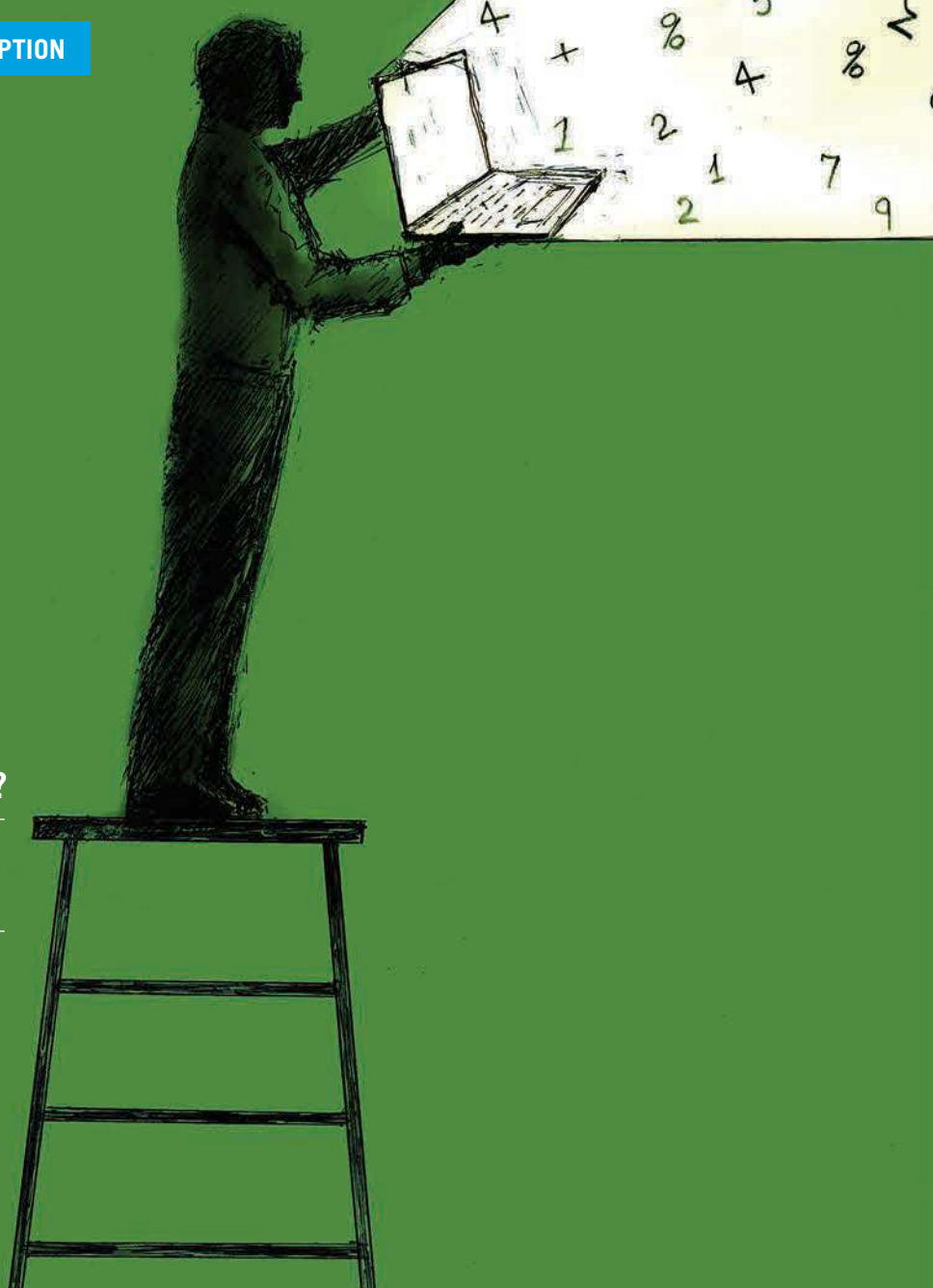


Artificial intelligence: Real opportunity

FRANKLIN TEMPLETON THINKS™

DISRUPTION



The real appeal: Why should we care about artificial intelligence?

The real feel: How will AI affect us?

The real deal: Helping investors understand what to look for



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INVESTMENTS

Mapping the growing influence of AI and machine learning

In recent years, the evolution of artificial intelligence (AI) has rarely been far from the headlines. Its influence now reaches into nearly every sector and geography and holds economic and political ramifications that many experts say are on par with the Industrial Revolution.

This transformational technology of the digital age is powering new kinds of automation, more pervasive and smarter than ever before. It holds the potential to affect every industry—not just logistics, manufacturing or transportation—and will impact both white-collar and blue-collar workers.

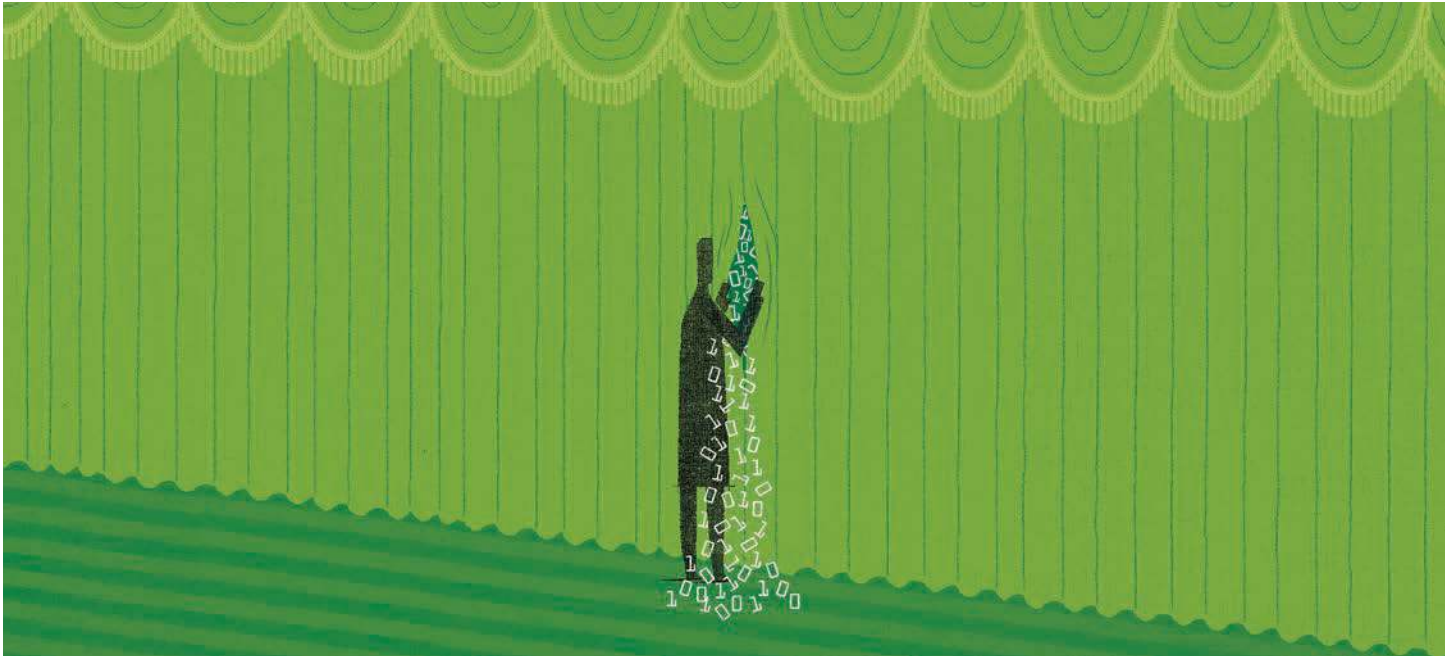
We've recently seen an explosion of new applications from some of the biggest names across a range of industries. And that's just the tip of the iceberg, as AI becomes a larger part of our daily lives. The impacts may not always be obvious to consumers, but companies are applying this technology in ways that help them do what they do better.

As with any technological innovation, particularly those that promise as much as AI, expectation and aspiration can outpace reality. It's our job as analysts to cut through the hype: to assess what is feasible and where the real benefits can be found.

Not everything that AI proponents promise will come to fruition, but the confluence of a number of factors, including data, computational power and talent, gives us confidence that AI will be a growing influence in the world.

Key takeaways

- 1** The rapid advancement in AI—supported by a large base of always-connected consumers and things, high-speed internet access and expanding global cloud computing infrastructure—is ushering in a radical technological transformation that will allow the global economy to digitally evolve.
- 2** AI is attracting growing amounts of corporate investment, and as the technologies develop and start to make an impact, the value that can be unlocked will grow.
- 3** The real differentiating factor for companies developing AI tools is the data used to solve a problem. Computing power is a commodity. Many relevant algorithms and machine learning techniques are in the public domain, and are largely a commodity as well. That's why we believe companies with proprietary datasets or privileged access to differentiated datasets, which they can learn from, should be the winners in the long-run.



The real appeal: Why should we care about artificial intelligence?

AI is the application of technology to achieve real-world goals. Its practical application throughout the economy is growing apace.

AI uses “machine learning” to allow computers to perform tasks that usually require human intelligence. These tasks include data analysis, speech recognition, decision-making and translation.

The application of AI technology can help make sense out of vast amounts of data so humans can leverage it—in many cases more quickly and efficiently than an individual could ever accomplish.

Technology can accomplish analysis and activities that, in some cases, would require companies to hire thousands, if not millions of employees. Used

correctly, AI can enable businesses to do more with a standard workforce than was ever thought possible.

Further out on the AI frontier, traditional analytics is giving way to newer “deep learning” techniques across industries and business functions. This is where neural networks, as a subset of machine learning, create AI systems based on linked “neural units,” loosely modeled on the way that neurons interact in the brain.

Computational models based on neural connections have risen to prominence as computing power—and the world’s computing infrastructure—has increased sufficiently enough to handle large labeled training datasets, allowing for many (“deep”) layers of simulated interwoven neurons.

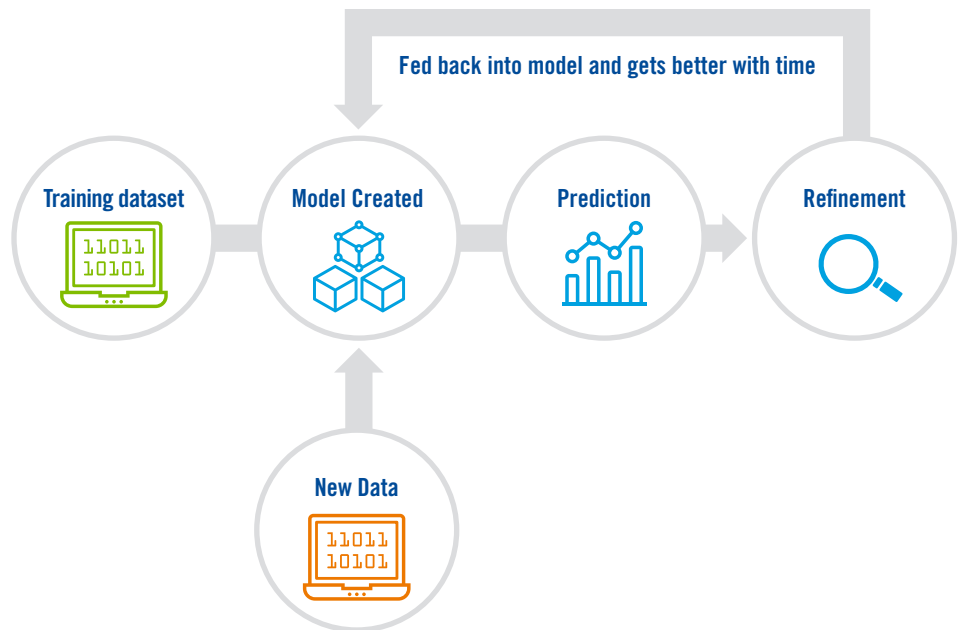
MACHINE LEARNING VS AI

The terms AI and machine learning are often used interchangeably. However, there is a technical difference.

Machine learning is a sub-area of AI, representing AI’s most common application. Without machines learning by themselves—for instance by observing patterns in real-world data and making models that can predict outcomes—there would be very little progress in the field of AI. In general, all machine learning is a form of AI, but not all AI is a form of machine learning.

HOW AI WORKS

AI, or more specifically machine learning, is the ability to progressively improve performance on a specific task, or “learn” with data, without explicitly being programmed. It works by applying an algorithm to data to discover patterns and generate insights. Those insights refine the algorithm to produce increasingly better insights.



Why now?

Scientists have had a theoretical understanding of the principles underpinning AI/machine learning for more than 30 years. But the technical ability to put that knowledge into practice has only emerged in the last few years.

Several developments have contributed to AI's leap forward, in particular the huge volumes of data that are now available thanks to the internet, social media and sensors associated with the Internet of Things (IoT).

THREE REQUIREMENTS FOR MACHINE LEARNING

- 1 Data
- 2 Computational Power
- 3 Talent (Computer Scientists)

TODAY WE HAVE

- 1 Internet / IoT / Sensors / Cloud
- 2 Moores Law Of Computing Cost
- 3 Growing Number of Computer Science Graduates

Quality data: Better learning?

The quality of machine learning, and therefore of AI, is a function of the amount and relevance of the data available. Accordingly, the ability to collect and use rich data to better understand and serve customers is a vital component of the global economy's digital transformation. This data management ability is therefore vital for a company to capitalize on AI capabilities to improve its business.

In the past, the ability to solve problems and develop outcomes relied on the availability and skill of individuals—generally skilled programmers. Today, adaptive learning algorithms can run simulations millions, even billions, of times in the blink of an eye.

Those simulations can map multitudes of events, look at the outcomes and constantly update themselves with new information.

With so much rich data available from so many sources—including smartphones, smart vehicles, the IoT—its quality has become significantly better over time. Meanwhile, advances in technology mean it's now possible to collect and

store those volumes of data in a cost-effective way that's suitable for feeding machine learning.

The barrier to solving problems has gone from having enough programmers, to having enough data and computing resources. Currently, big internet (bellwether) companies are best suited to break down that barrier as they possess vast consumer datasets for use in AI and machine learning.

Lower cost computing and new skillsets

Computing power has become cheaper and more readily available. That, together with the expansion of cloud companies, has driven the cost of storing data down.

There has also been an expansion in the standing of computer science, resulting in a substantial increase in the number of students leaving school with detailed knowledge of the fundamentals of AI, including the ability to set up machine learning algorithms.

The combination of all these factors has contributed to the development and influence of AI technologies.

The real feel: How will AI affect us?

AI is already in use in many applications we use on a daily basis. For example, streaming services and social media platforms employ AI technology as part of their pattern and behavioral recognition programs. When a streaming service recommends movies or music you may like, they've been curated by AI. When a social media app suggests friends to tag in a photo—also AI.

But the opportunity AI presents is much greater.

Application of AI

The growing adoption of AI across multiple sectors has been born out of necessity as increasingly data analysis and application has become automated.

Many industries have found that they must innovate, partly because the global economic growth environment has been slower than we have seen in past recoveries, technology driven productivity gains have become more important. These industries have been adopting AI technology to eke out incremental growth or productivity to accelerate earnings.

Retail, media, financial services and transportation are among the industries feeling the impact of the emerging tech-centric platform disruptors. We believe these disruptors are successful now because they are building service oriented, data-rich relationships with their customers, often through deft

integration with today's consumer gateway companies.

To respond, non-tech centric companies are increasing their information technology (IT) investments across AI, cloud computing, CRM (customer relationship management) and other emerging technologies.

In the near future, we believe software applications and smart devices across all industries are likely to feature some form of embedded AI in them.

Without a doubt, the rapid advancement in AI—supported by a large base of always-connected consumers, high-speed internet access and expanding global cloud-computing infrastructure—is

INDIVIDUAL APPLICATIONS FOR AI



Fraud Detection

Credit Cards. Online Activity.



Transportation / Route Planning

Waze / Google Maps. Ridesharing.



Email

Spam Filter. Categorization. Automated response technology. Commitment language in email text.



Facial Recognition

Facebook / Apple.



Digit Recognition

Mobile Check Deposits. Addresses on Letters.



Language

Voice-to-text. Alexa. Robo-readers.



Recommendation Engines

Amazon, Netflix.



Health Care

Patient diagnoses. Addressing disease prevention.

ushering in a radical technological transformation that is permeating all areas of the global economy. Companies will likely have to keep up or be left behind as machine- and deep-learning take hold and become more prevalent.

Industrial applications for AI

- **Preventive maintenance:** AI applications can predict when machines or equipment need to be updated or replaced. Businesses and consumers won't need to wait for things to break or stop working before they are fixed.
- **Fraud detection:** The availability of large volumes of customers' real-time transactional data can be used to identify credit card behavior patterns that are irregular for specific customers.
- **Supply chain, stocking and pricing:** AI and big-data analytics already help retailers make some of the riskiest decisions: those related to inventory planning and allocation. By combining early demand signals, sell-through rates and regional and demographic data, AI tools can predict whose products could have the largest impact on a company's bottom line. The data often come from proprietary sales reporting systems, competitor pricing, social media and online reviews.
- **Healthcare:** Large health systems are teaming with tech and tech-focused industrial companies to develop applications that integrate AI across the continuum of care. AI has been employed in the fight against cancer—by providing an intuitive way for doctors to sort through vast databases of cancer research to identify targeted treatments.
- **Biotechnology:** Speed research in rare diseases. Identifying genetic markers will provide a significant boost to research and development efforts and result in faster diagnoses.
- **Retail sales:** Voice assistants, chatbots and messengers play a critical part in

next-generation retail sales and customer service, and growing smarter over time by ingesting large quantities of data and offering tailored recommendations to clients.

Who is spending on AI?

AI is expanding across virtually all industries. According to the International Data Corporation (IDC), Worldwide spending on cognitive and artificial intelligence (AI) systems will reach \$19.1 billion in 2018, an increase of 54.2% over the amount spent in 2017.¹

Traditionally banking has been the biggest spender on AI, but the IDC predicts that in 2018, retail will take the top spot, spending \$3.4 billion versus banking's \$3.3 billion.²

Discrete manufacturing spend on AI is expected to surpass \$2 billion in 2018, while AI investment in the health care sector is forecast at \$1.7 billion. Utilities and transportation are forecast to be among the fastest-growing industries for AI products, with compound annual growth rates of 68% and 61%, respectively, through 2020.³

Artificial intelligence shouldn't replace the real thing

The expanding influence of AI also raises more existential concerns for some observers. In particular, it's easy to draw conclusions about the possible impact on employment if AI were to make job roles redundant.

Some research suggests technology can contribute to more and better-paid jobs.⁴ Nevertheless, many economists still cite advances in robotics and AI as a factor keeping a lid on wage growth in the United States even as the unemployment rate falls. The argument goes that improved technology has broadened the range of tasks that can be automated, compressing wages for low- and medium-skilled occupations.

THE NUMBERS: WHO IS SPENDING ON AI

\$2B+

Expected AI spending
by discrete manufacturing
sector in 2018

\$1.7B

AI investment forecast
in health care sector

However, in our view, if automation was playing such an important role, we would expect to see faster productivity growth and modest gains in employment; so far we have seen exactly the opposite.

Our research suggests there is little chance of human contribution becoming obsolete just yet.

We feel that the companies best adapted to succeed in the AI sphere are those that have figured out how to ask interesting questions about data and then operationalize the findings.

At the moment, it's human beings that are asking those questions. Machines aren't yet running completely on their own. People who have deep insights of how business operates are directing them.

While data is a vital component, in our view, it's not enough to just have the data, you also need the human capital that understands how to make sense of it.

1. Source: IDC. Worldwide "Semiannual Artificial Intelligence Systems Spending Guide." March 22, 2018. There is no assurance that any estimate, forecast or projection will be realized.

2. Ibid.

3. Ibid.

4. Source: PricewaterhouseCoopers. "Seizing the Prize." July 2018.

The real deal: Helping investors understand what to look for

Evaluating investment potential for AI capabilities

AI is attracting growing amounts of corporate investment. As the technologies develop and start to make a broader impact, we think the potential value that can be unlocked is likely to grow.

Our ambition when seeking out AI opportunities is to find companies with access to proprietary, domain-specific datasets that can be used to solve real

business problems, and unlock easily quantifiable value.

Further, we look for cases where this could lead to network effects whereby a solution for one customer can be used to improve the offering and more easily win future business.

In assessing an opportunity, we focus on three areas: value creation, value realization and defensibility.

Value Creation. What is the customer's specific problem? How much value does

solving it unlock and how many similar customers are there to build up a total available market, in other words the total market demand for the product or service?

Value Realization. How does the company think about the return on investment? How easy is it to adopt the technology internally with employees and externally with customers? Does the company have the right data to solve the problem? Does the solution require



additional infrastructure (such as the addition of sensors to collect data)? Does it require a change in business flow?

Defensibility. Can someone else come in and disrupt a niche? Are the data proprietary? Is it public domain data? Can someone else come and build the same algorithms? How fungible is that dataset? Are there network effects? Does new data (for example from a new customer) improve the algorithm?

Although we aim to take a comprehensive look across the AI and technology landscape, we also consider the drivers and opportunities for non-tech companies leveraging AI now and in the future.

Concepts that propel bigger ideas are part of our deeper analysis and investment thesis. Being embedded in Silicon Valley, we gain academic partnership-level insight from “AI intelligence developers” and firms that possess unique AI-based platforms and datasets.

What's AI worth?

Global consulting firm PricewaterhouseCoopers estimates that by mid-2030s AI will contribute up to \$15.7 trillion to the global economy.⁵

McKinsey & Company consultants estimate that AI techniques have the potential to create \$3.5 trillion–\$5.8 trillion in value annually across nine business functions in 19 industries.⁶

Within the financial services industry alone, the application of machine learning could result in \$1 trillion in cost savings by 2030.⁷

Application software as a stealth play for AI

With their massive datasets, control of computing power and large teams of AI specialists, we think tech bellwethers in e-commerce and social networking are obvious beneficiaries of recent AI advancements.

Less obvious, we believe, are the opportunities emerging for enterprise software-as-a-service (SaaS) application companies as machine learning advances and as customers embrace SaaS deployment models over more cumbersome “on-premise” technology deployments (those installed in an enterprise’s data center).



We regard SaaS companies as a stealth play for AI. Application software companies should likely benefit from AI technology because they control two unique and compounding datasets:

Product Usage Data. Unlike their legacy on-premise peers, SaaS companies have near-perfect visibility into how their products are being used. They can leverage this usage data with machine learning to improve a SaaS company’s products. We believe this should support SaaS companies’ pricing, reduce churn and make the sales process more efficient.

Customer Data. Unlike their legacy on-premise peers, SaaS companies have access to their customers’ data. They can mine these data to generate new revenue sources and keep customers more engaged with SaaS providers’ offerings. We believe this represents a profound change and can create significant opportunities for SaaS vendors well beyond the traditional software market.

Challenges to adoption

Innovation in AI will likely bring us closer to further technology integration in our

SUPPLY AND DEMAND SIDES

As investors scope out opportunities, we consider the machine learning universe in two ways: supply and demand.

SUPPLY

The supply side features companies that design, build and facilitate machine learning. These might include:

- Companies that generate algorithms,
- Semiconductor capital equipment companies (companies that build the semiconductor factories known as fabrication plants, or fabs),
- Semiconductor companies (chip and memory manufacturers), and
- Companies offering cloud services.

DEMAND


The demand side includes companies that use machine learning to enhance their business.

Examples of demand-side business might include companies with unique and compounding datasets that they can leverage to drive greater productivity in their businesses as well as new sources of revenue.

5. Source: PricewaterhouseCoopers. AI Impact Index. June 2017.

6. Source: McKinsey & Company. “Modeling The Impact of AI on The World Economy.” September 2018.

7. Source: Autonomous.com. “ARTIFICIAL INTELLIGENCE: \$1 Trillion in Exposure from Artificial Intelligence on Finance.” April 24, 2018.



“There is a level of urgency among CEOs that they need to transform their businesses otherwise somebody is going to put them out of business. So the level of engagement is really high.”

Ed Abbo

President and Chief Technology Officer
C3



day-to-day lives. But incorporating the technology isn't as easy as just hiring some data scientists and running some algorithms.

In our experience, successful integration requires a top-down commitment to transforming various aspects of a business. Our research tells us the biggest bottleneck for more effective AI application in business remains the data. For many companies, a lot of data are simply untapped, in others the data are siloed, not normalized, not labeled and not really usable.

According to Alston Ghafourifar, CEO, of AI start-up Entefy: “When it comes to the data readiness, I believe it's 100% a will problem. We have had customers with extremely valuable data they could use and we find out that they are dumping it every month because they don't want to pay the extra storage.”

Speaking on a panel of AI start-ups hosted in San Francisco by Franklin Templeton, Ghafourifar added: “It's no different than any type of organizational change: it has to be fully embodied at the executive and upper echelons of an organization.

“If you don't have the organization will to address the data readiness problem from a system's perspective then you are not going to be leading the stack.”

In practice that can include reconsidering workflow management, workflow orchestration, and process automation, he said.

Speaking on the same panel, Ed Abbo, President and Chief Technology Officer at C3, a leading provider of big data, IoT and AI applications, said there was an acute sense of engagement among business leaders. “There is a level of urgency among CEOs that they need to transform their businesses. Otherwise somebody is going to put them out of business. So the level of engagement is really high.”

“Most of my career has been spent talking to chief information officers of companies, now we're increasingly finding ourselves hosting executive teams where the CEO is coming in with their executive team to come spend time with us and other Silicon Valley companies,” he added.

In order to succeed, in our view, a company needs the ability to leverage

the right combination of technology investment to add the compute power and data services necessary along with the human resources to apply the correct skillsets to create the desired outcomes.

That's not an easy feat for many companies, but those who can take advantage of the data they are naturally creating as a business can use it to their advantage against a newer competitor.

AI and beyond

AI presents the opportunity for a new frontier that could stretch across every facet of business and the economy. The technology involved can help people make faster, better and cheaper decisions, but most observers believe the relationship has to be collaborative. And if successfully implemented, we believe this intertwined environment of machines augmenting human intelligence should result in better outcomes.

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WHAT ARE THE RISKS?

All investments involve risks, including possible loss of principal. Investing in fast-growing industries, including the technology sector (which has historically been volatile) could result in increased price fluctuation, especially over the short term, due to short product cycles, falling prices and profits, competition from new market entrants and development and changes in government regulation of companies emphasizing scientific or technological advancement as well as general economic conditions. Growth stock prices reflect projections of future earnings or revenues, and can, therefore, fall dramatically if the company fails to meet those projections.

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