Governance Insights Center
Technology series
Emerging technologies

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The Essential Eight technologies
Board byte: artificial intelligence

Artificial intelligence is changing how companies do business. What should boards know?

Companies across industries are using, investing in or planning to invest in artificial intelligence (AI). AI is improving industry processes and making machines "smart." It is expected to be one of the most disruptive technologies impacting industry and business. As the market for AI grows, boards should understand how this technology will affect their company's strategy.

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AI is wide-ranging

AI is an umbrella term for "smart" technologies that are aware of and can learn from their environments. Robotic process automation (RPA), machine learning, natural language processing and neural networks all incorporate AI into their operations. What are they?

- *RPA* software automates repetitive business, industrial and other tasks. *RPA can help users in the back office optimize their processes.*
- *Machine learning* allows computer systems to learn from data and recognize patterns, predict outcomes, assist humans with understanding or suggest actions (becoming "smart") without being explicitly programmed. *Among other things, machine learning can inform decision-making and make process automation more flexible.*[1]
- *Natural language processing (NLP)* interprets aspects of natural spoken language or text in order to provide insights or enable functions. *NLP allows computer systems to analyze and understand the human language.*
- *Neural networks* are interconnected networks of artificial neurons, or nodes, that simulate human brain cells. They're designed to learn from labeled patterns in data that flow through the network layer by layer. They record what they learn by weighting or unweighting an input – to determine how correct or incorrect it is – with the ultimate goal of using probability to solve the task being performed. *Deep learning is machine learning using several hidden layers of neural networks.*

We've all heard of artificial intelligence (AI). It's in the movies and is now in our everyday lives at home and work. AI is more than just a single independent technology. It's making smart devices smarter, data more valuable and cloud-based tools more efficient. It's turning autonomous vehicles into reality. It will disrupt business models, create new ways of working and facilitate digital transformation. In the not-so-distant future, most technology applications will likely incorporate or harness the output of some form of artificial intelligence.

So what is it, exactly? In a nutshell, AI enables computers and other devices to perceive, analyze and adapt to their environments. Using software algorithms, these devices can perform tasks that would normally require human intelligence. AI enables machines to sense their environments, think, learn and respond on their own, becoming increasingly autonomous. In effect, AI allows machines to contribute more intelligently to business activities. They do this by recognizing and interpreting digitized text, sound and images, making it possible to answer questions, suggest solutions and diagnose problems or take actions. As a result, AI can reduce the amount of rote work humans are faced with everyday.

"Just as electricity is fundamental to the way we live, in the not-so-distant future, it is not hard to see how AI will become the new electricity – embedded and/or supporting just about every aspect of our life."

– Daniel Eckert, PwC's Emerging Tech Leader

AI: the future of everything?

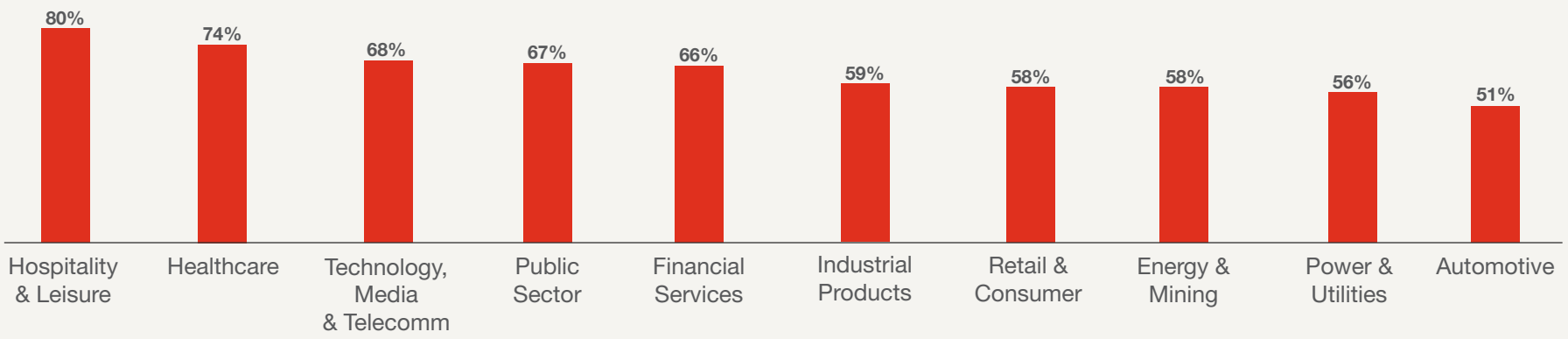
72% of business leaders believe AI will be the business advantage of the future.

– PwC, 20th Global CEO Survey, 2017

After analyzing more than 150 emerging technologies, PwC categorized AI as one of its Essential Eight technologies. AI is transforming all industries. In fact, CEOs agree that AI will impact every facet of business, offering unprecedented ways to innovate and grow companies in nearly every industry. And the market for AI is growing – fast. In 2016, the AI market attracted more than $3 billion in venture funding.[2] The total projected market is expected to reach $70 billion by 2020.[3] According to PwC's *2017 Global Digital IQ Survey*, the number of companies that are investing or have plans to invest in AI is second only to those investing in the internet of things (IoT).

So why are companies investing in this technology? Companies are looking at AI as a means to foster innovation, optimize business efficiency and improve productivity. AI also enables other emerging technologies, like robots and the IoT, and it can improve data analytics.

Artifical intelligence investment in three years by industry



Source: *PwC, 2017 Global Digital IQ® Survey*.
Bases: Automotive: 72; Energy & Mining: 135; Financial Services: 332; Healthcare: 237; Hospitality & Leisure: 75; Industrial Products: 375; Power & Utilities: 131; Public Sector: 156; Retail & Consumer: 217; Technology, Media & Telecommunications: 433

AI in action today

- **Jeeves goes digital** – Digital assistants – AI programs that help people get answers to questions and perform tasks and services – are most commonly used at home, through mobile devices or computers. They can interpret language to search vast amounts of information for answers to questions, make changes to your calendar and even control some household appliances and smart home devices with verbal commands – part of the IoT. Forty-two percent of consumers already use them, and 72% of business executives do.[4] What else is coming? AI assistants as tutors, travel agents and tax preparers.

- **Never forget a face** – Uploading your pictures to social media and tagging your friends? Often, their names pop right up, thanks to AI. But there's more to facial recognition technology today than what you see on Facebook. Companies in the advertising, security and automotive industries are using image recognition, machine learning and deep learning to better serve customers. The data from an image can help identify customer preferences and offer new suggestions. Its benefits also extend to law enforcement – the data can be used to detect suspicious behavior. And it can help Alzheimer's patients and the visually impaired as well.

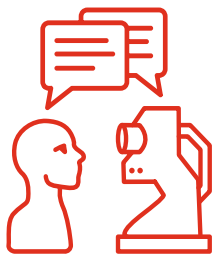
- **AI in the sky** – Some researchers are looking to AI to develop a "smarter" autopilot that does more than fly pre-planned flight paths. The autopilot can learn how to adapt to changing conditions, such as bad weather or engine failure, by studying pilot actions and sorting through flight data. Airlines are also starting to use AI outside of the cockpit for preventative and predictive maintenance, as well as for route management, booking and customer service.

Four ways to apply AI, from simple to advanced:

- *Automated intelligence* is the automation of manual or cognitive tasks and does not involve new ways of doing things (e.g., software that compares documents and spots inconsistencies and errors).
- *Assisted intelligence* improves what people and organizations are doing today, helping people perform tasks better (e.g., industrial robots, medical image classification, paper check reading and verification by a bank's ATM).
- *Augmented intelligence* enables them to do things they otherwise couldn't do and make better decisions (e.g., Netflix suggesting viewing choices for users based on a customer's patterns of behavior and those of the broader audience, guided personal budgeting).
- *Autonomous intelligence* automates the decision-making process without human intervention, establishing machines that act on their own (e.g., automated trading in stock markets, fully autonomous self-driving cars, full-fledged language translation programs).

What's next for AI?

Transforming healthcare. AI is fast becoming a critical part of the healthcare industry. A vast amount of patient healthcare data has been collected in recent years. With AI, that data can be sorted, organized and interpreted, helping doctors and nurses make better and more efficient patient care decisions. The healthcare industry can also use AI for diagnostics, for example, to detect small variations within patients' health data, compare them to similar patients, and enhance imaging diagnostics in radiology and pathology. AI can also help identify potential pandemics early and track the incidence of diseases to help prevent or contain their spread.[5]



AI is changing the relationship between humans and machines. Leaders across industries are banking on the connection between human and artificial intelligence. AI could process, analyze and evaluate the vast amounts of data generated today, allowing humans to focus on creative high-level thinking. Companies are also thinking about what AI could mean for their workforce. How will AI affect employees? Will it change the kinds of skills we need? How will humans and machines work together? Do we pair our best people with the technology so it can learn from them? Or do we have the technology handle certain tasks while employees focus on others?

Adoption benefits and barriers

76% of CEOs are concerned about the possibility of unintended biases creeping into AI algorithms or decision-making models.

– PwC, Global CEO Pulse Survey, April 2017.

Companies adopting AI expect to see increased productivity. New efficiencies can be derived from streamlining tasks that previously took humans weeks to complete and improving work processes by pairing people and machines in new ways. Many businesses also believe AI will accelerate and enhance innovation, creating new jobs. And some expect to see increased consumer demand from more personalized and higher-quality AI-enhanced products and services.

Some worry that AI and automation will end up eliminating jobs. But to capitalize on the technology, companies will need to hire people with AI experience or the skills to analyze and use the data. This talent is in short supply, though, which means securing it could become expensive. Companies also need the computing power and system infrastructure to support AI-enabled products and services, and they need platforms to organize and integrate their data. Getting this infrastructure in place can be costly.

The data collected by AI presents another big challenge. How do companies ensure it is valid? What limits do they need to put on its use? Can safeguards ensure that machines carry out human orders as intended? There are concerns that unintended biases may find their way into AI algorithms or decision-making models. Companies need to establish strong controls to prevent this from happening and monitor the systems that learn through AI. Letting stakeholders know about the company's oversight can help establish trust with stakeholders that companies are using AI responsibly. And given the vast amounts of data collected by AI, privacy and data protection are other big concerns.

Questions boards can ask

Boards will want to understand AI's opportunities, and its risks. Here are some questions boards can ask management about how AI will fit into the company's strategy:

- Have we considered how AI could transform our products or services and which aspects of our business could benefit from increased automation or machine learning?
- Have we considered the potential efficiency and productivity benefits that may come with adopting AI?
- How might AI fit with other emerging technologies we are investing in?
- Do we have the computing power and infrastructure to support the use of AI? Do we have the digital skills and talent to move forward?
- How will we gain the trust of our stakeholders if we use AI? How can we ensure that biases do not alter AI decisions? Do we have established practices and controls in place to minimize any reputational or other risks?
- Have we thought about how we would use data collected by AI? Have we considered cyber risks and data privacy issues?

Boards that develop a basic understanding of AI and the other Essential Eight technologies can better oversee management's decisions on which of these technologies are most relevant to the company's business and most likely to create strategic opportunities.

For more resources on what boards should know about the Essential Eight and digital transformation, go to our website, ***Digital hub: insights for corporate board members.***

Find additional ***resources on AI*** and emerging technologies on PwC's ***Next in Tech*** hub.

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1. Tami McQueen, “The Future of Artificial Intelligence Will Amplify And Catalyze Workflows,” Forbes, October 3, 2017; https://www.forbes.com/sites/forbescommunicationscouncil/2017/10/03/the-future-of-artificial-intelligence-will-amplify-and-catalyze-workflows/2/#1735cb412293.
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4. Ibid
5. Brian Wilson, “Enabling better healthcare with artificial intelligence,” PwC Next in Tech blog, August 28, 2017; http://usblogs.pwc.com/emerging-technology/ai-in-healthcare/.

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