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New Technologies Changing Asset Management:

What investors should consider

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Key takeaways

Each second, oceans of new data are being generated by the internet, smartphones, satellites and other innovations. This data is commonly referred to as "Big Data" or "alternative data."

Many asset managers are seeking to harness the power of Big Data by using technologies like natural language processing, image recognition and machine learning to analyse it and find investment insights.

BlackRock's Systematic Active Equity investment team has been using these technologies to analyse alternative data for more than a decade. Over this time, the team has learned four lessons that can help effectively use these technologies in an investment process.

Four lessons for asset managers that seek to incorporate Big Data in their investment process:

LESSON 1 — **There needs to be lots of data sources, as well as the "right" data.**

LESSON 2 — **Technologies like machine learning must be paired with the dedicated expertise to use them.**

LESSON 3 — **An investment team's technology may lose its edge without constant innovation.**

LESSON 4 — **Innovation is dependent on a collaborative team culture, which needs to be developed over time.**

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Introduction

New technologies are transforming our lives. Smartphones, GPS and "smart home" devices like Alexa and Siri are just a few examples of technologies that are changing communication, transportation and daily tasks. Industries are being transformed just as much, with companies finding new ways to improve their goods and services using innovative technologies. Asset managers are no exception.

Why wouldn't asset managers want to use every tool available to them to generate better returns for clients?

In particular, many asset managers are focusing on the new kinds of data that innovations in technology are creating, such as electronic text, geolocation and web traffic, also known as "alternative data" or "Big Data." When structured in the right ways, alternative data has the potential to provide insights into company and industry prospects. Consequently, asset managers are gathering large amounts of alternative data and analysing it using technologies such as natural language processing, image recognition and machine learning in order to improve investment performance.

BlackRock has been at the forefront of this evolution. For close to a decade, BlackRock's Systematic Active Equity (SAE) team has been analysing Big Data using technologies like machine learning in its quest to constantly improve investment outcomes.

However, as other investment managers start using these technologies, they face risks along with their clients. Unbridled enthusiasm for what something like artificial intelligence can do for investment performance may result in unrealistic expectations and could obscure the requirements for effectively using it.

Over the years, BlackRock's SAE team has learned four lessons when applying technologies to analyse massive data sets. We believe using Big Data and technologies such as machine learning in an investment process requires: 1) access to and experience with many kinds of alternative data; 2) seasoned expertise in creating, refining and applying technologies to structure alternative data; 3) the ability to continually innovate new ways of analysing this data; and 4) an investment culture that sustains innovation through collaboration and constructive debate. Clients can view these lessons as criteria for evaluating how effectively asset managers will be able to use Big Data and technologies like machine learning to gain investment insights.

Figure 1: For about a decade, BlackRock's SAE team has been using innovative technologies to analyse Big Data. In recent years, other asset managers have started to as well amid much media hype.

Is Big Data the Key to Bigger Investment Returns? -MORNINGSTAR

Machine learning is transforming investment strategies for asset managers -CNBC

Race is on to grab most possible from machine learning -PENSIONS & INVESTMENTS

Asset management's fight for 'alternative data' analysts heats up -FINANCIAL TIMES

Source: Headlines from Morningstar (2/2018), CNBC (6/06/2017), Pensions & Investments (4/16/2018) and Financial Times (1/29/2018). Provided for Illustration only.

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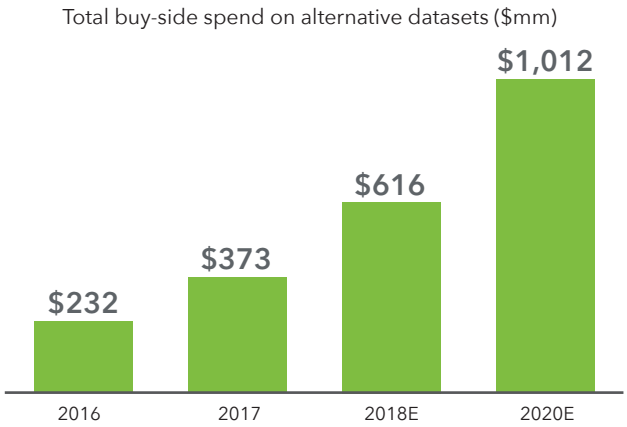
LESSON 1

Lots of data sources, as well as the "right" data

Investment teams looking to harness the power of Big Data must cast a wide net when seeking to find the right data to enhance investment outcomes. Why is that? The global economy and financial markets are highly complex, so the data they generate are often unstructured and noisy. It is important to leave no stone unturned and to evaluate as much data as possible to determine which may be most useful in an investment process (see Figure 2). That is why SAE researchers trialed over 70 new datasets in 2017 alone.

Figure 2: Asset managers are spending more on data however, they must discern which data are useful.
Spend in alternative data



Source: AlternativeData.org, as of March 31, 2018.
The above estimates are those of AlternativeData.org.
There is no guarantee that forecasts made will come to pass.

The data itself needs to be tested for its quality and additivity to a forecasting model. When SAE on-boards a new dataset, we clean it and then run it through our own battery of statistical tests to determine the value of the information it provides. In technologically advanced regions such as the US where we already have a lot of information about the firms we invest in, the bar to finding new data that is useful is high. After years of experience, we have learned that new data is not always additive to existing models. However, you never know that unless you try! And even in projects that are not successful immediately, these are often ideas that can be used for other projects in the future.

Once the "right" data is found, it is highly unlikely that a single data set will produce accurate forecasts. We have learned that if an asset manager wants to use data science techniques in seeking to enhance its investment outcomes, it needs to use multiple datasets. What does that look like in reality?

Take analysing data on consumer behaviour when seeking to forecast future sales growth of a retailer. Geo-location data sourced from mobile phone beacons can be useful in recording consumer foot traffic in physical stores. But, foot traffic in and of itself does not mean any sales occurred. Fortunately, there are many data sources that can shed light on consumer intentions and could help inform our assessment of a retailer's sales growth.

At one end of the spectrum, analysing aggregated internet search activity can capture changing consumer sentiment towards a company's brand or products. Still, data on internet search activity has a long forecasting horizon and less forecasting accuracy given there are several steps consumers must take after an internet

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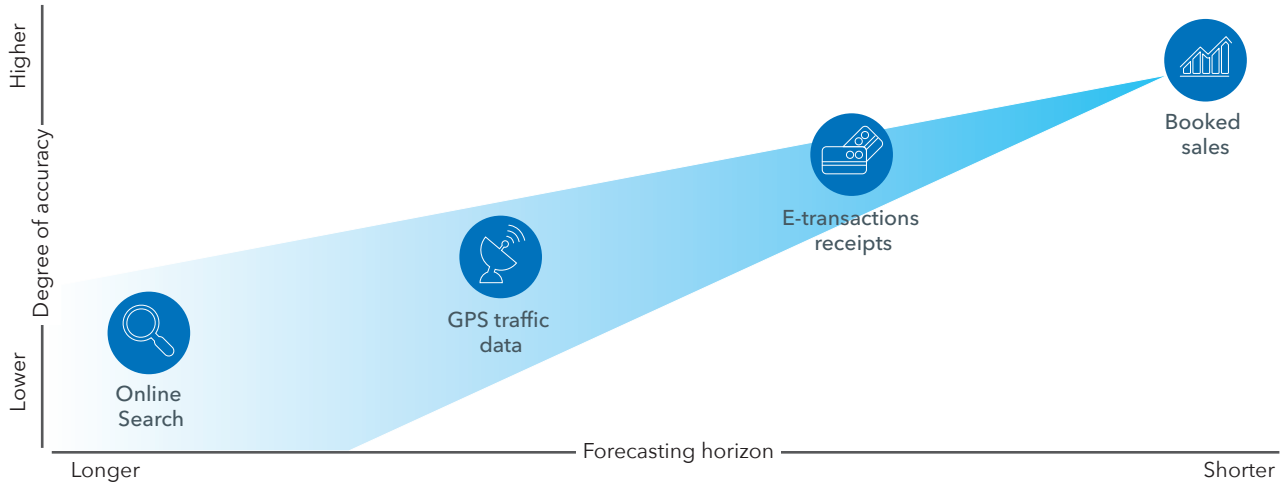
search before they purchase. At the other end of the spectrum, aggregated consumer transaction data as recorded by banks and credit card providers can enable our forecasting models to track actual consumer spending (and ultimately, reported revenues). By using multiple data sources to corroborate one another and answer the same investment question, we can significantly improve the quality of our forecasts (see Figure 3).

Lastly, as recent press has highlighted, when using aggregated consumer data, there needs to be a strict procurement and compliance framework to protect individual privacy. As a part of BlackRock, SAE has a variety of compliance rules it needs to adhere to when using data sources. SAE only uses aggregated and anonymised data, so we deliberately avoid accessing personally identifiable information.

Figure 3: Datasets taken individually have varying levels of accuracy when used to forecast. When datasets are used in combination, they can increase a forecast's overall strength.



Source: BlackRock, as of May 31, 2018. Provided for illustrative purposes only, not meant to depict actual data.

Questions for the investment manager

What is their current number of alternative data sources and how has that number grown over time?	What is their annual budget for new data sources and has it grown each year over the last five years?
Describe the processes in place to assess new sources of data.	What procedures does the asset manager follow to ensure its investment process is not compromised by breaches of personal data?

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LESSON 2

Technology is little help without the expertise to use it

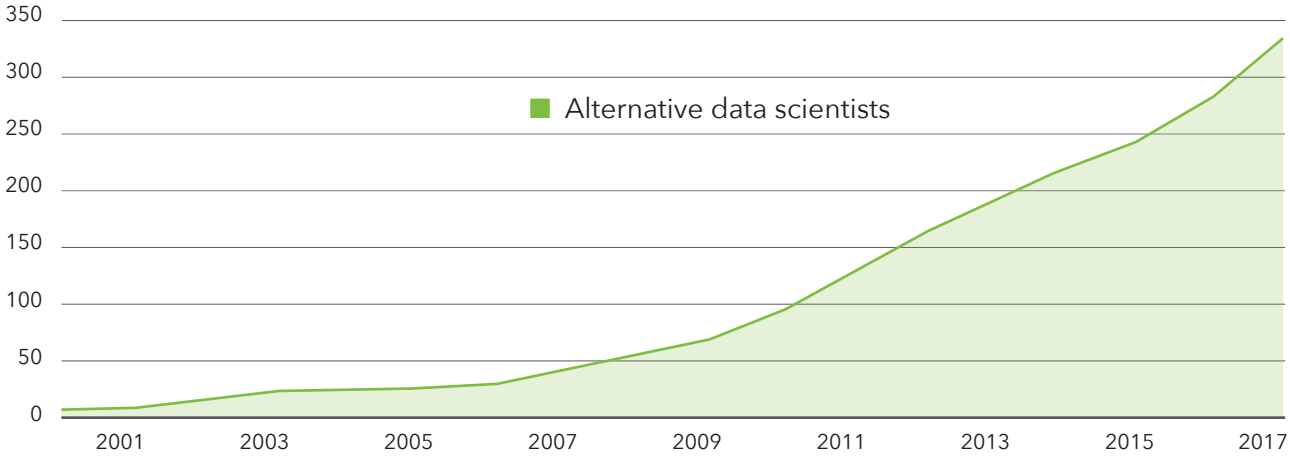
The ability of technology to analyse a massive amount of data within seconds is so impressive it can make us forget that it is human expertise that brings technology's power to life. Take machine learning. Not only can machine learning algorithms analyse reams of data in a flash and generate insights, they can determine relationships between a vast number of data inputs in a way that adapts to changing data patterns. In doing so, machine learning can learn faster than humans in addition to quickly analyse large amounts of data.

Though the computational and adaptive ability of machine learning exceeds human ability, the ultimate success of the application (or any technology) is still reliant on human beings developing and refining it. To that end, SAE has built up its data and computer science capabilities over the past decade through hiring and developing talent, so we can both create and improve the technologies used in our process (see Figure 4 depicting hiring of data scientists in the asset management industry).

What does that research expertise look like in practice? Take signal combination. Signal combination is a machine-learning model which SAE researchers developed to learn the relationship between stock returns and a vast array of quantitative data, including accounting information and analyst forecasts. One issue highlighted by our research was that the model was treating periods of stable performance and infrequent episodes of drawdown with equal importance when analysing market data. This observation led to an important change where the algorithm was refined to penalise drivers of extreme negative short-term performance. Put another way: SAE researchers had to calibrate and train the model to think and learn like an investor.

When designing a machine learning technique it is additionally important to take into account what we as investors have already learned about markets. Making sure that new technology is adding value to existing models is a key tenant of any piece of SAE research. Thus, the expertise that is needed encompasses not just the ability to create and refine technology but also knowing to ask the right questions to vet ideas. For example, a highly sophisticated model using cutting-edge techniques, which simply rediscovers well-documented stock market behaviours such as "momentum" or "value" would represent a highly inefficient use of research resources. In practice, we encourage the technology we use to reveal insights we as investors know less about.

Figure 4: Asset managers have been hiring experts in "alternative data" since the early 2000s, but in recent years, hiring has gained momentum.



Source: AlternativeData.org, as of March 31, 2018.

Questions for the investment manager

How many data and computer scientists are dedicated to the firm's investment teams, what are their years of experience in their fields and their tenure at the firm?	What special steps (if any) is the firm taking to recruit and retain its data and computer science talent?
In what ways are data science, computer science and other technology expertise integrated into the investment process?	In what ways are data and computer scientists included in the vetting process for incorporating (or improving) new technology to ensure that the new technology will add value?

LESSON 3

Technology may lose its edge without continuous innovation

The philosophy of SAE is informed by its belief that markets are continuously changing, so investment opportunities have a lifecycle. Investment opportunities are created by market inefficiencies, and these opportunities can be discovered by analysing alternative data through data science techniques. However, investment opportunities will be broadly discovered over time and efficiently priced. To keep up with new opportunities as others fade, an investment team needs to be relentless about 1) finding new data sources and 2) innovating the technologies used to analyse that data.

Take as an example SAE innovated its natural language processing techniques to analyse corporate language to help forecast company prospects. The initial work focused on measuring sentiment in broker reports or company filings through counting the use of positive words that had been predefined by SAE researchers (e.g., "Upgrade", "Growth", "Opportunity") vs negative (e.g., "Downgrade", "Threat", "Competition"). As time went on, we began to focus on the source and target audience of the text. For example, we discovered that on corporate conference calls, remarks by CEOs tend to be more positive and scripted, so focusing on the CFO's remarks or the Q&A sections of the call proved consistently more useful. We also began comparing sentiment from one source (such as information given to the market) with another source (such as information given to a regulator) to help identify instances of company spin versus hard facts (see Figure 5).

Finally, a material innovation came through combining natural language processing with advanced machine learning techniques. SAE innovation no longer relied on researchers having to programme a set of predefined words, as in days past. By applying learning algorithms, the technology learns in an adaptive way what words are most important for forecasting future returns and fundamentals for a given stock.

SAE's continuous innovation in machine learning has made corresponding insights very different from the ones that we used eight years ago; thereby, creating an ability to find new investment opportunities. Soon others may be implementing our approach as well, but by that time, our expectation is that we will be using an evolved technology.

Figure 5: Natural language processing can be used to detect ways a company may try to make its prospects appear better than they are.

8K non-earnings related announcement

8K

The company strongly **disagrees** with the contents of X's resignation letter and regrets that he felt the need to write such a letter. It is our understanding that X has recently **suffered** a serious head **injury and trauma**. Hopefully, as he recovers he may regain his perspective. However, should he persist in his behaviour and his assertions, the company will vigorously **defend** itself in any resulting **litigation**.

How does the tone of the 8K compare to the corresponding press release?

PRESS RELEASE

It became apparent to X's board of directors that the board and X had philosophical differences regarding the focus, financing, and the direction of the company. The board will take the **opportunity** to refocus management on short-term, critical objectives such as **improving** sales, customer relations, and **bolstering** earnings. We wish X all the **success** and **happiness** with his future endeavours.

Source: SEC EDGAR. Paul Ma, *Information or Spin? Evidence from Language Differences Between 8-Ks and Press Releases*, 2012.

Questions for the investment manager

Over the past year, in what ways has the asset manager innovated the technologies that it uses to analyse alternative data in its investment process?	Give examples of the ways that innovations over the past year have found differentiated sources of alpha.
How is innovation incentivised on the team (e.g., is it connected to compensation)?	How long is the typical innovation cycle, from idea to implementation in live portfolios?

LESSON
4

Innovation is dependent on a collaborative culture developed over time

The reams of data generated by technologies like the internet and smartphones can be structured to provide investment insights. While there needs to be dedicated data and computer science expertise within an investment team to analyse the data, our experience in integrating teams with diverse skill sets has shown us that having specific expertise on a team is not enough.

If a team is to be truly innovative, we believe there must be a culture of collaboration and constructive debate across these disciplines. Members — from senior to the most junior — must be encouraged to work together regularly to improve current data techniques and to test ideas in a beta environment, without fear of failure.

SAE teams regularly engage in "hackathons" where team members work together and compete to create technologies and new uses for current technologies that can aid the investment process. These cutting-edge tools may find new sources of alpha for all SAE strategies.

Collaboration requires knowledge sharing, which can be facilitated with the right tools. For example, SAE's more than 30 years of prior research is accessible to all its team members via an internal intranet page. This open archive supports efficient idea generation through documenting both successful and unsuccessful projects.

In the end, a culture that enables innovation to thrive can require many years to create as it depends on the right leadership and team chemistry. Yet, without it, effective innovation may not be sustainable.

Questions for the investment manager

Does the asset manager have a culture of collaboration and constructive debate (that can sustain innovation over time)? Give examples.	On a daily basis, how exactly do data and computer scientists collaborate with team members with more traditional investment roles and backgrounds?
Meet with data scientists (and other technologists), portfolio managers and junior level members on the team. How would they describe their team's culture?	Is knowledge sharing required and facilitated among all team members through formalised means, such as through an intranet page?

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Conclusion

Today, investment managers can discover fresh investment insights by using powerful technologies to analyse Big Data. However, there are right and wrong ways for investment managers to use Big Data and the technologies that analyse it. Ultimately, it is an investment team's expertise and culture that translate the power of technology into better investment outcomes. Investors can use the questions provided in this paper to help determine if an investment manager has the elements to realise the potential that new technologies may have for performance.

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