million this year. In an August 2016 press release, the firm said that “these technologies have use cases and applications in almost every industry and promise to significantly change existing business models while simultaneously creating new ones.”
- A February 2016 forecast from research firm MarketsandMarkets (M&M) predicted that the AI market would increase from \$419.7 million in 2014 to \$5.05 billion by 2020, at a compound annual growth rate (CAGR) of 53.65% between 2015 and 2020. In a press release, the firm wrote that North America was expected to account for the largest share of the AI market during the forecast period, with Asia-Pacific experiencing the fastest growth. M&M also expected the media and advertising industry to account for the largest share of the AI market during the forecast period, specifically with the goal of analyzing consumer behavior to “influence their buying pattern.” Machine learning technology was by far the most dominant in the worldwide AI market, while the market for natural language processing technology—which has significant growth potential in media and advertising, retail, finance and other areas—was expected to grow at the highest rate.
- BCC Research predicted the worldwide market for smart machines reached \$6.6 billion in 2015, would hit \$7.4 billion in 2016 and approach \$15 billion in 2021. This will represent a CAGR of 15% between 2016 and 2021.

- A forecast report from Bank of America Merrill Lynch, cited by the Financial Times in November 2015, estimated that the market for AI and robotics would rise from \$58 billion in 2014 to \$153 billion by 2020, including \$70 billion for AI-based systems and \$83 billion for robots. The report also noted that global investment in AI technology had risen from \$1.7 billion in 2010 to \$14.9 billion in 2014.
- In its February 2016 report “Magic Quadrant for Advanced Analytics Platforms,” tech consulting firm Gartner predicted that by 2020, predictive and prescriptive analytics would account for 40% of net new investments by enterprises in business intelligence and analytics. The company also reported that by 2018, more than half of large organizations worldwide would “compete using advanced analytics and proprietary algorithms, causing the disruption of entire industries.”

Other research has attempted to quantify the market for enterprise vs. consumer-focused AI initiatives. In August 2015, venture capital advisors Ajit Nazre and Rahul Garg created a database of 312 companies with funding over \$100,000 that were actively working on projects that involved AI and/or machine learning. Analysis of this list revealed that the majority were in the US and that 224 were focused on enterprise applications, while 88 were focused on consumer applications. The study also found that machine learning, robotics and drones, augmented reality, image and facial recognition, natural language processing and predictive analytics received the most active funding.

DRIVERS OF AI ADOPTION

AI has been heralded, often prematurely, as the next big thing in business technology. But after several fits and starts, a number of forces are finally coming together to accelerate commercialization:

Advances in computing power. More powerful—yet smaller and less expensive—hardware, accessible cloud computing platforms and more advanced data analytics programs are the building blocks of AI technology and are setting the stage for widespread adoption.

The internet of things (IoT). Many industry watchers see the internet of things as key to pushing AI along, in large part because artificial intelligence has significant potential in powering IoT solutions and in crunching the massive volumes of data the IoT is already starting to provide. “All the related disciplines that are commonly lumped together as artificial intelligence are being stimulated by the burgeoning growth of internet of things,” Janel Garvin, CEO of marketing research firm Evans Data, said in a June 2016 statement. “These technologies are being incorporated very rapidly into the design and development process across a host of industries, and types of applications, but it’s IoT that is the strongest driver.”

Data overload. The avalanche of data from computers, mobile devices, IoT sensors and other connected things has become overwhelming and not humanly manageable. According to information on IBM’s website, the world creates approximately 2.5 quintillion bytes of data each day, and “90% of the data in the world today has been created in the last two years alone.” Many businesses are turning to AI solutions to help them make sense of this data and to use it in new ways.

Tech giants with deep pockets. Many of the world’s major tech companies—including IBM, Google/DeepMind, Microsoft, Facebook, Samsung, Amazon, Salesforce and Alibaba—operate their own development labs and have rolled out commercial services to bring AI technology to the masses. For example, IBM Watson, Microsoft Azure, Amazon and Alibaba each launched turnkey, cloud-based machine learning software-as-a service (SaaS) solutions in 2015.

Many of the same companies are also investing in and aggressively pursuing acquisitions of smaller niche players. An October 2016 blog post from CB Insights reported that more than 50 private AI companies had been acquired by big tech players—with Google, Intel, Apple, Twitter and Salesforce leading the pack in terms of acquisitions.

Innovative startups. While the tech giants of the world are touting their AI capabilities, some of the technology they're using comes from smaller startups that have successfully attracted venture capital. These companies are developing a rich pipeline of niche AI technologies for specific business problems, some of which go on to be highly coveted by the tech giants. In a February 2016 blog post, CB Insights reported that the number of AI deals and the amount invested worldwide had grown significantly between 2010 and 2015, with a variety of companies investing nearly \$400 million in 2014 and \$310 million in 2015.

Number of Deals and Amount Invested in Artificial Intelligence Companies Worldwide, 2010-2015

	Amount invested (millions)	Number of deals
2010	\$45	6
2011	\$19	7
2012	\$52	20
2013	\$141	30
2014	\$394	60
2015	\$310	54

Note: read as \$310 million was invested in 54 artificial intelligence companies during 2015

Source: CB Insights as cited in company blog, Feb 4, 2016

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A collaborative academic community. Data scientists and AI researchers at big tech companies, startups, universities and private research consortia are increasingly coming together to advance AI technology for the common good. They have developed common standards and libraries of open-source material. This means smaller companies seeking to dip their toes into the AI waters need not write their own algorithms or recreate the wheel.

Successful use cases. As AI continues to produce results, it is attracting the attention of more and more business decision-makers.

A Crowded Market, with a Few On Top

Most of today's large-scale AI development is being spearheaded by the world's tech giants, which are taking a multipronged approach. They are creating their own technology, investing in companies with promising ideas and acquiring startups with niche products. Here are some of the heavy hitters:

IBM. IBM's Watson supercomputer—which is based on natural language processing, machine learning and reasoning algorithms and can extract meaning from images, videos, text and speech—became one of the most visible and famous examples of AI when it beat two of the best-ever "Jeopardy!" players on the TV game show in 2011. Since then, IBM has created about 100 commercialized products, apps and services built on Watson. In 2015, IBM announced its Cognitive Business Solutions Unit, an internal consulting organization working to tailor the company's data and cognitive technologies to a wide variety of industries and business needs. For example, Watson has been used in the medical field to help healthcare providers diagnose patients and to power ecommerce apps. According to IBM's Parekh, solutions are being built, used and deployed in more than 45 countries and across 20 different industries.

Google. Over the past decade, Google, with its DeepMind unit, has become one of the heavyweights in AI. Since 2015, the company has incorporated deep learning technology called RankBrain into its search engine to help it understand and respond to some queries more effectively. Machine learning underpins its driverless car technology and in early 2016 its Watson-like machine, AlphaGo, beat world champion Lee Sudol in Go, the highly complex and strategic board game that originated in China. Google also offers its own version of an automated virtual assistant, Google Now, a chat app (Allo), an upcoming speaker-like device called Google Home and TensorFlow, an open-source machine learning software library. "Machine learning is a core, transformative way by which we're rethinking how we're doing everything," Google CEO Sundar Pichai said on the company's October 2015 earnings call. "We are thoughtfully applying it across all our products, be it search, ads, YouTube or Play. And we're in early days, but you will see us—in a systematic way—apply machine learning in all these areas."



Apple. Apple's most well-known AI initiative is Siri, the intelligent personal assistant that runs on iPhones, iPads and the most recent version of its desktop operating system. But the company also has a host of other behind-the-scenes initiatives that help its products and services recommend content, recognize faces, predict word choices, recognize usage patterns and improve device battery life. At its annual developer's conference in June 2016, Apple announced that its new operating systems would incorporate more AI features with predictive capabilities, such as scanning and organizing photos using facial recognition and grouping them together based on location. Apple also opened Siri and other AI-driven apps to third-party developers, giving them access to its neural network technology. Apple is "making it as easy as possible for people to add neural nets to their apps," Chris Nicholson, CEO and founder of deep learning startup SkyMind, told Wired in June 2016. Apple's recent acquisitions include Emotient, whose software can measure the intricacies of facial expressions and map them to emotional responses, and Turi, which helps developers incorporate machine learning into apps and research projects.

Facebook. Compared with IBM and Google, Facebook arrived late to the AI party. But since then, it has been working aggressively to build out its machine learning and AI capabilities. In keeping with its mission to connect people with each other and with the digital world, the company has used AI-based algorithms to recognize and tag faces in photographs, curate News Feeds and manage ad placements. In June 2016, Facebook announced DeepText, a text understanding engine based on deep learning that it says can understand textual context of thousands of posts—in more than 20 different languages—per second. "DeepText has the potential to further improve Facebook experiences by understanding posts better to extract intent, sentiment and entities (e.g., people, places, events), using mixed content signals like text and images, and automating the removal of objectionable content like spam," Facebook said in a blog post. The company's intelligent agent, M, part of Facebook Messenger and now in beta testing, can communicate via text with users and perform a number of customer service functions like booking travel arrangements and ordering flowers. Future projects are expected to include recognizing individuals by their voices from within videos.

Microsoft. The company is "betting its future on AI," according to a July 2016 article in The Verge. Microsoft has been experimenting with neural networks and deep learning for many years and has recently made a number of acquisitions, including SwiftKey, a keyboard app that analyzes users' typing history and learns their usage patterns. Several years ago, Microsoft produced one of its most important breakthroughs, Skype Translator, which uses voice recognition to translate speech and text in real time. The company is now putting the technology to use in its other applications, including search engine Bing, and to translate documents in its vast knowledge base. Microsoft also offers the Cortana Intelligence Suite, based on its digital personal assistant, Cortana; Microsoft Cognitive Services, which help developers use AI technology in their applications by adding simple code; and its Azure cloud computing platform and toolkits for machine learning and to help developers create intelligent bots based on Skype's text, voice, video and 3-D communication capabilities. "As an industry, we are on the cusp of a new frontier that pairs the power of natural human language with advanced machine intelligence," CEO Satya Nadella said in a March 2016 press release.

Samsung. The company announced that it was "actively looking" to acquire developers of AI and other software, according to a March 2016 Bloomberg article. As part of Samsung's "smart devices" initiative, the fourth-largest investor in global AI companies wants to push further into the software business and marry AI technology with the hardware it already makes for phones, consumer electronics, appliances and cars. In August 2015, it made a multimillion-dollar strategic investment in Vicarious, a machine learning startup focused on integrating AI software and hardware. "We will let software drive and lead our businesses rather than assisting the hardware," Samsung executive vice president Rhee In Jong told Bloomberg. "We aren't just looking at a particular technology or area. But artificial intelligence is clearly a path to take."

Salesforce. The world's fourth-largest enterprise software company has been on an AI startup acquisition spree over the past two years. Its most recent acquisition, MetaMind, develops natural language processing, computer vision and predictive analytics tools. The company introduced Salesforce Einstein, a new AI platform, in September 2016. Einstein integrates AI into the company's sales, service and marketing platform and enables customers to build AI-powered apps. "If this is not the next big thing, I don't know what is," Salesforce CEO Marc Benioff told Forbes in August 2016.

Amazon. Over the past couple of years, the ecommerce giant has been bulking up its AI team, accelerating work on a number of projects that bolster its core retail business and help customers boost theirs. While the company has long used AI in its search function and recommendation engine, data scientists are working on more sophisticated demand forecasting models that predict how likely customers are to click on products shown in search queries, and how likely they are to click on related links and make purchases. In 2015, it rolled out its Amazon Machine Learning Service as a competitor to cloud products from Microsoft and Google, and in 2016 it made its deep learning software—called DSSTNE—available to developers. The company’s Amazon Echo home speaker system comes with an AI-powered virtual assistant, Alexa, that can recognize speech and answer general knowledge questions; read books, articles and other content; play music on demand; control smart-home devices; and, of course, order products.

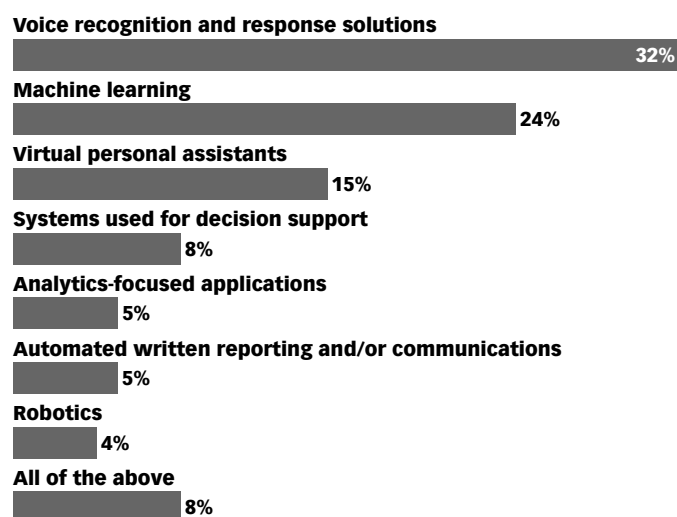
Alibaba. In 2015, Alibaba joined IBM, Microsoft and Amazon in launching a turnkey cloud-based machine learning service. The platform, called Aliyun, incorporates machine learning and deep learning algorithms that can help developers predict user behavior and build applications more quickly. In August 2016, the firm’s cloud computing arm released a new suite of AI solutions, including video, image and speech recognition technologies that can be used in a variety of industries to increase efficiency, lower costs and monitor risks. The company faces stiff competition from its US-based competitors but hopes to find a niche in helping China-based companies expand their AI capabilities worldwide.

Baidu. Through its artificial intelligence lab in Silicon Valley and deep learning lab in China, the search giant has developed a variety of AI-powered initiatives that it is integrating into its core search and web services offerings. Examples include image recognition, video analysis, augmented reality technology and medical image recognition. It is also using developing technology for self-driving cars and using neural networks to find malware on its network and to target ads. In August 2016, China Money Network reported that the company cut funding for a more obscure food delivery drone project to focus resources on AI. The company plans to make several AI projects publicly available in the coming months. “To Baidu, AI is the top priority,” founder Robin Li told Advertising Age in September 2016.

The May 2015 Narrative Science survey found that 58% of US business executives polled were already using AI—particularly in conjunction with big data technologies. Of those, nearly one-third (32%) said voice recognition and voice response solutions were the AI technologies they used most. The study showed that organizations also used AI for machine learning (24%) and as virtual personal assistants (15%). Smaller percentages cited decision support systems, automated written reporting and communications, analytics-focused applications and robotics.

Most Widely Used Artificial Intelligence (AI) Technology at Their Company According to US Executives, May 2015

% of respondents



Note: among the 58% of respondents who already have AI-powered solutions deployed at their company; numbers may not add up to 100% due to rounding

Source: Narrative Science, "State of Artificial Intelligence & Big Data in the Enterprise," June 11, 2015

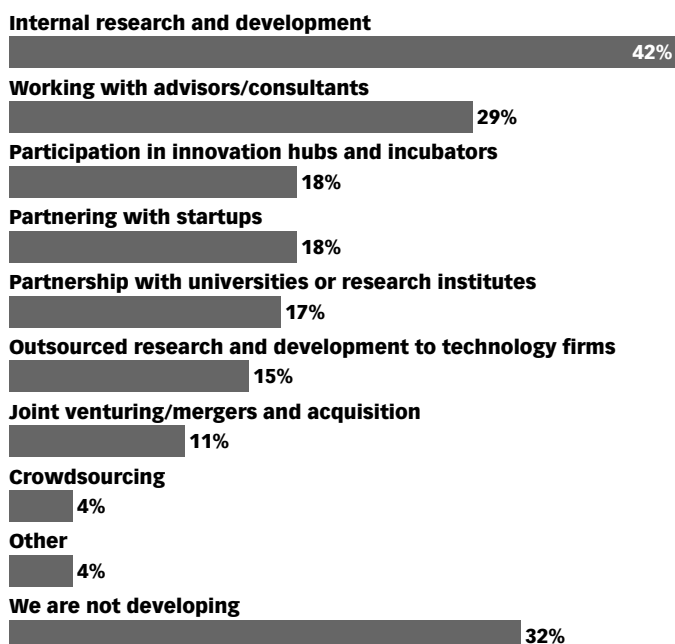
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Businesses in all industries are also making choices about how they will acquire AI technologies. For example, a January 2016 survey of global executives in the financial industry by Euromoney Institutional Investor Thought Leadership found that 42% of respondents said their organization used internal R&D to develop its AI/machine learning capabilities. Other ways included employing consultants and research firms, participating in innovation hubs and incubators, partnering with other businesses and/or academia, crowdsourcing and joint ventures, mergers and acquisitions.

Ways in Which Their Organization Is Developing Artificial Intelligence* Capabilities According to Senior Financial Executives Worldwide, Jan 2016

% of respondents



Note: *artificial intelligence/machine learning
Source: Euromoney Institutional Investor Thought Leadership, "Ghosts in the Machine," April 25, 2016

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WHAT'S NEXT FOR AI?

Many AI projects have yet to reach their expected potential in terms of business results. A July 2016 survey of US executives by Deloitte found that a low number of respondents reported that artificial intelligence had or was having "the most significant" effect on their business, though many of the technologies that were having a more significant effect probably included AI components.

Technology-Related Trends that Have Had* vs. Currently Have the Most Significant Effect on Their Business According to US Executives, July 2016

% of respondents

	Have had* most significant effect	Currently have most significant effect
Information security (cyberintelligence)	17.2%	14.2%
Cloud infrastructure	13.0%	11.4%
Analytics	11.6%	10.0%
Mobility	6.4%	9.2%
Social business/social media	6.2%	8.4%
Big data	8.2%	8.0%
Legacy (core) system modernization	6.2%	7.4%
Internet of things (IoT)	6.0%	6.6%
Cloud ERP or hybrid cloud apps	8.6%	5.8%
Artificial intelligence	4.6%	4.8%
3-D printing (additive manufacturing)	2.2%	3.6%
Virtual/augmented reality	4.0%	3.6%
Wearable technologies	3.0%	3.4%
None of these	2.8%	3.6%

Note: *in the past 12 months
Source: Deloitte, "Technology in the mid-market," Aug 18, 2016

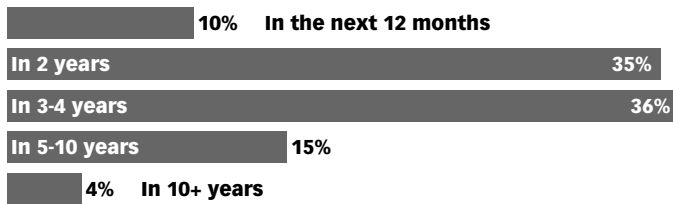
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Similarly, most executives in Europe queried by OpusCapita in April 2016 reported that AI wasn't yet having a dramatic effect on their business. But roughly the same percentage believed it would start to have a significant impact within two years (35%) or within three to four years (36%).

Timeframe in Which Machine Learning/Artificial Intelligence Will Significantly Affect Their Business According to Executives in Europe*, April 2016

% of respondents



Note: n=74; *70% of respondents are from the Nordics
Source: OpusCapita, "Robotic Process Automation & Artificial Intelligence Survey 2016," June 6, 2016

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The possibilities for AI are wide-ranging. A November 2015 survey of IT executives in North America by 451 Research found respondents used or planned to use machine learning techniques for a long list of tasks, including asset and risk management, data discovery, decision-making and cybersecurity.

Tactics for Which IT Executives in North America Use* Machine Learning Programs, Nov 2015

% of respondents

Asset management	47.0%	Customer segmentation	23.2%
Data discovery	44.6%	Call detail record (CDR) analysis	21.4%
Decision-making	38.1%	Product recommendations	20.8%
Risk management	37.5%	Clickstream segmentation and analysis	20.8%
Cybersecurity	35.1%	Energy network management/optimization	20.2%
Campaign and sales program optimization	30.4%	Abnormal trading analysis/detection	20.2%
Credit risk scoring	28.6%	Event/behavior-based targeting	19.6%
Pricing optimization	26.8%	Customer churn management	19.0%
Cross-channel analytics	26.2%	Market basket analysis	18.5%
High-speed arbitrage trading	25.6%	Events/activity behavior segmentation	17.9%
Forecasting and optimization	25.6%	Supply chain analytics	17.3%
Ad targeting/selection	25.6%	Power generation management	16.7%
Network performance optimization	25.0%	Patient care quality and program analysis	14.3%
Campaign management and optimization	25.0%	Threat detection	12.5%
Market and consumer segmentation	24.4%	Social graph analysis	12.5%
Fraud detection/prevention	24.4%	Drug discovery and development analysis	12.5%

Note: e.g., cluster analysis/segmentation, outlier detection, predictive analytics, recommender systems, similarity search; *currently use or plan to use
Source: 451 Research, "The State of Enterprise Data Quality: 2016: The Role of DQM in Machine Learning and Predictive Analysis" commissioned by Blazent, May 10, 2016

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A separate study conducted by 451 Research for Microsoft in April 2016 found that 43% of global IT decision-makers surveyed planned to make substantial investments in AI technologies over the next five years.

Technologies in Which IT Decision-Makers Worldwide Plan to Invest, April 2016

% of respondents

Cloud-based software and applications	59%
Cybersecurity protection	58%
Cloud-based infrastructure	57%
Mobile platforms and applications	55%
Collaborative tools/productivity tools for employees	53%
Customer experience management systems	53%
Data integration across multiple LOBs and platforms	53%
Agile software development processes for fast feedback	51%
Data mining and analytics	50%
Social media-enabled business process	50%
Governance/regulatory tools	48%
Sensor-based technology	45%
Artificial intelligence	43%
Wearables	40%
3-D printing	39%
Robotics	39%

Note: over the next 5 years; responses of 8-10 on a 10-point scale where 1=no investment and 10=significant investment
Source: Microsoft, "Hosting and Cloud Study 2016" conducted by 451 Research, May 11, 2016

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"We're really in the very early stages of this technology," said Felix Laboy, CEO of AI travel company WayBlazer. "If you're talking about a soccer match, we're in the first five minutes of the game when it comes to AI. And so, over time, you'll start to see more and more companies feel comfortable implementing the technology."

"There are a great many different AI applications in varying states of maturity, but we're certainly seeing a lot of success and a lot of activity," said David Raab, principal consultant at Raab Associates. "The basic thing you have to realize is that AI is going to be everywhere, and in many ways it already is everywhere."

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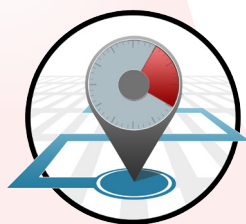
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