

THE (NEW) TOOLS OF THE TRADE

BLACKROCK®

A Conversation with Ryan LaFond, PhD

The past few decades have witnessed changes to the investment environment that are massive and permanent. Trading volumes have exploded, driven in part by the colossal surge in passive investing. The United States alone now has more than 20 trading venues (compared to 8 in 1994), with high frequency traders dominating volumes in many stocks. However, perhaps the biggest impact is the radical increase in the amount of information available for investment decision making, and means to access and process it that were beyond comprehension just a few years ago. The landscape is transformed, driven by the Internet boom, proliferation of social media and technological advances.

Recently, Ryan LaFond, PhD, a head researcher for BlackRock's Scientific Active Equity team shared his views on the magnitude of change and how the team has evolved its tactics to embrace cutting-edge technology.

What every stock investor wants to know

Our entire team has one singular goal: accurately forecasting stock returns. As researchers we are constantly seeking new ideas and insights; new ways to answer four fundamental investment questions:

1. **Value:** Is this stock attractively priced?
2. **Quality:** Is this a high-functioning and well-positioned business that will continue to generate cash flows?
3. **Sentiment:** What do other investors think about this stock?
4. **Macro themes:** Are there any macro headwinds or tailwinds affecting the company's business model?

However, the process for determining the fundamental four has changed. The context in which you need to review each of these factors has changed. The amount of data you need to consider has increased significantly. Unlike generations past, the web, traditional media and social media sources now generate mountains of data, which gets quickly priced into the market. And increasingly efficient markets mean opportunities appear and disappear much faster—so the speed at which you need to be able to make investment decisions has accelerated.

We ask these four fundamental questions for 8,000 companies every day, analyzing up to 90 different metrics to come up with our view for each one. How can we follow this many stocks? By applying cutting-edge technology that allows us to process and sift through vast amounts of data.

Using the same investment processes and tools from the past limits an investor's ability to succeed in today's environment. Bottom line: the world has changed—and we've evolved the way we manage money in response.



Ryan LaFond, PhD, Managing Director, is head of research for the Asia Pacific and Emerging Markets Equity group within BlackRock's Scientific Active Equity (SAE) team.

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Recovering academics

We joke that the SAE team is a group of “recovering academics,” because of the more than 30 PhDs and additional subject matter experts who have backgrounds in computer science, engineering, physics, finance, accounting, and economics.

For example, Dr. Bradley Betts, who heads up our efforts on statistical modeling and text analysis, holds multiple engineering degrees and was formerly a principal computer scientist at NASA’s Ames Research Center, and a lecturer and researcher at Stanford University.

And to say that we “wrote the book” on applying this type of technology is only partly tongue in cheek. Dr. Ronald Kahn, our global head of research and 15-year veteran of the SAE team, is co-author of one of the best-selling textbooks on quantitative investing.

Together, we build, maintain and refine the fundamentally driven models that drive our stock selection process. This constant evolution of our process is the way the team has been able to continually push the envelope.

Which approach—chain saw or scalpel?

So what do these immense systemic changes mean for investment research? Let’s talk about the structural changes in the markets first.

Think about the explosion in trading volumes—a result of reduced transaction costs, proliferation of passive investment products, increase in trading venues and high frequency traders. This has created an entire generation of equity holders whose primary motivation is different from investors of the past. They’re not concerned with fundamentals. Instead they want specific exposures to baskets of stocks or they have holding periods so short that fundamentals don’t matter to them. If, for instance, they like healthcare, these investors may buy a healthcare ETF, rather than trying to determine which of the hundreds of healthcare firms are best positioned for the future.

We take a different, pinpointed approach. We might start with the thesis that America’s changing diet will result in opportunities for the healthcare sector. We then engage our tools to comb through patent and drug trial data, to systematically search company reports, web pages, news media and other sources to capture which healthcare firms are focused on the impact of eating habits. For example, which healthcare companies are working on diabetes-related drugs versus those fixed on other areas, such as cancer research?

While exposure-based investors are targeting broad swaths of the markets, we use our detailed view of the world to pinpoint long-horizon structural trends that we think will be profitable. This helps guide us to stocks that we expect to go up and choose to “buy long,” balanced with stocks that we anticipate will go down in price to “sell short.” Meanwhile, our technology-based model allows us to discover and act on information faster than more traditional methods used by other investors.

THE MAGNITUDE OF CHANGE: HOW DO INVESTORS STAY AHEAD OF THE GAME?

	Pre-1980s	1980s–2000s	2000s–Today
Daily average traded value (world stocks)	Billions	Tens of Billions	Hundreds of Billions
Broker reports published daily	Dozens	Hundreds	Thousands
Number of data vendors	~25	~150	~400
Number of hedge funds	< 500	< 2,000	> 7,000
Listed ETFs (developed exchanges)	0	Hundreds	Thousands
% US exchange volume traded algorithmically	0	<10%	>50%

Source: BlackRock.

The information superhighway: Shifting into passing gear

The web and computing power have not only resulted in an enormous increase in the amount of data available for investment decision making, but have created a massive cultural shift. For instance, when was the last time you used a printed encyclopedia?

Instead, when we have a question we hop online, trusting the underlying technology to quickly unleash a host of information and answers. Every time you use a search engine or shop online you are interacting with an algorithm. Think of how your search activity and purchase history are used by your favorite shopping site to make connections for you—predicting what you might like and generating specific recommendations almost instantaneously.

Technologies like this provide ways of gathering information that did not exist 10 years ago. Sources like Facebook and Twitter now capture actions and trends by the second. For instance, 20 million poll-related Tweets were posted on US Election Day 2012. One of the effects is the speed at which the markets react to this flow of information.

How do you find unique opportunities when information is priced in so rapidly that your edge can quickly disappear?

The best way to answer that question is to share some examples of the research that we use—and how we think this helps to manage money smarter than in the past. Think about the few examples that we talk about here as a minute part of what we do every day—as we analyze thousands of pieces of data for each of the thousands of companies we fundamentally select for our investment portfolios.

Viva la evolution

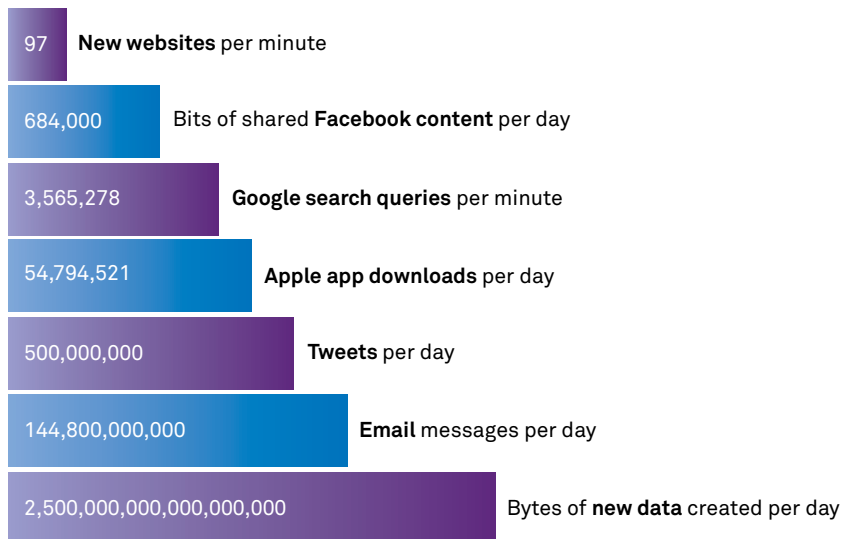
In the past 50 years, most portfolio research teams approached investment decision making in the same way—by reading analyst reports, talking to company management and maybe picking up the phone for an occasional customer or supplier conversation.

However, as markets and information flow have changed, so have we. Our process has now evolved to:

- ▶ Take in and analyze more than 2 terabytes of “unstructured” text daily (a volume of data equal to 2,000 sets of the Encyclopaedia Britannica)
- ▶ Translate reports, conference calls and web data into minute-by-minute, investable insights

What is the point to this? To find—with precision and speed—the inefficiencies that reward investors, even in seemingly efficient markets.

MAKING SENSE OF IT ALL (2012)



Source: Apple Inc.; marciaconner.com; royal.pingdom.com; statisticbrain.com; Twitter Inc.

Data points hiding in plain sight

Sophisticated algorithms search for investment insights by sifting through vast amounts of public data. Among other things, SAE's applications look to:

- ▶ Analyze text
- ▶ Identify a specific piece of data (think of a needle in a haystack)
- ▶ Review customer/supplier information
- ▶ Catalog web search traffic
- ▶ Discover relevant news items

Aggregating millions of views within seconds, we have the capability to respond quickly to opportunities that other investors may have overlooked.

Revealing information: Structured vs. unstructured data

Traditional investors are extremely limited in the amount of information they can consume. There is only so much time in a working day for reading reports, listening to conference calls and digesting the news.

So how can we follow 8,000 stocks every day? Because our fundamental process is enhanced by sophisticated algorithms that categorize and aggregate data so that patterns emerge and connections are revealed.

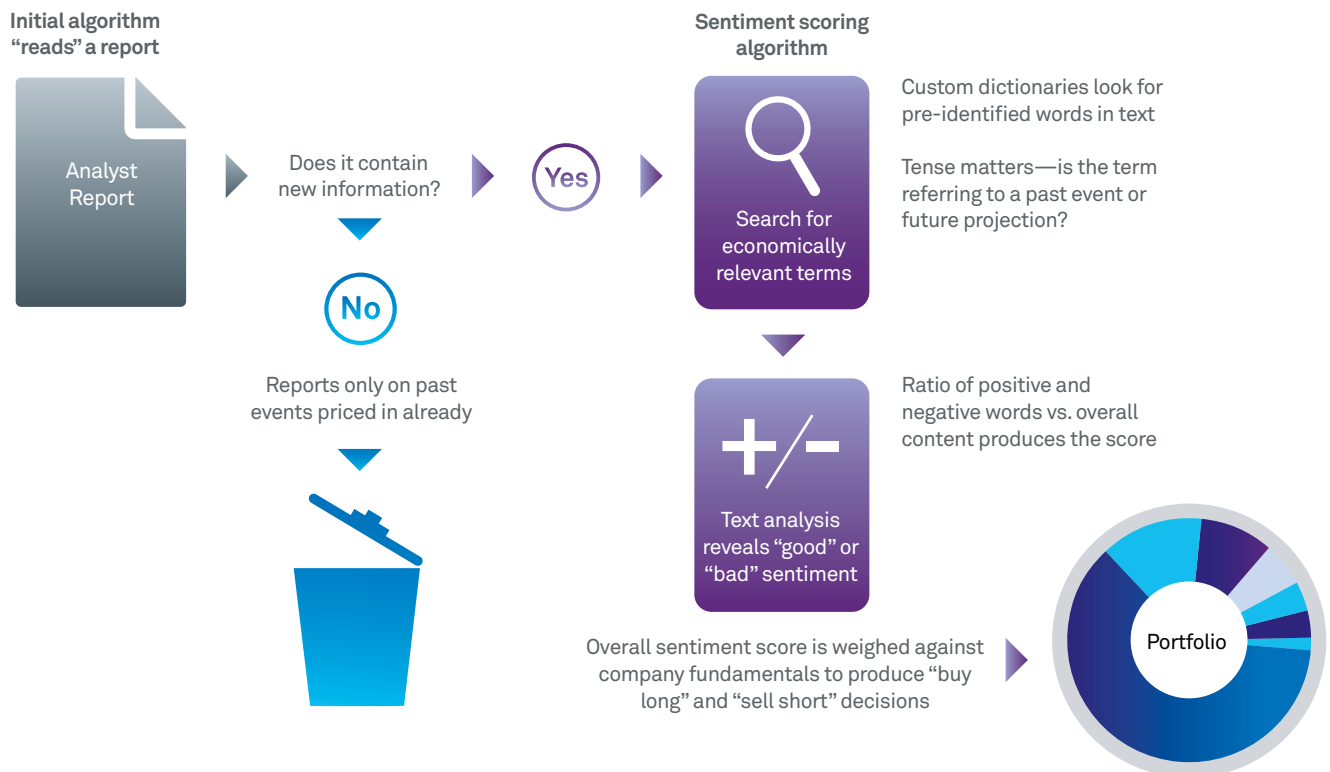
We apply this technology to review both “structured data” (the numbers) and “unstructured data” (the wording) in analyst reports, regulatory filings and earnings calls to gather information.

For instance, our approach to analyst reports is different. We're not focused as much on the reporting of what already happened—as that is already reflected in prices—as we are in a forecast of the future.

In many cases this forecast is subtle rather than stated, and examining the narrative may reveal certain expectations even if this doesn't yet show in the numbers. For example, an analyst may convey excitement about a new product—or their increasing concerns about a company—well before there is the opportunity to model the impact on earnings per share. By analyzing the text of the report we look to capture the “changes in feelings before the facts.”

TEXT ANALYSIS ENHANCES THE FUNDAMENTAL DECISION-MAKING PROCESS

SAE's Algorithm-Based Model “Reads” and Scores 4,000 Analyst Reports Every Day



For illustrative purposes only.

Case Study: Uncovering “hidden” sentiment

Imperial Holdings (IPL), South Africa, August 2012

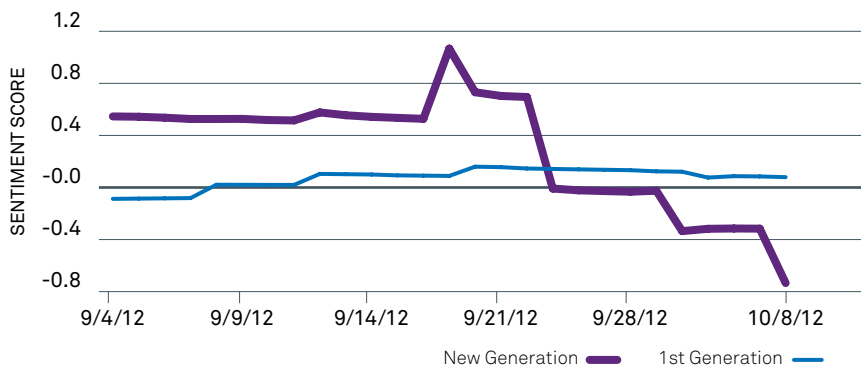
Kicked off by miner’s strikes, substantial labor unrest soon spills over into the entire country. IPL’s labor force is 100% unionized and the company voluntarily suspends most of its trucking/transport-related operations as unrest deepens.

SAE’s sentiment scoring interprets information on two levels

Based on past experience, the SAE team knows analysts tend to write about events informally before incorporating their insights into formal forecasts. To account for this, SAE’s text analytics score analyst commentary on two levels:

- ▶ 1st generation: Evaluates sentiment through the lens of fundamentals, such as analyst revisions
- ▶ New generation: Analyzes all text in analyst reports to seek out “hidden” sentiment that might otherwise be overlooked

IPL SENTIMENT SCORES DIVERGE



Source: BlackRock. Date: 9/4/12 to 10/8/12.

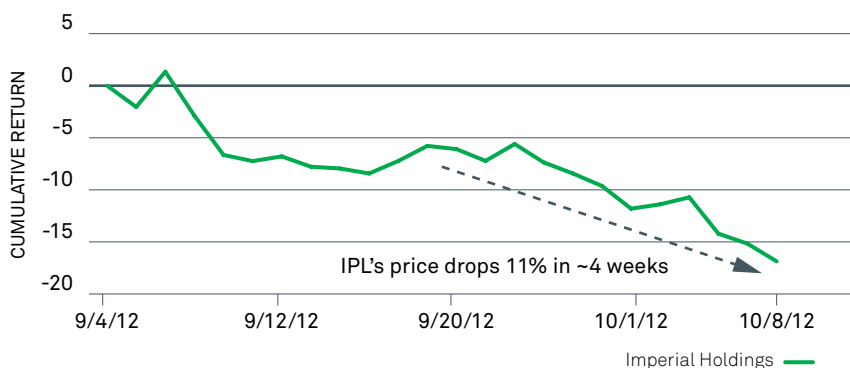
Formal sentiment (1st generation)

Analysts maintain “Outperform” ratings and target price.

Informal (New generation) sentiment

Meanwhile, analysts’ unease over heightened risk from labor unrest comes through in text analysis.

DISCOVERY OF “HIDDEN” SENTIMENT RESULTS IN A SELL DECISION



SAE’s discovery of analysts’ “hidden” sentiment triggers further fundamental review.

Factoring in both levels of analysis results in a sell decision for IPL.

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Understanding the nuances to forecast fundamentals

Specific wording in company reports and conference call transcripts can signal positives and negatives. For instance:

- + Mention of “new customers” suggests good news for sales growth
- “Increasing input prices” forecasts bad news for future margins
- + Expect to hear lots of specific numbers, e.g., “10% to 12% expected revenue growth” when things are going well
- Anticipate a weaker showing if the environment is defined as “uncertain” or “challenging”

Are we there yet?

In addition to our work with analyst reports, let’s talk about how we use similar methods and technology to analyze text from other sources—such as annual reports, regulatory filings, conference call transcripts, and more.

First, we don’t simply wait for the mail to show up. We have programs constantly checking the exchanges and regulatory websites asking every few seconds for new reports. Think of this as the small child in the back seat asking every five minutes “are we there yet?”

Once we have a report, we tear it apart on dimensions that our researchers and portfolio managers believe to be economically relevant. For example, we compare this year’s report to last year’s to understand what has changed, and measure whether these changes are positive or negative based on the terms used. We also compare to see if the same topics are covered in reports by competitors, customers and suppliers. If a company does not mention topics identified by our algorithms as relevant, we view this as a very bad sign.

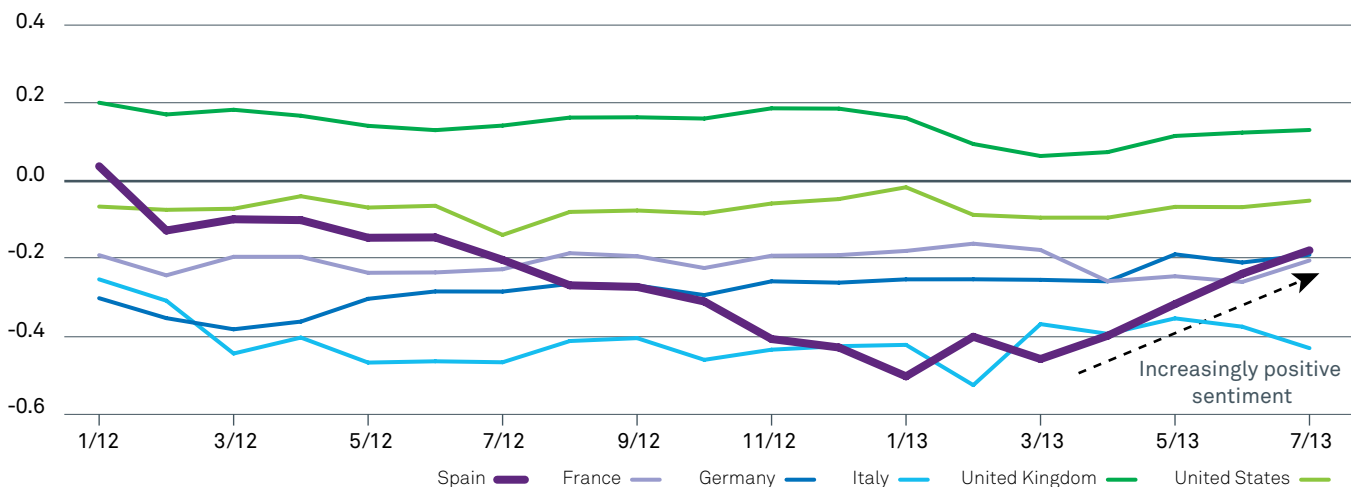
Think of this as our attempt to measure whether the company’s management actually knows what’s going on in the world and how this might impact their business. For instance, this allowed us to identify situations such as PC makers who seemed to have no idea about tablets replacing PC functionality.

Not only does this allow us to draw conclusions on individual companies, we also apply this methodology to identify actionable information in the aggregate. For instance, although a typical analyst report is written about one company or industry group, when you add them all together you can often identify trends.

In the same vein, aggregating our analysis of thousands of company conference calls helped us to identify recent increasingly positive sentiment regarding Spain. This is a classic “green shoots” example where managers are able to see positive signs and start talking about them before the hard numbers are reported.

AGGREGATING DATA FROM MULTIPLE SOURCES PROVIDES ACTIONABLE INFORMATION

Consensus of Positive Sentiment Emerges by Combining Data From Hundreds of Calls



For illustrative purposes only.

Who said that?

Interestingly, we have found that it is important not to simply analyze what is said, but more importantly, who says it.

For instance, when it comes to company conference calls, we have discovered that there are multiple levels of communication taking place at the same time. Not surprisingly, prepared statements—think of those delivered by investor relations or the Chief Executive Officer—tend to have a positive bias and less variation.

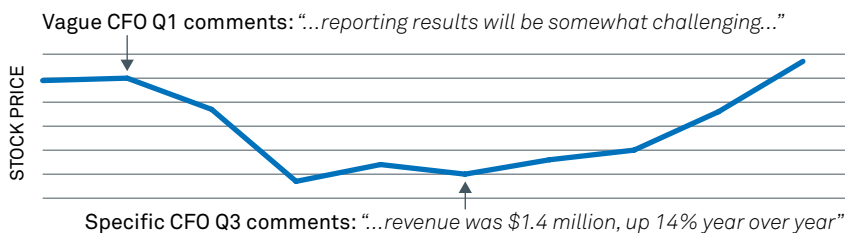
However, we have learned to give much more weight to what the Chief Financial Officer says, as those comments tend to be more balanced, and in our experience also contain more relevant information.

Case Study: Decoding managers' comments

The SAE team discovered that there are measureable insights to be gained from the tone and content of conference call transcripts, both from what is said and not said. To uncover how managers view the company's prospects, SAE algorithms analyze:

- ▶ Are comments specific or vague?
- ▶ Who made a particular statement?
- ▶ How many positive/negative words are there vs. the overall total?
- ▶ What is the ratio of positive and negative words to each other?

CONFIDENCE LEVEL SHOWS IN HOW RESULTS ARE PRESENTED



Greater specificity during earnings calls, particularly by the CFO, leads to a score increase.

CFO COMMENTS CARRY MORE WEIGHT

Speaker	Number of words			Sentiment (score)
	Positive	Negative	Total	
Investor Relations	6	0	194	3.1%
CEO	56	20	1,092	3.3%
CFO	35	45	1,752	-0.6%

Positive sentiment by the CFO provides valuable input in determining candidates for long investments, while a negative tone helps us decide on stocks to short.

"Second quarter revenues were up 2% due to acquisitions. Organic revenues **declined** 1%, primarily due to the **lag** effect from **negative** sales in...Overall our professional businesses once again delivered a **robust** performance, **growing** 6% during the quarter, while...**declined** 1% and was down 3%...The U.S. legal market remains **challenging**...That said, we are **pleased** with the **progress**...also came on the back of a more pronounced **decline** in print revenues...continue to be a **drag**, **declining** 7% during the quarter..."

Number and ratio of positive words (**green**) and negative words (**red**) lead the SAE team to a truer understanding of the position held by a company's leaders.

For illustrative purposes only.

Insight at the touch of a button

SAE's in-house team of data scientists maintains a massive proprietary database whose volume is:

- ▶ Eight times larger than the Library of Congress
- ▶ Four times the size of Wikipedia®

Data is continuously updated and algorithms fine tuned so the team has the latest company and market insight available.

Discerning the “wisdom of the crowd”

So far we've talked mainly about how we analyze unstructured data in the form of text, but that is just part of the picture. We go much broader in our research tactics to detect economic trends—both at the macro level and the company specific level—by also collecting insights from email, social media, web traffic and more.

For instance, cataloging web search data can quickly shed light on the success of new products, rather than having to rely solely on traditional economic indicators that are released only after quarter end. Take smartphones as an example. By comparing web search results for different brands, it can tell us about competitive trends and the relative success of different business and product strategies.

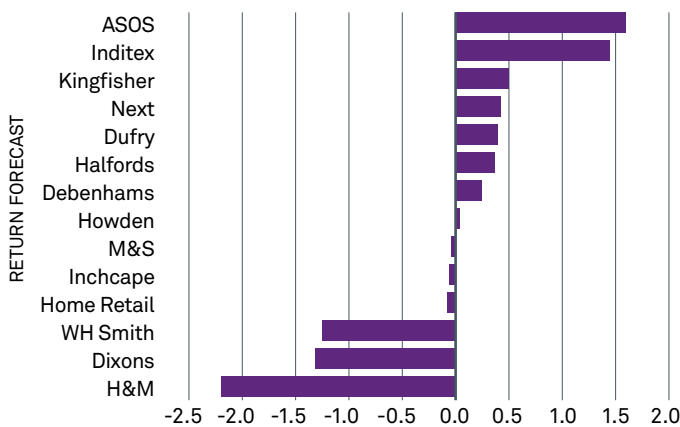
Now if you just looked at raw search data today, you'd see that it's dominated by searches for topics related to the current sports season or news of popular celebrities. This is where the fundamental analyst in all of us comes out.

We sift through this clutter by pre-determining and then looking for specific product names or product areas in search results to identify themes. For example, we might use the number of people searching for vacation destinations as an input to help us forecast the stock price of an online travel company. Or use the number of people searching for a job in a certain geographic area as an early indication of economic conditions there.

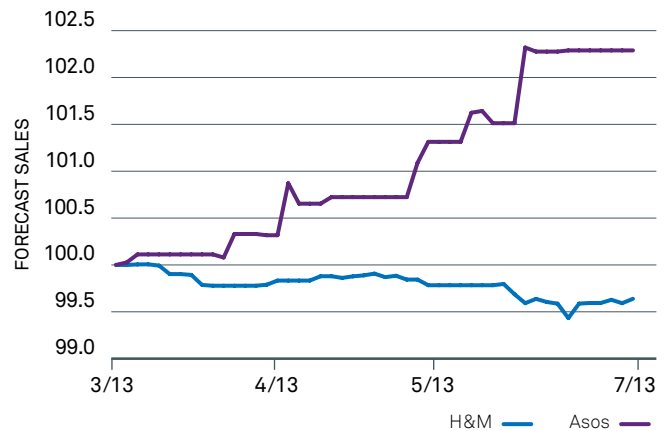
By gaining these insights in real time, it gives us the opportunity to capitalize on specific opportunities faster.

UNSTRUCTURED DATA IS A GOOD INDICATOR OF ECONOMIC TRENDS

Web Search Volume for European Retailers Provides Another Tool to Forecast Sales



Source: BlackRock. Return forecast based on SAE web signal analysis of search volumes. Data as of 3/31/13.



Source: Bloomberg estimates. Data as of 5/7/13.

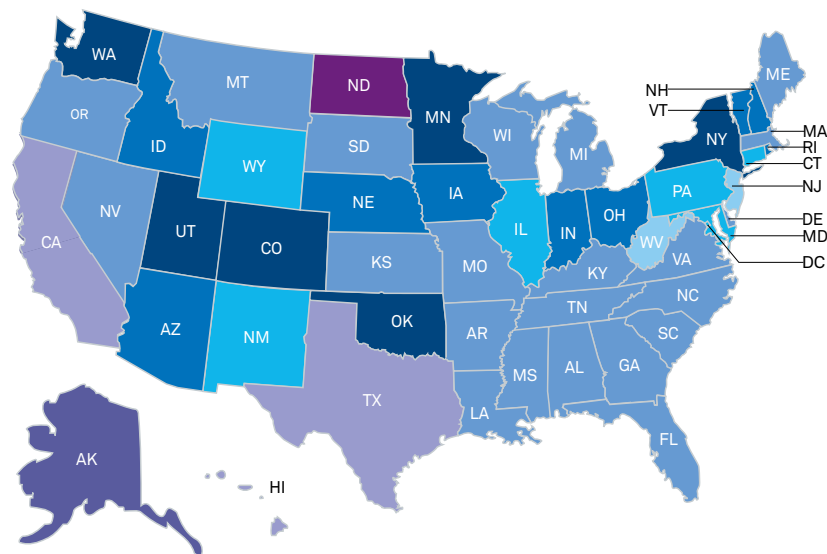
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Case Study: Studying regional differences to identify small cap companies

Many investors tend to view US stocks as one big basket, but the reality is that there are massively diverse local and regional differences. Once the SAE team has identified a specific theme, they look to see how this plays out in different locales. This geographic focus is especially useful in analyzing small cap companies, which tend to be more closely aligned to the health of their local economies.

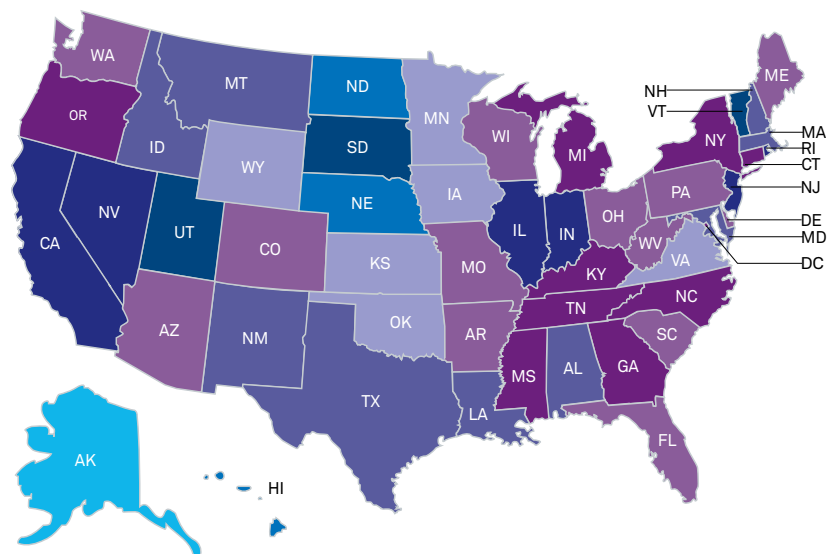
LOCAL CONDITIONS FACTOR HEAVILY IN SELECTING SMALL CAPS

12-Month Change in Average Weekly Wages (%)

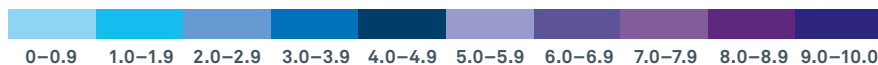


Source: Federal Reserve Bank of St. Louis. Data as of 3/31/13.

Unemployment Rate (%)



Source: Federal Reserve Bank of St. Louis. Data as of 3/31/13.



Select Companies: Exposure by State

State	Tractor Supply	Lithia Motors	Otter Tail
California	2%	14%	-
Michigan	6%	-	-
Minnesota	1%	-	33%
Montana	-	11%	-
New York	6%	-	-
North Dakota	1%	4%	33%
Ohio	7%	-	-
Oregon	-	25%	-
Pennsylvania	6%	-	-
South Dakota	1%	-	33%
Tennessee	6%	-	-
Texas	12%	20%	-
Washington	2%	9%	-
Other	50%	17%	1%

Source: BlackRock, March 2013.

By early 2013, the oil and shale gas boom has had a significant positive impact on the local economies of North Dakota, South Dakota and Minnesota.

SAE team exposure mapping identifies Otter Tail (owner of a number of companies related to power supply, manufacturing and infrastructure) as likely to benefit from spillover effects.

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Degrees of separation

Whereas many other investors limit themselves to identifying obvious connections, the SAE team delves deeper to understand far-reaching effects.

Obvious connections

- ▶ Supplier
- ▶ Distributor

Non-obvious connections

- ▶ Supplier to direct supplier
- ▶ Landlord
- ▶ Service provider

Mapping the (non-obvious) connections

Our research tools not only provide deeper and quicker insights into individual company fundamentals, they also allow us to establish a better understanding of the ways in which different companies around the world are linked. In fact, we have built a dynamic map of how all the companies in our investable universe are connected based on their business descriptions. These narratives help us capture how companies think about themselves, how they make money and what's important for them.

We analyze the text of these business descriptions to uncover connections between companies. For instance, if the word “apple” appears we look for specific associated words to ensure the correct mapping. If the text also relates to “iPhone®” and “app,” then we know to point to Apple, Inc., rather than to Del Monte, the food company.

Unlike more traditional approaches that rely on things like industry classifications, our text-based approach is dynamic. As companies shift their business or the economy changes, so does the firm's location on our map.

So how do we capitalize on these findings? By concentrating on the “non-obvious” connections—the ones that other investors take longer to uncover or don't recognize at all.

FINDING INEFFICIENCIES IN THE “VIRTUAL ECOSYSTEM”

Like a rock dropping into a pond, when a market or company-specific event takes place, it creates ripples that run throughout the markets. The SAE team has created a “virtual ecosystem” of connections between 8,000+ global firms to help predict and capitalize on even the most non-obvious results of an event.



Case Study: Capitalizing on ripple effects

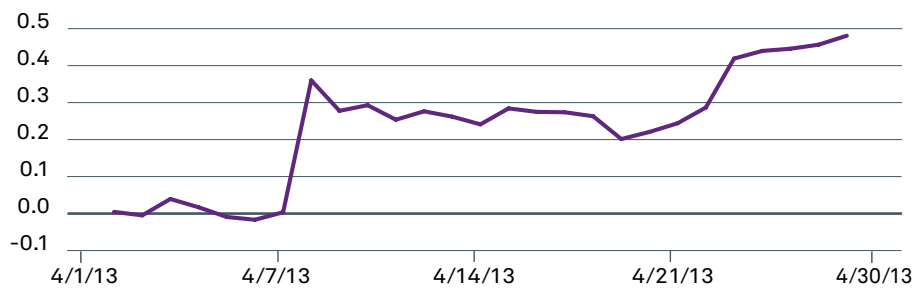
Power-One Inc. (PWER), United States, April 2013

Spurred by market events, such as widespread reporting on China's air pollution issues, the alternative energy industry—and pure play power companies in particular—have a strong showing in early 2013.

A deeper dive reveals potential beyond the obvious

Using text search for terms such as “solar,” “renewable” and “wind” in company descriptions, the SAE team identifies Power-One, a major provider of high efficiency and high-density power supply products. In spite of its industry classification as an electronic/electrical equipment company, many of Power-One's products are specific to renewable energy.

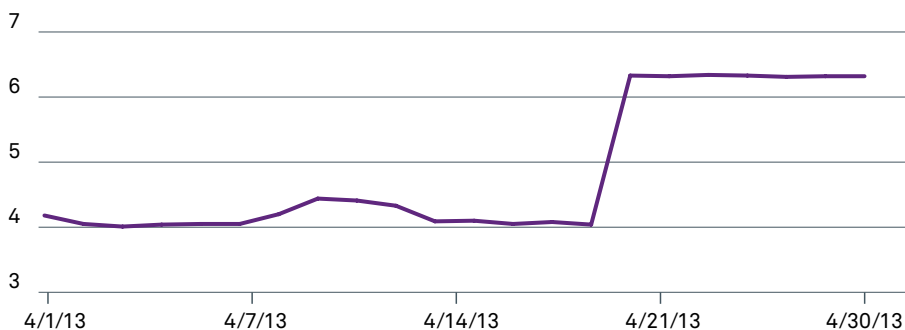
ENERGY CLUSTER AVERAGE RETURNS



Source: BlackRock. Data from 4/2/13 to 4/28/13.

Based on the return pattern of energy-related stocks, SAE team expects pure-play power companies to benefit—along with partner companies within the ecosystem.

POWER-ONE STOCK PRICE



Source: BlackRock. Data from 4/1/13 to 4/30/13.

Benefitting from its non-obvious connection to alternative energy, PWER is acquired at a 57% premium in late April by ABB (a European power and distribution company).

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Finding the inefficiencies in seemingly efficient markets

The point to the SAE team's research and methodology is to find the inefficiencies that reward investors, even in seemingly efficient markets. The power of our approach is the ability to extract information quickly from massive amounts of data. Our technology can process more information and do it faster than any human or team of humans is capable of doing.

None of the examples that we've talked about here would be possible except for one of our most important innovations, which was to build out an entire team of data scientists focused on developing new ways of gathering insights. At the beginning, it took us two years before the first insight generated by the team entered our investment process. This type of investment requires a company—such as BlackRock—with a large amount of resources, commitment and patience.

We believe that our competitive advantage is in the reach and resources of BlackRock, and the process that allows us to glean more public information about companies we cover, to obtain it sooner, and finally, the capability to understand the implications better than our competitors.

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