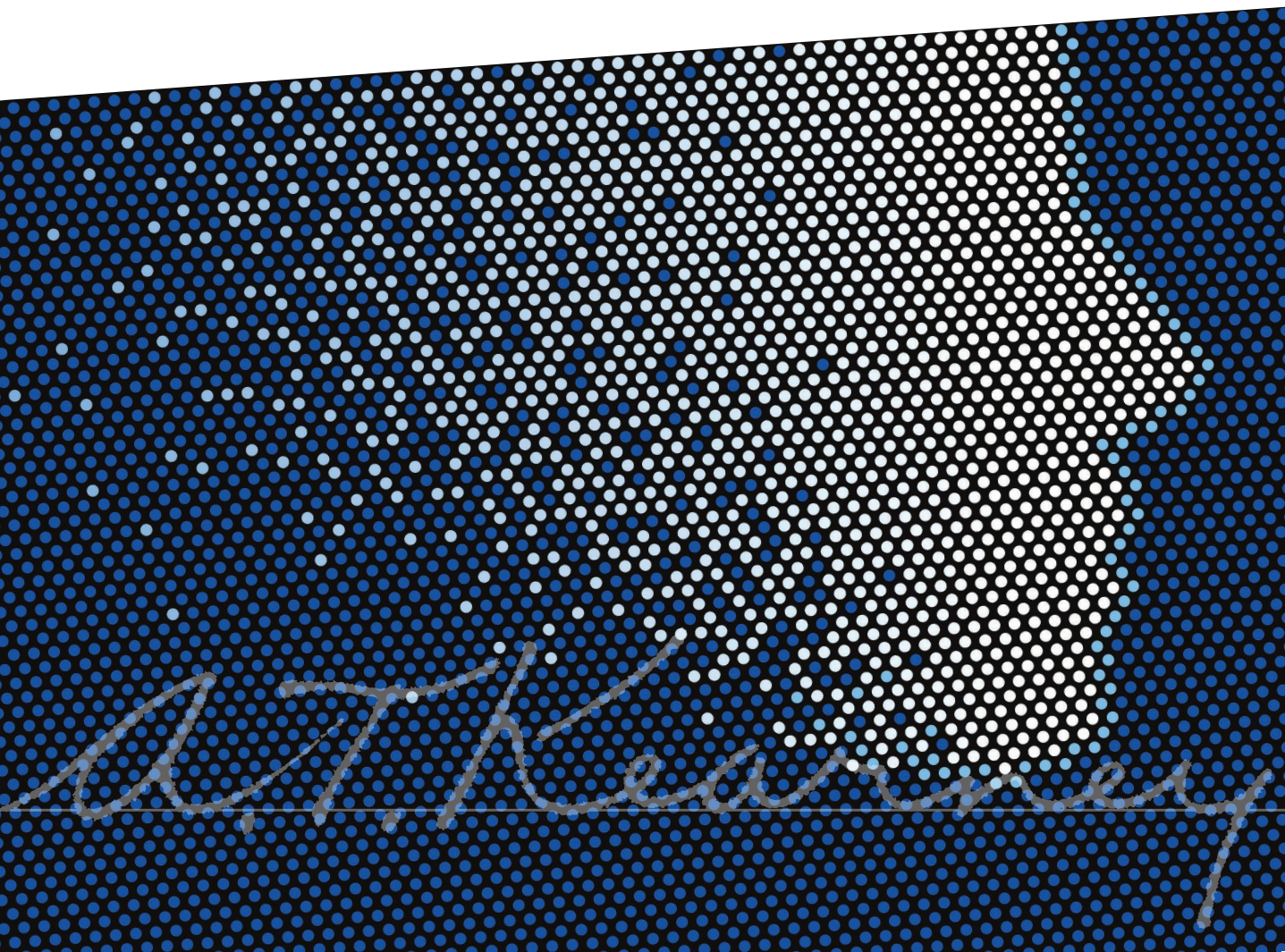
AT Kearney

Will You Embrace AI Fast Enough?

From Alexa and Siri to factory robots and financial chatbots, intelligent systems are reshaping industries. But the biggest changes are still to come, giving companies time to create winning AI strategies.



Artificial intelligence (AI) is a fast-moving technology with a long road ahead of it. For all its surrounding hype, AI is still in its infancy. Intelligent systems have moved from simple, rule-based tasks such as spell-check into narrow machine-learning activities such as predictive maintenance and robotic process automation (RPA), but they remain far from their ultimate destiny as fully realized facsimiles of human intelligence capable of complex, contextual reasoning and strategic decision-making.

The emergence of a technology that teaches machines to think like people has vast implications for individual workers, businesses, industries, and the economy as a whole. Machines have already conquered many blue-collar jobs (for example, manufacturing and manual labor) and now they are taking aim at white-collar jobs. Within companies, AI will reshape knowledge-worker functions ranging from sales and marketing to back-office administration. For example, cognitive systems have disrupted IT departments, replacing highly paid systems administrators with self-monitoring, self-diagnosing, self-repairing machines. Microsoft has developed software that writes code, raising the possibility that robots may someday program new robots. Legal "bots" have displaced paralegals and customer service "bots" have replaced many human agents.

> Successful companies will let business strategy lead AI deployment, not the other way around. They will focus on what their business needs, not what the technology can do.

Backed by billions in investment capital and top-flight tech talent around the world, AI will continue to fulfill its transformative potential over the next decade or so. Companies that start preparing today will position themselves to thrive in an environment redefined by AI. The good news is that companies still have time for a deliberate, strategic AI transformation.

Successful companies will let business strategy lead AI deployment, not the other way around. They will focus on what their business needs, not what the technology can do. Most importantly, they will understand the extent of organizational change required as automation supplants human employees across the enterprise. Companies need new capabilities, structures, and processes to meet a new set of challenges brought on by widespread AI adoption.

What Is AI?

Even as AI generates breathless media coverage and sharply conflicting opinions about its potential impact on humankind, the technology itself is not widely understood. Artificial intelligence is a collection of digital tools that enable machines to perceive, learn, and make decisions like humans.

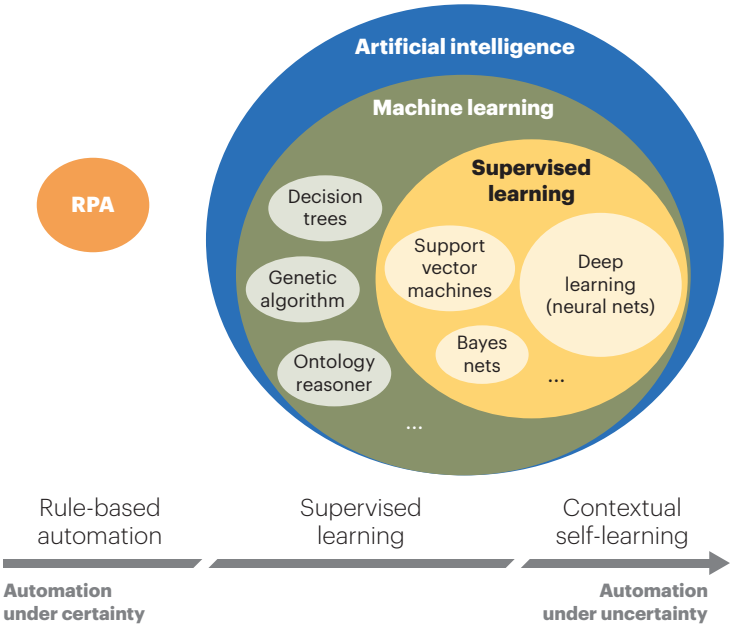
Most familiar are tools that support existing processes (such as the interactive voice response systems customer service organizations have been using for years) and take a series of preprogrammed actions. More recently, human augmentation technology has begun

automating entire business processes, such as on-boarding new employees, giving financial advice, or acting as a personal assistant. True artificial intelligence capable of emulating human behavior in complex, unpredictable environments—such as highway driving—is progressing rapidly, but is still a work in progress.

Futuristic as it may seem, AI has been around for decades. AI algorithms first appeared in the 1960s. Preprogrammed for simple "if-then" reasoning, they gave rise to early expert system platforms but found no commercial applications. AI development languished in the 1970s and 1980s amid government research funding cuts. A revival began in the 1990s with the emergence of limited machine-learning systems, embodied memorably in "Deep Blue," the IBM computer that defeated Russian chess master Garry Kasparov.

AI is the science of getting computers to act intelligently without being explicitly programmed. Machine learning **(ML)** is the subdiscipline of AI focused on using math-based algorithms and software to mimic smart actions, whose performance improves as a function of training data. There are numerous types of machine-learning algorithms available today. Deep learning, based on neural networks that mimic how brain neurons learn, is one type of algorithm that has made rapid breakthroughs recently (see figure 1).

Figure 1
Machine learning, and particularly deep learning, has accelerated in the past decade



Robotic process automation (RPA):
Virtual resources that can automate highly repetitive, structured tasks with very specific, linear decision criteria

Artificial intelligence (AI):
The discipline of making analytical machines intelligent, enabling an entity to function appropriately and with foresight in its environment

Machine learning:
Techniques for learning and performing cognitive functions (examples include algorithms for supervised and unsupervised learning)

Deep learning:
A statistical machine-learning approach based on deep neural networks that attempts to mimic brain architecture for learning

Source: A.T. Kearney analysis

Machine learning has accelerated in the past decade. Supervised, unsupervised, and hybrid-learning paradigms are flourishing, as neural networks based on architectures resembling the wiring of human brains enhance the ability of AI systems to compile information and apply knowledge in varying scenarios. Just over the horizon is autonomous machine learning, in which AI systems independently accumulate data and insights on a scale surpassing human intelligence.

A combination of forces is fueling the recent surge in AI development, especially in the area of machine learning:

Computing power. Dramatic increases in computing speeds enable systems to collect and process vast amounts of data very rapidly. Computers now process information 10 to 100 times faster, powering growth in neural network computational models.

Costs. Costs are falling as computing speeds accelerate, improving the economics of intensive machine learning. With the cost of 1 million transistors dropping 33 percent annually, capital requirements are down and potential returns are up.

Talent availability. Growing interest in AI among technically minded students has led universities to create programs focused on the technology. Graduates of these programs expand the talent pool for companies building automated systems.

Cultural acceptance. Cultural barriers to AI are crumbling as consumers grow more comfortable with "smart" features in a range of everyday items. In a relatively short span of time, people have started communicating with their televisions and taking advice from Alexa, Siri, and other digital personal assistants.

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Propelled by these forces, automated systems are learning faster, extending to new applications, and beginning to perform some tasks with greater speed and accuracy than humans. In a virtuous cycle, improving AI capabilities spur consumer demand for more convenient, customized services, which in turn attracts new start-ups that push technological boundaries and challenge dominant industry players.

The Continuing Evolution of AI

Despite its long-term promise, AI probably won't expand beyond a relatively narrow range of business uses for the next few years. Commercial applications are emerging in five primary cognitive systems: **natural language processing** systems that recognize voice and text expressions; **computer vision**, which identifies objects, scenes, and activities; **pattern recognition** systems that find recurring themes in large quantities of data; **reasoning and optimization** technology capable of complex inferences and efficient evaluation of various options; and **robotics**, which integrates cognitive technologies to perform end-to-end physical and cognitive processes.

In each area, AI has moved along a spectrum of intelligence from rule-based decision-making through supervised learning and into limited applications of unsupervised learning (see figure 2 on page 4). For example, natural language processing has evolved from spell-checking programs to personal assistant technologies that respond to questions. Computer vision, originally used to spot defects in fruit, now performs complex classification tasks by

Figure 2

The use of artificial intelligence will be narrow in scope in the near term

Rule-based RPA → Narrow AI → Broad "human-like" AI

Cognitive modes	Rule-based inference	Supervised learning	Unsupervised narrow learning	Unsupervised context-aware learning	Self-aware unsupervised learning
Natural language processing	• Spelling and grammar check	• Voice-to-text dictation	• Personal assistant apps with basic voice Q&A	• Real-time dialogue and translation	• Idiom, sarcasm, and nuance articulation
Computer vision	• Scanning typed characters in format forms	• Facial recognition • Scanning handwriting	• Complex classification (for example, video segment search)	• Vision systems in complex settings (for example, vehicles)	• Autonomous exploration agents
Pattern recognition	• Loans risk inference based on rules	• Fraud detection (based on known patterns)	• Product recommendation based on hidden customer preference	• Real-time clinical diagnosis • Anticipate cyberattacks	• Mimicking intuition and creative connecting of dots
Reasoning and optimization	• History-based predictive forecasting	• Forecasting using demand-sensing input with learned segmentation	• Identifying hidden biases from forecasting data and input	• Beating best-in-class human forecaster in specific domain	• Beat best-in-class human forecaster in several domains

Now–2025 | 2025 and beyond

Notes: RPA is robotic process automation. AI is artificial intelligence.

Sources: WEF expert panel interviews, press releases, company websites; A.T. Kearney analysis

searching video segments or scanning invoices. Pattern recognition systems have moved from rule-based industrial inspection to narrow unsupervised learning activities such as product recommendations based on demonstrated consumer preferences. Reasoning and optimization tools have evolved from diagnosing problems in malfunctioning equipment to predicting and preventing breakdowns. Robotics, once limited to following preprogrammed instructions under rule-based RPA, is now developing the ability to predict and resolve problems in automated processes.

Capital is flowing across the sector, with autonomous vehicle systems landing the most money, followed by RPA technologies.

These advances foreshadow the potential of AI as cognitive systems develop essential characteristics of human intelligence—the ability to learn on their own in a context-aware and self-aware fashion. Such systems will gather information autonomously, evaluate it, and make decisions. They'll provide financial advice, anticipate and avert cyberattacks, and conduct scientific research. They'll even understand slang, sarcasm, and tone of voice.

Far-fetched? Not to the investors pouring billions into AI technologies (see figures 3 and 4). Some 5,000 AI start-ups launched since 2014 have attracted a total of $40 billion from venture capital

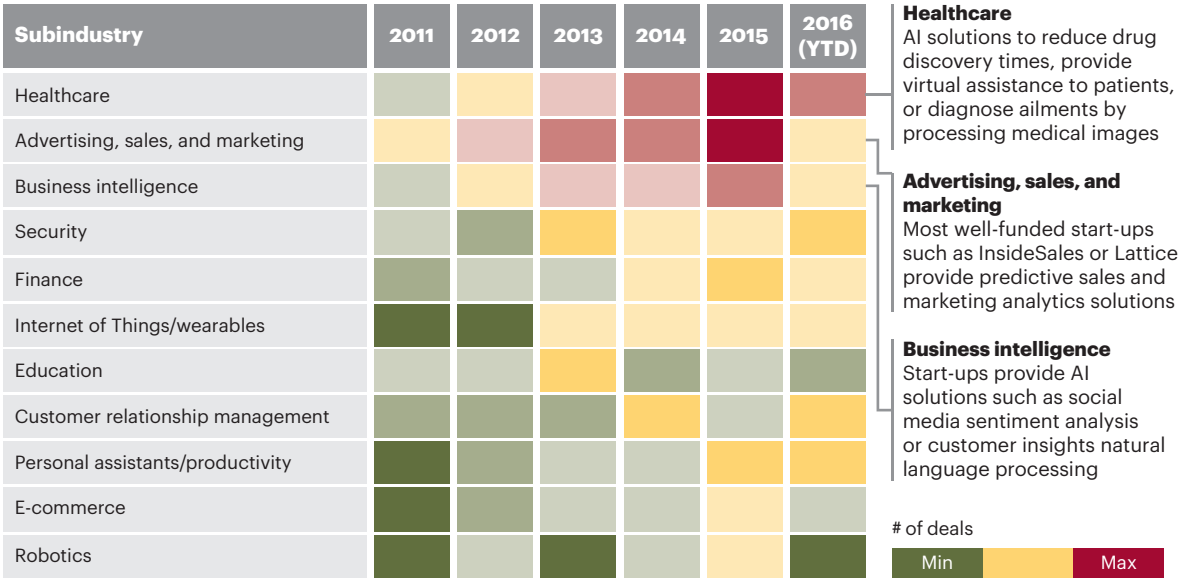
Figure 3
Investors are pouring billions into AI technologies

Clusters	Number of companies	Founding year median	Number of investments received	Investments received ($ million)	
				Total	Median
Autonomous driving	39	2015	67	$538.2	$1.7
Robotic process automation (RPA)	19	2015	27	$411.6	$2.0
Cognitive solutions/ platforms	39	2015	53	$336.6	$1.1
Deep neural networks (DNN)	22	2015	38	$306.6	$2.4
Marketing intelligence platforms	21	2015	33	$247.6	$0.53
Credit fraud detection/ prevention	44	2015	74	$218.4	$1.6
Image (face and emotion) recognition	21	2015	30	$184.2	$1.1
Patient records management	28	2015	46	$180.5	$1.5
Biotechnology	37	2015	48	$152.2	$1.1

Values: Low High

Note: AI is artificial intelligence.
Source: A.T. Kearney analysis

Figure 4
AI investment across applications



Note: AI is artificial intelligence.
Sources: CB Insights; A.T. Kearney analysis

firms and the investment arms of leading technology companies. Capital is flowing across the sector, with autonomous vehicle systems landing the most money, followed by RPA technologies.

Even as money pours in, AI faces challenges and risks that will affect the pace of commercialization and investment returns. Legal and regulatory concerns ranging from antitrust and data security issues to liability issues surrounding autonomous vehicles may slow deployment. Patent litigation among innovators could tie up key technologies, while talent shortages delay development of new applications. Though there is increasing adoption of certain solutions, there's no guarantee that customers will embrace AI technologies as quickly as innovators bring them to market.

Any technology attracting billions in capital carries significant financial risks. Some AI bets will pay off, but others won't. Companies that spend heavily on the wrong technologies or overpay for acquisitions will suffer. Conflicts over AI expenditures may arise, pitting innovators and company executives focused on long-term innovation against outside investors looking for quicker returns. So far, companies such as Amazon, Apple, Microsoft, Google, and Facebook have been able to fund next-generation technologies from the ample cash flows of their core businesses. But if those cash flows were to decline, shareholders might press management to cut spending on AI projects.

In the long run, these obstacles are unlikely to prevent AI from realizing its potential. But those who overlook or underestimate possible pitfalls risk painful stumbles.

AI Benefits

The scope of investment in various AI capabilities reflects a wide range of potential business applications. Early adopters of AI in many industries are starting to reap benefits across several dimensions, from customer service and marketing to manufacturing and regulatory compliance.

We have found that AI yields worthwhile benefits in any business process and underlying activities or tasks with six key characteristics:

High-quality data. Machine learning requires large quantities of easily accessible, heterogeneous data as a base for accumulating knowledge, recognizing patterns, and developing a set of decision-making options. However, AI is increasingly being applied to solving data quality issues, so that requirement will eventually go away.

High frequency. AI generates acceptable returns when it's used to reduce labor costs in recurring activities that involve significant amounts of human effort.

Analytical complexity. AI is well suited to analyzing complex data sets, where significant computing power is necessary to generate useful insights.

Risk mitigation. AI works best in areas where the impact of bad decisions and the learning time required to achieve acceptable error rates are well understood.

Clear parameters. AI improves efficiency in decision-making processes with clear, quantifiable inputs and outputs.

Ability to learn. The underlying process and task can be mastered by current machine-learning paradigms. Typically, these are activities that take a set of inputs and derive an outcome such as classification, prediction, or forecasting. More complex activities requiring context knowledge, human idiom, or emotional sensing are less amenable.

Most back-office processes meet these criteria. In accounting, for example, companies are automating such routine activities as invoice acceptance, general ledger coding, and weekly or monthly closings. Yet AI already is advancing from the back office to operational activities such as generating legal documents, providing customer service, and giving financial advice.

Some procurement organizations are applying RPA to the procure-to-pay process and looking to entrust purchasing decisions to cognitive buying assistants, and evaluating bots capable of overseeing entire sourcing programs. In oil and gas, drilling companies are experimenting with machine learning to select drill sites and set production targets.

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Following the AI Leaders

Not surprisingly, major technology firms are leading the way in commercializing artificial intelligence (see figure 5 on page 8). Amazon, Apple, Google, Facebook, Microsoft, IBM, and other digital heavyweights see AI as an opportunity to transform not only the tech sector, but a wide swath of the economy. For these companies, maintaining a leadership position in the next wave of technological disruption is a strategic imperative. In a sign of its determination to dominate artificial intelligence, Google recently changed its rallying cry from "mobile first" to "AI first."

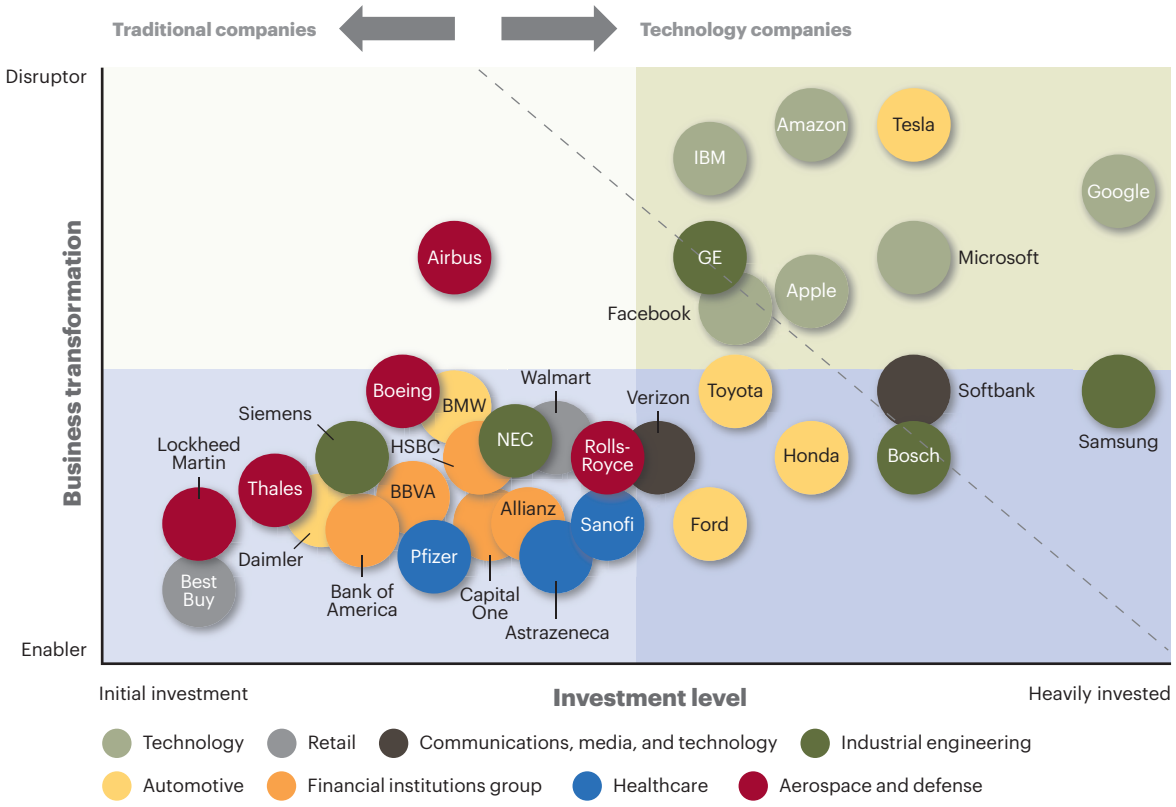
Perhaps more surprising is the enthusiasm for AI among old-line industrial organizations such as GE and Ford. These companies recognize the importance of cognitive technologies in a broader digital transformation of their core businesses. Both companies aim to create new or better products while also spawning markets for services made possible by AI technology.

The leading tech firms have launched an array of AI-based applications, and provide AI-as-a-service to other companies. Most advanced are offerings based on natural language processing, text analytics, image analysis, and speech recognition.

Digital personal assistants—Apple's Siri, Amazon's Alexa, Google Voice, and Microsoft Cortana—use natural language processing to understand and emulate human speech. Apple's face recognition security interface and photo organization app capitalize on image analysis. Machine learning and other AI capabilities feature prominently in new Google products such as the Pixel 2 smartphone, Clips camera, and Daydream View virtual reality system. Watson, IBM's digital interlocutor, is a big bet on AI in business-to-business markets. And Amazon is deploying data science and AI engines and platforms in its quest to disrupt retail and other industries.

Figure 5

Investment level against business transformation **Relative placement**



Source: A.T. Kearney analysis

Companies outside the tech sector take a more-focused approach to AI. Automakers including BMW, Ford, Honda, Tesla, and Toyota are pumping resources into autonomous vehicle technologies likely to alter not only their products but also their business models and basic industry structures, such as General Motors' intent to offer ride-sharing services with self-driving cars. Other manufacturers such as Bosch, GE, and Samsung are investing in machine learning, connected devices, and the Internet of Things to create service offerings that support and expand their existing business lines.

Getting Ahead in AI

Successful artificial intelligence transformations start with visionary leadership. Companies at the forefront of AI are led by far-sighted but pragmatic executives who deploy cognitive technology as part of a strategic effort to ride the next evolutionary wave. Innovation drives their corporate cultures, and top leaders support investment in both R&D and in-house venture capital units. Undeterred by the risk of failure, they're willing to place big bets on the future. On a practical level, they have large and growing storehouses of data, sophisticated algorithms, and large-scale processing capabilities paired with an entrepreneurial spirit to tackle the AI challenge.

For tech companies scrambling to keep their lead in AI, speed is an overriding imperative. They adopt the "agile" approach: take risks, fail fast, and quickly move on to the next investment or

product iteration. They're always scanning the horizon for potential disruptors, moving quickly to acquire start-ups with promising new technology. In the past few months, Google has acquired machine-learning start-up Halli Labs and computer vision specialist AIMatter. Amazon has scooped up a string of AI innovators, including cybersecurity firm Harvest AI and photo-recognition company Orbeus.

> Companies at the forefront of AI are led by far-sighted but pragmatic executives who deploy cognitive technology as part of a strategic effort to ride the next evolutionary wave. Innovation drives their corporate cultures.

Emphasizing technology leadership over narrow sector dominance, tech firms spread AI investments across numerous niches. In addition to acquisitions, they fully fund internal R&D. They also embrace open innovation models, collaborating with outside developers, universities, and research labs.

Companies in other industries move more cautiously, focusing on their primary markets and related sectors. They closely monitor potentially disruptive technology, aiming to keep ahead of industry rivals. Internal development and pilot-testing of new technologies play a big role in their AI programs. Further, non-tech companies often make exploratory investments, acquiring stakes in start-ups through their in-house venture capital operations. They also favor innovation partnerships with tech companies, and subscribe to AI-as-a-service. Tech companies bring digital expertise and computing infrastructure to these partnerships, while the industrial partner provides vast data troves, customer relationships, and manufacturing capabilities. Working together, they create niche AI solutions suited to the unique needs of the traditional company.

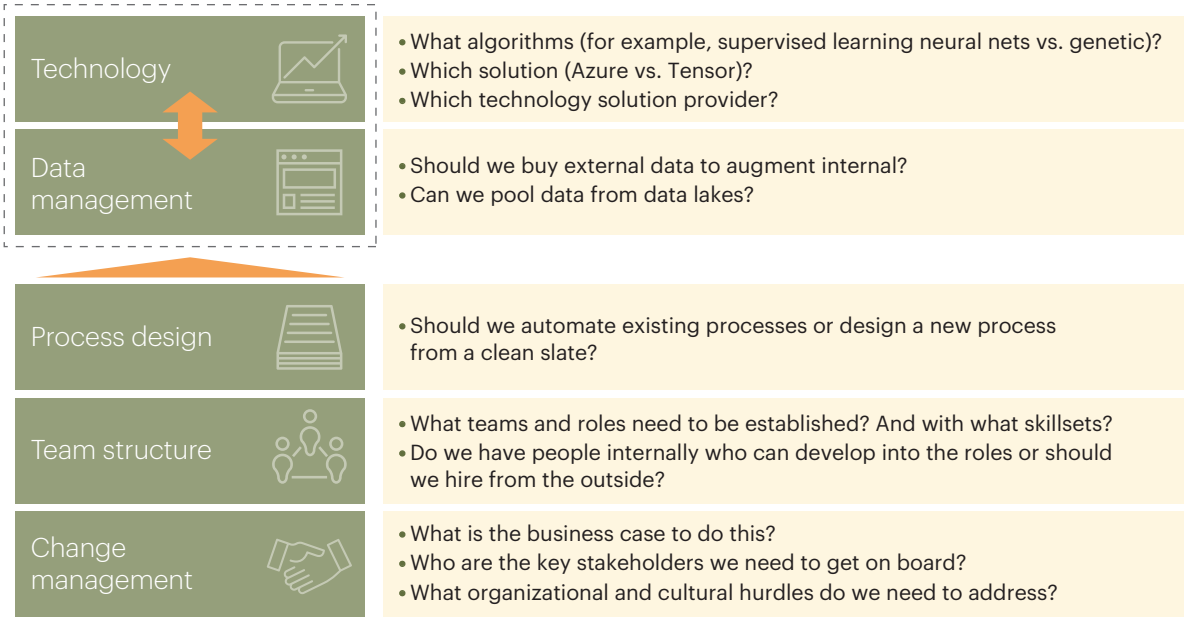
Embracing the Future

Artificial intelligence represents a challenge and an opportunity for virtually every company. Few industries can reasonably hope to avoid disruption by a technology that endows machines with human reasoning capabilities—and boundless processing power. AI will create new products, transform organizations and industries, and level playing fields in global markets. Capabilities once concentrated in a few large organizations will become widely accessible, enabling small challengers to take on entrenched industry leaders. Companies in many industries already have automated a wide range of processes. Yet AI has reached only a small fraction of its ultimate potential. The race is on, and some contenders have moved ahead, but nobody has a commanding lead yet. Companies that make the fundamental changes needed to integrate AI holistically into their strategies and operations still have a chance to win.

Such a revolutionary transition calls for equally deep changes in every enterprise. Spurred by burgeoning hype, some have rushed in with ad hoc, opportunistic AI initiatives. While these

Figure 6

A complete reorganization is necessary to win in AI



Note: AI is artificial intelligence.
Source: A.T. Kearney analysis

moves may generate useful early insights, they're no substitute for a thoughtful, comprehensive approach.

Simply buying AI software and implementing new technology and data management systems will not be enough. Nothing less than a complete process and reorganization around AI will do (see figure 6). Organizations that reconfigure themselves to tackle those challenges will keep pace with evolving AI technology, and reap their full share of the benefits of this transformational technology. Even at this early stage of development, automation is generating improvements in customer service, product design, and operational efficiency. Far greater rewards await those who make the right moves today.

A long journey lies ahead. But nobody has fallen behind—yet.

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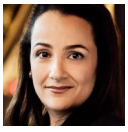

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