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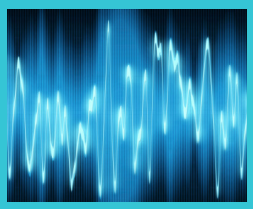

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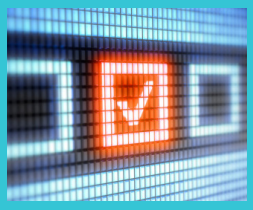

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Please visit **GSAM.com/gsamperspectives** for additional insights including:

Podcast featuring Armen Avanessians, Chief Investment Officer, Quantitative Investment Strategies, GSAM

Video featuring Gary Chropuvka, Head, Alternative, Customized Beta & Tax-Efficient Strategies, Quantitative Investment Strategies, GSAM

The Data Revolution

The Big Deal About Big Data

A closer look at how data analysis is driving innovation across a wide variety of industries and the economy at large.

Revolutionizing Industries: Better Insights, Better Results

Digital information is stored, shared and accessed more than any of the technologies preceding it. Investors have access to an enormous amount of information on every public company—information that can potentially influence stock prices and other investment opportunities. There are limitations to what any single person can take in, which makes computing power more essential than ever. Advanced analytics and superior processing technologies are key to extracting value and actionable insights from this abundance of information.

Here are a few examples of how data analysis is driving innovation and competitive advantages across the economy at large.

Health care: McKinsey & Co. estimates that big data has the potential to create $300–450 billion in cost savings in the health care industry by optimizing patient care—through detection and remediation of ailments earlier and more effectively.[1,2]

Auto insurance: Many insurers now offer discounted rates to customers who install tracking devices in on-board

diagnostic systems—providing that they drive with care.

Agriculture: "Precision agriculture" uses high-tech equipment, cloud services and data analytics to increase crop yields, lower environmental impact and reduce costs.

Transportation: Ride-sharing services are crowd-sourcing the taxi industry through a network of drivers for hire. Users can download a mobile application to their smartphones, and rides are priced based on time of day, location and demand.

Travel: Many data-driven travel websites offer comprehensive booking options and calculate prices in real-time from a wide range of sources to identify the best deals.

Retail: Customer loyalty programs collect consumer data which is used in predictive models to segment customers, drive pricing and determine which promotions to offer.

Sports: Advanced player statistics enable organizations to construct more cost-efficient teams through improved talent evaluation.

Big Potential

Data alone has little worth unless it can lead to timely and informed action. Data users must also exercise judgment and careful oversight, since blindly relying on data analysis can be dangerous. Our view is that the effective use of data requires careful stewardship from investment managers, and that the pairing of human judgement with technology produces the best results.

We believe investors should recognize its potential to reshape the economic landscape. As the changes produced by the Data Revolution continue to ripple across industries, those who can harness the power of big data may enjoy a competitive advantage.

1. "Kayyali, Basel, Knott, David and Van Kuiken, Steve, "The Big-Data Revolution in US Health Care: Accelerating Value and Innovation," McKinsey & Co., April 2013.
2. Orbital Insight

Machine Learning Decoded

The ability to process data, gleaning insights that were previously hidden from plain view, and converting them to actionable information is critical to success for data-driven investors.

Today's analysts have access to a never ending stream of data, outpacing even the most prolific experts. By any metric, we are creating more data than ever before and at an ever-increasing rate. Simply having faster computers and bigger databases does not, by itself, solve the predicament of digesting this massive quantity of data. As a result, data processing algorithms have evolved from simply processing to learning how to process. This approach is called machine learning.

Machine Learning

Machine learning has roots in artificial intelligence. It creates relationships between known data points and uses those relationships to make predictions on new data. The past two decades have seen advances in theoretical and practical machine learning technology, and an increasing need for accurate machine learning algorithms to tackle the unprecedented amounts of data today.

There are two basic types of machine learning algorithms: supervised and unsupervised. Supervised machine learning algorithms are used to make predictions based on historical observations. These algorithms analyze historical data (called training data) and model the relationship between input data (defined by its 'features' in machine learning parlance) and labeled output data. Handwriting recognition is one innovative application of supervised machine learning, where

a supervised machine learning algorithm looks at a large set of pictures of handwritten alphabets. These pictures are generally pre-labeled with the actual letter they contain. The machine learning algorithm therefore learns the relationship between the input data (pictures of letters, pixel colors and intensity) and the output data (the actual letter). A successfully trained supervised machine learning algorithm can then be used to make predictions on live data. The US Postal Service, for example, uses this technology to read handwritten letters and sort them by address.[1]

The goal of unsupervised machine learning is to analyze a large set of input data in order to create structure around it. One application of this process is to analyze data with the objective of classifying it into particular categories. For example, unsupervised machine learning can be used by apparel makers to decide how to size their small, medium and large-sized t-shirts. This process would begin with data on the target customer population, such as height, weight, etc. An unsupervised machine learning algorithm could then analyze the distribution of heights and weights in the sample and create three segments that contain a population set of similar height and weight characteristics. It can also define a natural delineation between the other segments and determine how the dimensions of a particular t-shirt differ from other sizes.

There is a finite group of algorithms that can aid in supervised or unsupervised machine learning. The choice of which algorithm is best suited for a particular application depends on the data being analyzed and the purpose of the analysis. Ultimately, successful machine learning algorithms allow us to create intelligent processes that can generate predictions—an invaluable asset in today's data-driven world.

A Rapidly Changing World

Self-Driving Cars

In the US, the average person spends over 50 minutes a day commuting to work,[2] of which 20% is typically spent in traffic, representing approximately $42 billion a year in wasted fuel.[3] In addition to the costs of congestion, the National Highway Traffic Safety Administration (NHTSA) estimates that traffic accidents cost almost $826 billion annually in the US.

Self-driving cars (also known as autonomous vehicles) have the potential to reduce commute times, allow drivers to utilize their commute more efficiently, and over time improve the safety of driving. This means avoiding many of the preventable, human causes of crashes, including fatigue, texting, alcohol or speeding. A self-driving car will not get distracted and has been programmed to constantly develop a back-up plan in case of any identified threats. For every vehicle on the road, self-driving cars can generate a defensive plan based on a multitude of potential situations. If an adjacent car happens to swerve or come to a sudden stop, the driverless car's computer algorithms can react within milliseconds. If it works as intended, autonomous driving has the potential to greatly improve road safety. However, as with any new technology, it will come with its own unique safety concerns. How the automobile industry continues to navigate these safety issues as they arise will be critical to the technology's success.

Self-driving cars' ability to drive autonomously relies heavily on a similar learning process to humans. They utilize a suite of 360-degree cameras along with a spinning laser that enables them to measure the exact distances to objects in

their vicinity. All this data is digested through sophisticated machine learning computers that interpret the surrounding environment much like a human would do while driving, in real-time. The computer algorithms combine pre-defined driving rules (i.e. stop at a red light) with real-life empirical evidence gathered through actual driving experience, in an effort to become better drivers. Human drivers, in a similar fashion, typically learn through examination of pre-defined driving rules, supplemented with behind-the-wheel driver training. All of this works in concert to create a more comfortable, productive and safer commute, resulting in truly powerful benefits.

Precision Agriculture

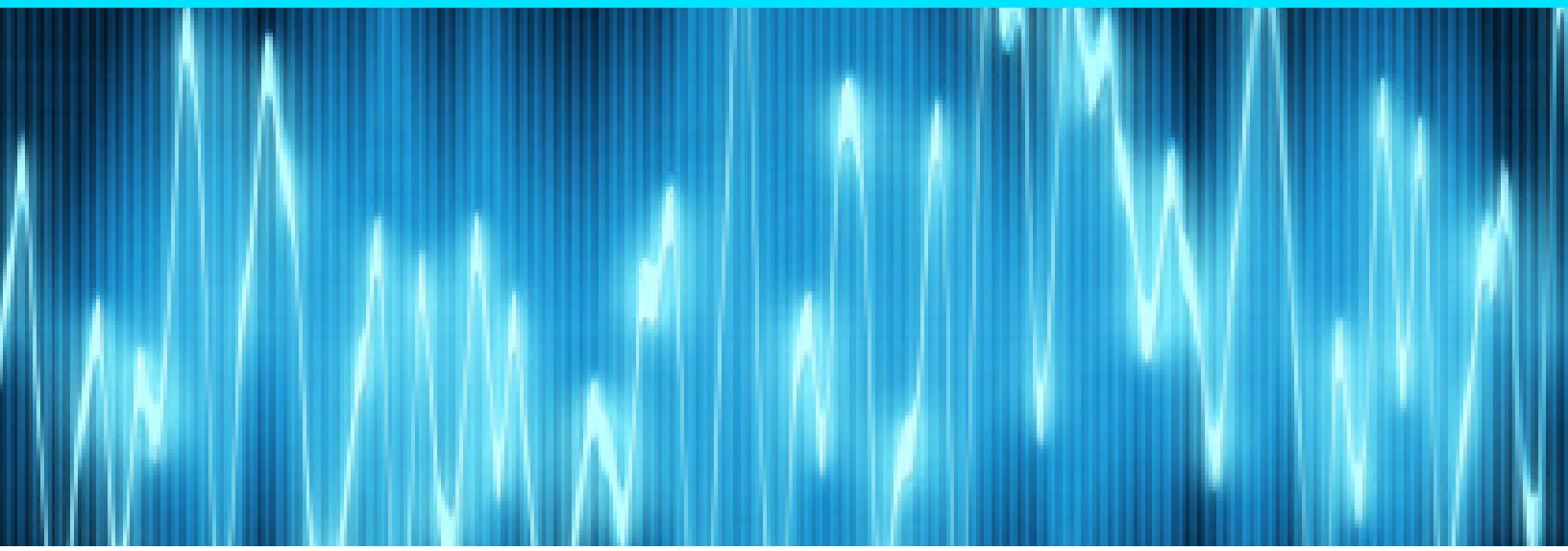
In a practice known as "precision agriculture," farmers use big data to improve their productivity and the quality of their crops. While best known for its seed and pesticide businesses, some large agricultural companies have been willing to make large investments that enable them to make decisions based on big data.

By analyzing real-time field measurements collected by drones and remote sensors, climate data and the growth characteristics of thousands of crops, farmers are able to determine the optimal day to plant certain crops. This detailed analysis, combined with information about the topography of certain fields, can also establish the ideal depths and spacings for millions of individual seeds. Using a planter loaded with this type of data and equipped with a GPS, farmers can more precisely plant their fields. Farmers who utilized this technology-driven system reported crop yields that increased by almost 5% over two years, a more significant improvement than any other recent innovation.[4]

Conclusion

Machine learning is transformative as it can help make predictions using complex datasets in almost any environment—ultimately gleaning powerful insights that were previously hidden from plain view. Having more data, in itself (and there is certainly much more data today than ever before), does not necessarily empower companies or people to become more efficient. Simply having bigger and faster computers does not necessarily lead to intuitive outcomes in a real-life, human environment. Machine learning allows computers to learn very much like a human would learn—by operating with pre-defined rules of the road (i.e., a driver's manual), but then more importantly, learning from empirical evidence as more data is gathered and interpreted (i.e., learning to drive by actually driving). Automation and gains in productivity have been at the core of every technological revolution (agricultural, industrial, computer and data revolutions) over the past two centuries—and machine learning advances these gains into new territory, potentially driving significant results. Nonetheless, the necessity of human oversight and intuition cannot be understated. A computer can beat a human at chess, but we believe a computer *with* a human can beat any computer by itself.

1. US General Services Administration
2. http://www.census.gov/prod/2011pubs/acs-15.pdf
3. http://www-nrd.nhtsa.dot.gov/pubs/812013.pdf
4. http://www.economist.com/news/business/21602757-managers-most-traditional-industries-distrust-promising-new-technology-digital



Text, Tone and Topic

Exploring Potential Benefits of Natural Language Processing

While computers today may not yet be as adept with language as humans, natural language processing will become a crucial part of the investing process in the coming years.

Language is a complex and difficult problem for computers. The fastest super-computer in the world can perform up to 54 trillion calculations per second,[1] yet it struggles to produce and understand our language at even a toddler's level. Vast amounts of information in the world are stored in language form, from textbooks and encyclopedias, to websites and social media, so researchers are hard at work to enable computers to bridge the divide from the digital bits and bytes to the world of language. This technology is called "Natural Language Processing" (NLP), and it represents one of most promising areas of machine learning within the field of modern computer science.

In the past decade, enormous advancements have been made in NLP technology. Today, online translation software can convert most documents into a hundred languages with astonishing accuracy. Numerous online businesses now offer customer support with a virtual agent, a computer that is able to interpret a number of common questions and refer users to the proper answers.

Over the past several years, research has been conducted on how natural language processing can be used to discover trends and sentiment in the market, and in the future, this technology will be a crucial part of what it means to be an investor.

Analyst Research Reports & Earnings Call Transcripts

Investors often utilize analyst research reports to help select stocks. For example, investors may take the current average earnings per share (EPS) estimate for a company (the "consensus" of the analyst community), and compare it to the average EPS estimate from the previous quarter. The companies with the highest average EPS revision, meaning those companies that analysts view as having the most promising and improving earnings prospects, are then favored according to this signal.

Investors have focused on headline EPS forecasts—even quantitative managers—to process a single number from analysts' reports across different companies over time. A consequence of this approach was that the body of the analyst report (the actual prose) was often ignored. However, much of the information in a research report is conveyed through its words, tone and phrasing. Rather than relying on headline EPS figures, investors can look at subtle shifts in tone and diction in any analyst's research reports on a given company. Analysts are reticent to change their buy, sell or hold recommendations frequently, so will often subtly shift the tone of their report to indicate a potential change in view while keeping their headline rating the same. By utilizing natural language processing to parse through an analyst's writing, investors can help predict changes in their headline forecasts before those shifts take place.

A similar analysis can be performed on the transcripts of companies' earnings calls. Management will frequently hint at shifts in their viewpoint through their phrasing and tone. By utilizing natural language processing to parse through earnings calls, investors can isolate subtle shifts in management's sentiment around their company, which can be helpful in more accurately forecasting future performance.

In both of these cases, natural language processing is a powerful tool that enables investors to gauge subtle shifts in how analysts and company management are thinking about the future of a company using non-numerical, language-based data.

Topic Analysis

Natural language processing can also help identify what trends are driving the market and what companies are best positioned to take advantage of those trends. For example, a positively trending topic such as wind energy in Europe may point to greater investor interest in renewable energy, potentially impacting the producers, suppliers and related companies in the space in ways that were not so obvious at first glance. Identifying trends objectively and dispassionately is not a task at which humans tend to excel. Humans are often affected by unconscious biases, favoring trends they prefer and neglecting those that interest them less. Computers are experts at weighing evidence without prejudice. However, much of the information investors use to identify trends is conveyed through human speech and writing—e.g. news reports, online blogs and company filings. Natural language processing allows us to parse through millions of news articles and other text-based data sources per year, extracting those trends that are most compelling with efficiency and objectivity.

Conclusion

With over 13,000 public corporations around the world, global investors would have to digest hundreds of thousands of pages in annual reports and over 30,000 hours of earnings calls every year. For decades, people have utilized computers to help us grasp an increasingly complex world around us, limited to dealing with numerical and easily quantifiable data. Natural language processing is helping to remove that limitation. Computers are increasingly able to answer questions like "What topics are trending in the market place?" and "How are research analysts thinking about the oil industry?" Successful investing has always been about maintaining an informational and analytical advantage. With the enormous amount of information embedded in the language around us, it is likely that natural language processing will be a critical tool for tomorrow's investors.

1. http://www.economist.com/news/business/21602757-managers-most-traditional-industries-distrust-promising-new-technology-digital

The Role of Big Data in Investing

Observations and views from investment professionals across GSAM's Quantitative Investment Strategies team on the role of big data in potential investments.

Osman Ali, *Portfolio Manager, Quantitative Investment Strategies, GSAM*

Takashi Suwabe, *Portfolio Manager, Quantitative Investment Strategies, GSAM*

Dennis Walsh, *Portfolio Manager, Quantitative Investment Strategies, GSAM*

Q. Can you explain your investment philosophy and how access to big data has impacted how you invest?

OA: We are focused on creating data-driven investment models that can objectively evaluate public companies globally through fundamentally-based and economically-motivated investment themes. These models have historically utilized a large set of company-specific data like publicly available financial statements, as well as market data like prices, returns, volumes, etc. With the growth and availability of non-traditional data sources such as internet web traffic, patent filings and satellite imagery, we have been using more nuanced and sometimes unconventional data to help us gain an informational advantage and make more informed investment decisions.

Q. What types of data are you analyzing and how does it differ from what you were looking at before the Data Revolution?

TS: We identify strong businesses with attractive valuations, positive sentiment and a strong connection with positive themes that are trending in the markets. The types of data we analyze now are quite a bit more expansive than what we used 10 years ago. In the past, computers could only analyze structured data, or data that is easily quantifiable and organized in a set form. New technologies allow us to analyze unstructured data, or data that is not as easily quantified. These innovations enable us to interpret information from a much wider variety of sources, including language, images and speech for the first time.

Access to new types of data, along with the ability to capture and process that data quickly, has given us new ways to capture investment themes such as momentum, value and profitability.

The Quantitative Investment Strategies Approach to Identifying Investment Opportunities

	Big Data Investment Approach
Momentum	Use machine learning techniques to identify the connections between companies based on industry sentiment, stock movements and correlations in economic factors
Value	Analyze a large universe of industry-specific data that extends beyond a company's financial statements to determine its "intrinsic value"
Profitability	Evaluate a company's web traffic patterns to identify businesses that are gaining e-commerce market share in real-time

For educational purposes only.

Q. How has your technology and infrastructure evolved to keep up with big data?

DW: New data storage technologies have created the infrastructure needed to capture, analyze and make informed decisions from new forms of real-time data. For example, the growth of distributed databases, where data is stored across several platforms in place of a single platform via a centralized database, allows for highly-scalable parallel processing of vast amounts of data. This can decrease processing time by several orders of magnitude for many applications. Unstructured data storage also allows for greater flexibility in onboarding and retrieving data from non-traditional sources and in managing large amounts of text-based information.

Q. How do portfolio managers interact with the models that are analyzing data and making recommendations?

TS: Data is the basis of our investment model, but the research and portfolio construction processes still require human judgement. Portfolio managers exercise their judgment when selecting the data and analytics that we use in investing, and also when reviewing and approving each trade in every portfolio. This is to ensure that all portfolio positions make sense—that they are economically intuitive and appropriately sized given current market conditions. We do not have a computer in the corner simply shooting out trades with no human interaction.

We are researching new factors and analytics that have an impact on stock prices, and our portfolio managers drive that research. Research success for us is not finding a new stock to invest in, but rather, finding a new investment factor that can help improve the way we select stocks. Investment factors should be fundamentally-based and economically-motivated, and the data enables us to empirically test our investment hypotheses. We would never work in the opposite direction—observing relationships in the data that we would seek to justify or explain after-the-fact.

Practically speaking, portfolio managers also rely on their own practitioner experience and market knowledge to assess the future success of any investment factor. Certain market trends or risk environments may bode well for particular factors and poorly for others. This awareness allows our portfolio managers to more effectively assess risk on a real-time basis.

Q. What kinds of boundaries are you pushing now and what do you see as the future of big data-driven investment approaches like yours?

DW: Active management has always been about uncovering opportunities before they are priced in by the broader market. The exponential growth in data is fueling our investment decisions and research agenda. We're seeking to push boundaries by moving beyond conventional data sources and leveraging alternative forms of data to gain an informational edge.

Today, we're able to process more data more quickly, in an effort to uncover insights and connections that aren't as obvious to other investors. Given new data availability and the development of machine learning techniques to learn quickly from such data, we are only at the beginning of this Data Revolution that we believe is transforming every industry globally.

Q. What kinds of machine learning data analysis techniques do you use?

OA: Machine learning techniques allow us the flexibility to create dynamic models that adapt to the data. Quantitative techniques in the past relied on more simplistic rules for ranking companies based on certain pre-determined metrics—take price-to-book, for example—newer machine learning techniques allow algorithms to learn and adapt from constantly changing data.

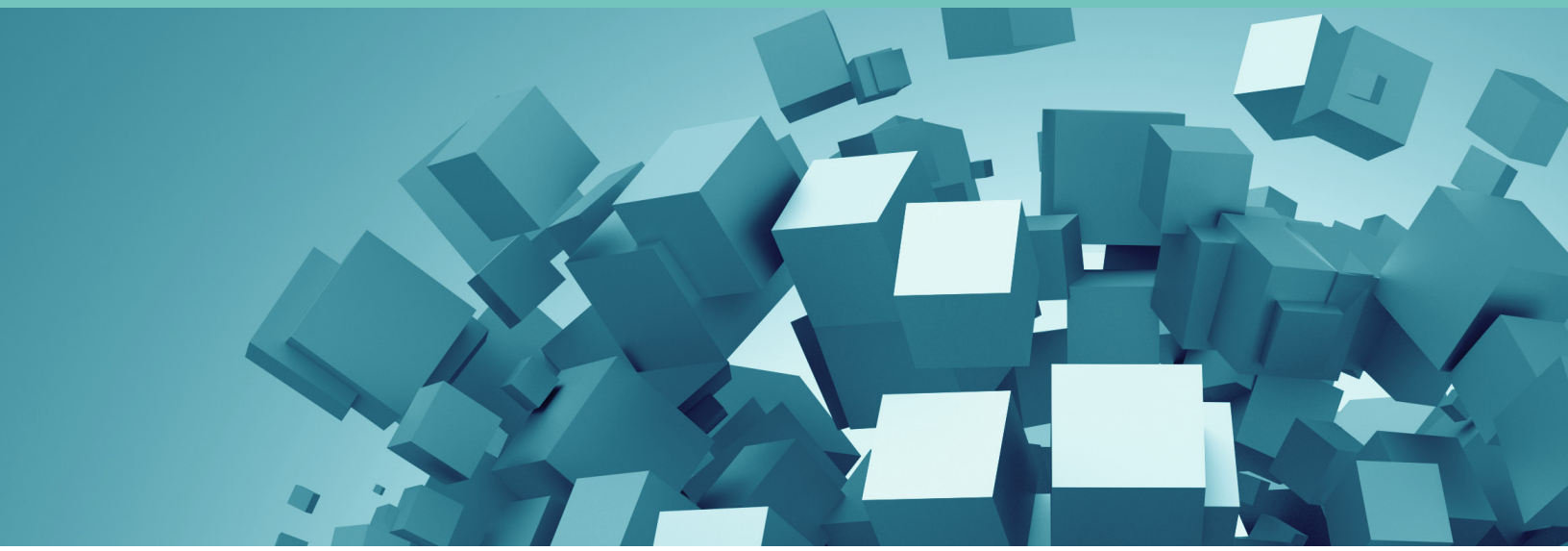
Natural language processing, or NLP, uses computers to read and interpret vast amounts of text, enabling us to incorporate textual data in multiple languages from a variety of sources. One of the more obvious NLP applications is to gauge sentiment in the text—is the tone in the news articles or research reports being published on a company positive or negative? An extension of NLP is topic modeling—summarizing a large body of text into topics and themes that are easily understood by humans, but can also be used for systematic analysis in statistical and machine learning applications. For example, what subjects did company management focus on in their earnings call this quarter versus last quarter?

NLP also allows us to pick up on subtle relationships between companies that might otherwise go unnoticed—we call this intercompany momentum. Traditional momentum focuses on the persistence of price movements for a single security,

while intercompany momentum seeks to understand how the movement in price of one security might impact, albeit subtly, the movement in price of other related securities. These not-so-obvious relationships can be assembled from the clustering of companies in text-based data, appearing together in news articles, regulatory filings or research reports.

Q. What is your approach to big data in Emerging Markets?

DW: We feel that the information asymmetry in emerging markets may create opportunities for data-driven investors like ourselves. A lack of available data is a sign of mispricing and uncertainty, and investors who are diligent enough to analyze and uncover potential opportunities in this environment may be rewarded. With over 4,000 companies in the emerging market universe, spanning 23 countries across 6 continents, it can be a challenge to capture and digest vast amounts of disparate information, especially since the quality of data or reporting governance standards in some of these countries is lacking. Our experience and sophisticated techniques make us well-positioned to act in this space and analyze potential investments without necessarily requiring us to have analysts locally based around the world. This centralization of data processing is more scalable and allows us to cover a wider breadth of companies when compared to traditional methods.



Big Data is Fundamental

GSAM's Fundamental Equity and Fixed Income teams discuss how big data can be a strategic advantage or disruptive force in companies and sectors.

Steve Waxman, *Portfolio Manager, Global Fixed Income, Goldman Sachs Asset Management*
Larry Tankel, *Portfolio Manager, Fundamental Equity, Goldman Sachs Asset Management*

Q. From an investment perspective, how does the use of big data by certain companies or sectors impact their appeal?

SW: We believe big data can provide a competitive edge for companies. For example, airlines were early adopters of using big data to optimize revenues through targeted pricing, which is now gaining traction across the transportation industry as a whole. As another example, we consider a well-developed customer loyalty program to be a positive indicator of strong future revenue in the consumer products, retail and hospitality industries. We think the quality of these loyalty programs and other forms of consumer purchasing data can be significant differentiators in these businesses.

Q. As an equity investor, how is big data influencing your view of opportunities in the tech sector?

LT: Within the technology sector, vast amounts of infrastructure, computing power and storage are necessary to capture and process big data. Hyperscale Cloud providers are currently big winners. They allocate computing and storage

resources dynamically based on demand and are increasingly the platforms on which these big data analytics programs run. Some of the legacy software and hardware players are also pivoting their businesses and adding cloud services to their offerings. Increased demand for computing power could also benefit semiconductor companies.

Large social media and e-commerce companies are another place we see opportunity. The large datasets inherent to these businesses position them well to leverage big data and provide faster services, more targeted advertising and a customized online experience. This should enable them to gain market share over time, creating longer-term profitability improvement and growth opportunities. Pure-play analytics companies also have an advantage stemming from the breadth of their services, which spans from security to business operations.

Q. How can big data help companies reduce costs?

SW: Big data may lower costs for companies by creating efficiency gains, particularly in the energy and utilities sectors. US shale oil producers are using technology to record well data from every hole made in the ground, which could help refine processes, reduce drilling times and lower costs. Utilities are increasingly deploying 'smart meters' that amass data on energy usage and could soon help curb outages and smooth demand periods. In the renewables space, European wind farms are eyeing big data for efficiencies in operation and maintenance, such as anticipating supply and preempting necessary repairs.

LT: Retailers are also using big data to synchronize the flow of product from supplier to shelf. Better synchronization can improve the accuracy of inventory management, reduce lead times and lower the costs of transportation, handling and other fulfillment costs. Using big data to improve forecasting can also allow companies to lower safety stock levels in distribution centers and stores. When these initiatives are used together, we think big data can drive incremental cash flow and lower logistics and transportation expenses.

Q. Where do you see the biggest potential change in terms of an industry's adaptation to big data technology?

LT: We believe a variety of businesses including healthcare, financials, advertising and industrials will be impacted to varying degrees. For example, the healthcare industry could see significant disruption through the advancement of data analytics, which should help improve the quality, efficiency and outcome of patient diagnoses while also reducing costs. Gene sequencing has become exponentially faster, more efficient and cheaper, leading to new possibilities in DNA sequencing and diagnosis. In 2000, the Human Genome project was completed in 13 years at a total cost of $3.8 billion, but today the human genome can be sequenced for approximately $1,000 per genome in less than three hours.

SW: The insurance industry could see significant disruption. Consider 'telematics,' a technology for collecting data on driver behaviors, including speed and abruptness of braking. Most large European motor insurers are now offering the technology, which can be a standalone device or function as a phone app, as a way for safer drivers to get better prices.

In the near term, this technology benefits early adapters and likely improves loss ratios and therefore margins. In the long term, the initiative could be a negative for the sector if it keeps premium rates depressed, especially since insurers are more likely to withhold discounts for bad drivers rather than increase prices. Some insurance startups are even moving towards providing 'on-demand' insurance for single items, which is based on their ability to use big data. To some extent, every insurer is going to have to be a software and analytics company in the future.

The Political Gets Analytical

The Rise of Big Data in Elections

Big data has become a powerful force in the election process and is likely to serve an increasingly central role in future political campaigns.

Big data has become a powerful tool for the modern political candidate. Complex models allow campaigns to gain a much more refined understanding of constituents at the individual voter or household level, whereas prior campaigns were typically limited to the general demographics of the state, county or zip code.

Micro-targeting of voters through the use of data analytics gained momentum in the 2008 and 2012 election cycles. David Plouffe, Barack Obama's 2008 presidential campaign manager, noted that, "In both Obama campaigns, we had outsized advantages over our opponents, both in the quality of our data analytics and predictive modeling, as well as our belief in it. It's how we made every decision." Similarly, Obama's 2012 re-election campaign manager Jim Messina made a pledge to "measure every single thing" in the campaign. That pledge resulted in the formation of a dedicated team of over 100 data analysts focused entirely on collecting vast amounts of data on campaign operations and the electorate. A new frontier of campaign analytics was born. Reflecting on the use of real-time metrics, Messina commented that, "Every night for 18 months, we did 66,000 computer simulations of the election, and that's how we based our tactics—we based it all on big data."[1]

Since the 2012 election cycle, the amount of time Americans spend watching television has decreased, while the amount of time they spend online has almost doubled.[2] Traceable online activity—people's digital footprint—reveals data about each voter's individual preferences and behaviors, and campaigns are able to use this information to better understand and communicate with their target constituents.

This tactic was featured in the Netflix series *House of Cards*, when Frank Underwood, fictional US president grows increasingly alarmed by his opponent's use of big data analytics to sway public opinion in the series' fourth season. By leveraging big data, candidates can effectively segment the voter population across a variety of metrics, including basic demographics (such as income and gender), lifestyle data and historical tendency to vote for a certain party. Candidates can also mine data from social media and other websites to measure individual voter interests, associations and affiliations. Once candidates have gained a clearer picture of their voters' identities, they can then adapt their communication strategy accordingly with the goal of more effectively reaching their target (and most receptive) audience. Rather than pursue mass mailings or call campaigns, candidates can focus their efforts on voters that could make the biggest impact on election day. Strong supporters can be identified early on and enlisted as local influencers or canvassers in the field, and potential swing voters can be prioritized in outreach campaigns—the goal to micro-target each individual voter, in mass scale, across the entire nation.

Understanding a campaign's voter base can also influence the medium that candidates use to communicate their message. For example, television ads are a common marketing tactic, but research has shown that one-third of voters do not watch live TV each week, while 52% of voters watch online videos on a weekly basis. By using big data to understand the behaviors and preferences of target voters, candidates can deliver content on the platforms that voters are most likely to use, thereby more efficiently using campaign resources and also potentially bringing down per voter acquisition costs.

Bernie Sanders implemented this strategy ahead of the 2016 Iowa caucuses when he launched a massive social media advertising campaign targeted at millennials. The ad campaign stretched twelve days and reached a wide mass of people on Facebook and Instagram in Iowa, 85% of whom were in the millennial age group.[3] By focusing his efforts on a platform that millennials use frequently, Sanders was able to reach a large portion of his target audience in a remarkably short span of time, ultimately winning the Democratic caucus in Iowa.

Big data can help candidates determine the delivery strategy for their communications, and also shape the content of the communications themselves. Candidates can address the same issue in different ways to appeal to different audiences depending on their preferences and beliefs. By personalizing the content of its outreach emails in the 2012 election, Obama's campaign was able to fundraise $460 million from email donations, whereas Mitt Romney's email outreach efforts only garnered $130 million. Matt Rhoades, former campaign manager for Romney, shared, "Unfortunately, it took Governor Romney's loss in 2012 for Republicans to get serious about funding our party's data programs." Candidates may also deliver personalized content through voter-targeted digital advertising services. These services use voter registration data to identify individuals by voting history or party affiliation and then serve them customized ad content that addresses specific political issues or positions that are of interest to the voter. The ability to use data to define voter-specific messaging, and then determine how best to deliver the messaging, creates a partnership that is difficult to beat.

From analyzing social media and demographic information to targeting and motivating voters, big data has become a powerful force in the election process in the US and increasingly in other countries as well. And while the tools and methods candidates use will continue to evolve, the large-scale interpretation and analysis of data is likely to be a centerpiece of most future political campaigns.

1. Messina, Jim. "EY Strategic Growth Forum." *Interview.* 14 Nov. 2015.
2. Carosi Dunn, Lee. "Election 2016: Connecting to Voters." GSAM Symposium. Washington D.C. Speech.
3. Corasaniti, Nick. "Bernie Sanders Takes to Social Media to Reach Younger Voters." The New York Times: Election 2016. *The New York Times*, 9 Feb. 2016. Web. 27 May 2016.

Interview with Daniel Nadler

Daniel Nadler, Founder and CEO of Kensho, provides his perspective on the power of big data analytics for Wall Street and beyond.

Daniel Nadler

Daniel Nadler is the founder and CEO of Kensho, the leading provider of market analytics systems to Wall Street. Kensho's clients include the largest global banks. In addition to Kensho, Dr. Nadler is the Director of Research for Financial Technology at Stanford University's School of Engineering. He completed his PhD at Harvard University.

Q. What was the catalyst for starting Kensho Technologies and what does the company do?

A: I came up with the idea for Kensho while serving as a visiting scholar at the Boston Federal Reserve in 2013. I was stunned to learn that as important developments were occurring around the world—central bank announcements, elections in Europe, the European sovereign debt crisis, turmoil in the Middle East, etc.—there was no existing mechanism to track similar historical events and analyze the implications so as to glean insights. Neither regulators nor bankers had an efficient and effective method for assessing the impact of similar events on financial markets beyond digging up old news clips and manually creating spreadsheets. I began working on it with some friends, and within weeks we had put together a small team and received early funding for the idea from Google's venture capital arm. Kensho Technologies Inc. was founded in May 2013.

Like Google, Kensho answers questions such as "How do defense, or oil, or airline stocks react to ballistic missile tests by North Korea?" But while a search engine can only find pages with existing analyses, Kensho can generate original answers by analyzing relationships between events, including natural disasters, political developments, corporate earnings

announcements, product launches and FDA drug approvals. Answers that might have previously taken 40 man-hours of research can be generated by Kensho in seconds, complete with graphs and charts.

Q. What is your firm's philosophy and approach?

A: We believe Kensho is in the vanguard of the Fourth Industrial Revolution. The First Industrial Revolution used water and steam to power production. The Second used electric power for mass production. The Third used electronics and information technology to automate production. This Fourth revolution is building on the third to create a "digital revolution." In this vein, our goal is to bring advanced technologies, like machine learning, to bear on aspects of the capital markets in ways that, until now, have been the provenance of a very select set of elite hedge funds. By making this technology more accessible, market participants are able to gain a more efficient and transparent understanding of capital markets. Through our media partnerships, we are also bringing greater market insight and transparency to everyday investors, revolutionizing their access to information that helps them achieve their goals.

Q. How has your business model evolved?

A: Over the next two to three years, Kensho will continue to expand its footprint within the financial services industry, both horizontally, by adding new clients, and vertically, by expanding coverage and functionality for existing clients. We are also creating new business lines, such as the application of machine learning technology to financial transaction flows, giving our clients unique predictive insights into the behavior of market participants, and creating indexes to help investors make sense of the New Economies that are transforming our world—emerging sectors like the commercialization of space, autonomous vehicles or wearable technologies. There are significant opportunities to apply our technology beyond financial services, with applications in government, retail, pharmaceuticals and healthcare, among others, in which we are actively engaged.

Q. As we adopt new technologies, how do you see financial intermediaries evolving? How do you see the roles of investment professionals changing as a result of big data innovations?

A: From the invention of the ticker tape to high-speed trading, technology has constantly changed the financial industry. Today, start-ups are taking aim at nearly every business line of traditional financial institutions. Decisions about loans are now being made by software that can take into account a variety of finely parsed data about a borrower, rather than just a credit score and a background check. Banks are trying to fend off the newcomers by making their own investments in big data innovations. And investment professionals will need to adapt as they always have, making use of new technologies where they help them to serve their clients more effectively.

Q. How has Fintech evolved and what opportunities and challenges do you see?

A: Stock trading, one of the earliest areas to go electronic, provides an interesting precedent for how automation can play out in various financial institutions. On the company's trading desks, stocks are now bought and sold by computers instead of people. Some traditional traders were replaced by programmers who design and monitor the new trading algorithms, and there are now new jobs in the data centers where the high-speed trading takes place.

Q. What is your outlook for big data?

A: We're at an interesting inflection point. Never before have we had so much data available to us to instrument the world and draw inferences about where to deploy capital. And that is coincident with the availability of computing power, analytics and machine learning to help us make sense of it. The smartest people asking the best questions will be able to use that to generate alpha, but the decay-time over which new signals become beta will shrink.

Q. Outside of finance, what industries do you think will be most impacted by advancements in big data and machine learning technologies?

A: According to an Oxford paper[1] and subsequent research, advancements in machine learning technologies vary significantly by industry. In healthcare, for example, where human interaction is vital, automation threatens fewer jobs than it does in the labor market as a whole. Taxi and truck drivers, on the other hand, may face a bleak future given recent advances in self-driving cars. Oxford researchers also took into account software that can analyze and sort legal documents, doing the work that even well-paid lawyers often spend hours managing. Journalists will have to compete with start-ups like Automated Insights, which is already writing up summaries of basketball games and financial reports.

Q. You've spoken about the ability of machine learning technology to perform traditionally "human" tasks more efficiently and accurately. What are your thoughts on the broader impact of machine learning on society?

A: I anticipate some form of strong artificial intelligence, whereby computers in the far future would be smart enough to anticipate our needs and usher in an era of abundance. For the next few decades, though, I predict a more complicated time—an interregnum in which the computers are not as smart as people, but smart enough to do many of the tasks that make us money.

1. Frey, Carl Benedikt, and Michael A. Osborne. "The future of employment: how susceptible are jobs to computerisation." Retrieved September 7 (2013): 2013.

Interview with Jake Flomenberg

Jake Flomenberg, Partner at Accel, weighs in on how big data application startups and open source software are transforming software development.

Jake Flomenberg

Jake Flomenberg joined Accel in 2012 and focuses on next-generation infrastructure, enterprise software and security investments. Jake is part of the team responsible for Accel's Big Data Fund and led investments in Demisto, Origami Logic, Sumo Logic, Trifacta and Zoomdata. Prior to Accel, Jake was director of product management at Splunk, where he was responsible for the product's user interface and big data strategy. Previously, he worked at Cloudera where he helped the founding team tackle a broad array of sales, marketing and product issues. Before Cloudera, he was a member of Lockheed Martin's Engineering Leadership Development Program.

Q. How has big data evolved recently? What have been some of its most significant effects?

A: Internet-scale consumer companies like Facebook, Google and Yahoo have inspired and directly created the underpinnings of the big data infrastructure software available today. While the rest of the world can now leverage offerings like Hadoop or BiqQuery, few companies have the internal resources required to build in-house "last-mile" applications, i.e., applications able to make big data useful for the masses, on top of this infrastructure in order to actually make big data useful to them. Thus, startups emerged to fill this gap.

The first wave of big data application startups offered data tooling to technical users to help reduce manual coding and improve the efficiency of analytics at scale. More recently, we've seen entrepreneurs directly attacking core enterprise

software applications, such as customer relationship management, helpdesk and security, as well as industry-specific applications such as farming, healthcare, etc., creating a wave of Data-Driven Software (DDS). DDS is end-user rather than manager-centric. It leverages an organization's data footprint in new ways to help users do their jobs more efficiently and effectively. For instance, Origami Logic collects data from myriad sources to empower marketers to answer the question "What happened today?" by measuring the marketing signals that matter. Marketers can now react and respond on a daily basis instead of monthly. Ultimately, we believe that all software should be data-driven, and incumbent vendors in every category of user-facing software must either adapt or risk being disrupted.

Q. What is the biggest misconception about big data?

A: The greatest misconception is that big data and DDS are only for large companies. Every company at any size needs to think about becoming a more data-driven organization to provide the best experiences for customers and end users. Businesses that fail to focus on their data and extract insights from it will inevitably be disrupted.

Q. What are the some of the main challenges for the big data industry?

A: There are two interrelated challenges facing the big data industry: programming interfaces and hiring talent. Soon after the first modern databases were developed in the 1970s, SQL (American National Standards Institute's Structured Query Language) emerged as a lingua franca, or common language, used to store and retrieve data. Today, we live in a sea of interfaces and tradeoffs created by different big data platform layers attempting to serve different needs. Compounding this problem is the supposed need for the mythical, all-knowing data scientist who understands math, statistical modeling, code and the intricacies of data pipeline engineering, as well as the business domain and storytelling. Classroom education may be part of the solution, but we absolutely need software to help bridge this gap; however, with companies built from the ground up to work on big data, such as Trifacta[1] for data preparation and Zoomdata[1] for visual analytics, we believe the industry is on the right path.

Q. What are some trends in big data to watch in the coming years?

A: We've seen a lot of focus on developing advanced analytic methods and frameworks, such as natural language processing, e.g., Apple's Siri, machine and deep learning, e.g., IBM's Watson, and now artificial intelligence. While horizontal platforms to apply these algorithms at massive scale are interesting for the most sophisticated of companies, few have the requisite data volume and skill sets to apply these techniques effectively. Thus, in the short term, it will likely be the verticalized players, such as IBM or Apple, who bring the power of these technologies to the masses.

A somewhat related recent tech meme is the rise of chatbots—programs designed to simulate intelligent conversation with human users. With large enough pools of training data to learn responses from as well as recent advances in natural

language processing, we are on the cusp of machine-driven conversational interfaces that are palatable to end users. While a chat interface is far more constraining from a design perspective than a traditional graphical user interface, there is an inescapable comfort and familiarity it offers end users. It's a magic curtain behind which a company can offer any blend of human- and machine-created responses they desire. For example, Demisto[1] Enterprises' Security Operations platform builds upon both these trends. It's the first intelligent automation and chatOps platform for security operations centers. Unlike most security vendors that analyze machine data, Demisto's platform learns from human data in part by offering an interface through which almost every action taken to resolve an incident is recorded. This allows DBot, the Demisto security chatbot, to determine what it can help expedite or even automate for incident responders.

Q. Will big data be dominated by traditional, large players (i.e., do they have a competitive advantage)? Or can smaller companies also make a splash here (i.e., what challenges do they face)?

A: This depends on the lens through which one defines "large" big data players. If it's the "holders" of big data, such as Amazon, Apple, Facebook and Google, then it's clear that they enjoy huge data network effects and learning feedback loops—advantages that make it very hard for industry upstarts to compete. Google's decision to open source its deep learning platform, TensorFlow, is a clear indication that Google believes that its data is the basis of its competitive advantage, even more so than its technology. In order for a startup to compete on a given application, it will need to find some way to create its own data advantage.

However, if you look at the containers for big data—the database management platforms—then the answer is different. Traditional database management vendors and new purveyors like Cloudera[1] are not in the same market. Platforms like Hadoop are, by and large, augmenting and not replacing current infrastructure. It's classic new-market disruption. Hadoop has lower performance in certain traditional attributes but has improved performance in new attributes—namely scalability and the ability to handle unstructured or semi-structured data. The business model here is different as well; from our perspective, to be successful over the long term, it must make money at a lower price per unit sold, which in this case is the amount of data.

Q. Will big data become commoditized at some point?

A: Value slowly moves up the stack. Technologies always get commoditized, but there are always new layers of innovation. More importantly, we believe it will be the enterprises that don't embrace big data technologies that become commoditized and irrelevant, whereas enterprises that appreciate and leverage their data assets will be the ultimate winners in their respective categories.

That being said, we are in the very early innings of this big data revolution. While there has been a lot of hype, there is still plenty of ongoing innovation and room for massive growth of new ideas. It will take years for these technologies to become mainstream. In order for average businesses to benefit from their investments in big data analytics, they will require software to deliver client solutions constructed specifically for the industries in which they operate.

Glossary of terms:

Hadoop: an open-source software platform that supports the processing of large data sets (i.e., big data) in a distributed computing environment, able to analyze both structured and unstructured data. Originally created by the Apache Software Foundation and previously known as Apache Hadoop, the name is now synonymous with big data.

BigQuery: a RESTful—representational state transfer—web service that enables interactive analysis of massive data sets, and Google's answer to the big data question/issue.

Open source: software where the source code is available for modification or enhancement by anyone.

"Last mile" applications: End-user facing applications which they interact directly with, as opposed to infrastructure software.

Chatbot: a computer program designed to simulate conversation with human users.

ChatOps: a conversation-driven development tool where a chatbot is configured to execute on a command via particular custom scripts and plugins.

1. Accel is a current investor in the company.

Interview with Josh James

Josh James, Founder and CEO of Domo, discusses how data analytics are revolutionizing the way people run and understand their businesses.

Josh James

Josh founded Domo in 2010 to transform the way CEOs and other executives manage their business, and to help drive value from the tens of billions of dollars spent on traditional business intelligence systems. Prior to Domo, Josh served as CEO of Omniture, a SaaS-based (software-as-a-service) web analytics company that he co-founded in 1996 and took public in 2006.

Q. How did you define big data and what does it mean to you and your business?

A: For me, big data is not about having more data, but rather, it is about having the right data and relevant information to inform business decisions. At Omniture, we evaluated data in real-time to assess web traffic and key metrics, i.e., search optimization tools and returns, which is how the company got its start. Today at Domo, we are not only providing online marketing data, but also including data from across a company's systems, and then packaging analytics on that data in a much more accessible manner. The goal is to provide business decision makers across the entire company a holistic view of what is happening in their respective businesses through a single platform—in order to collaborate with each other and make faster, better informed decisions, optimizing performance in real-time.

Q. How does a big data provider gain a competitive advantage in the space?

A: The types and rate at which data is being generated will not slow down any time soon. Businesses will need better strategies and tools to more efficiently and effectively use that data for a competitive advantage. Studies have shown that the best performing companies leverage multiple data sources to better harness their data, make more informed decisions and align their people to improve business results. At the end of the day, big data should enable businesses to make meaningful enhancements such as drive more revenue, improve employee retention rates or shorten the time it takes to collect payment from customers.

Q. How does Domo create information to help retailers and e-commerce companies stay ahead of the curve?

A: Ten years ago, companies were not adapting their advertising techniques and offers on a real-time basis. They would set up their advertising strategy for that holiday season and it largely remained static. Today, many of the largest retailers in the world are now looking at real-time data in an effort to develop multiple advertising plans simultaneously. The deployment of any one particular plan is dependent on ongoing customer responses from both online and offline stores. Companies are now considering different scenarios and plans on a daily and sometimes hourly basis, derived from this real-time analysis. I am personally excited about the downstream impact this may have on a company's productivity—that every employee in every small company may now have access to real-time data and analytics about their business. Over the last decade, organizations have largely relied on their own people to develop spreadsheets and piece together heat maps of data for a human to review on a manual basis. Moreover, the associated IT costs have often been prohibitive.

Today, you can get the data in people's hands quicker, and we believe this will transform the way that people run their businesses. For example, we partnered with one online retail company to develop a centralized inventory system, which enables the company to track product supply in a dynamic and real-time manner. Leaders across the organization are able to glean a holistic view of processes, improve efficiencies and inform strategy accordingly.

Q. Will the big data space be dominated by traditional, large player or can smaller companies also make a splash here?

A: We believe this is a $200 billion market with plenty of room for new entrants and disruptors in all different segments. As a data point, if you look at the *2015 Fast Company Most Innovative Enterprise Software* list, eight of the ten companies represented were smaller companies. Traditional, large players have big balance sheets and can buy some degree of competitive advantage, but I believe we will continue to see newer, nimble companies make the biggest splash because we are not stuck trying to solve traditional problems with traditional approaches—we are seeking to democratize the use of big data analytics.

Q. Are there any businesses you're aware of that have changed business practices based on data analysis?

A: A leading technology company in the global payments space has shifted their use of data to not just build reporting but to optimize their marketing investment. They used to spend a significant amount of time assembling data, which lived in silos, and very little time analyzing and applying it to their business. Their digital marketing team now uses this data to provide hyper-relevant offers, experiences, products and services to people at the right time, which makes them more likely to convert. They are now able to measure how people react to their advertising, and then continually optimize their marketing efforts based on real-time findings from that data.

Q. What are you excited about looking out 10, 15 years from now? What is your vision of what big data could mean going forward?

A: Think about how big data is transforming the way that boards govern companies. Board members are no longer receiving information quarterly or days ahead of a board meeting; they are, in fact, receiving information on a more real-time basis. We are in a very different environment today, and boards have a desire to react much more quickly to changing market and customer conditions on a real-time basis. My vision would be for most of the 230 million knowledge workers, or even many of the two billion working people across the planet, to have data analytics at their fingertips every day to run their business.

The views expressed in this article are solely those of Josh James and do not necessarily reflect the views of The Goldman Sachs Group, Inc. or its affiliates. Mr. James' consent to publishing this article should not be taken as an endorsement or recommendation of The Goldman Sachs Group, Inc. or its affiliates of Domo, Mr. James or their respective affiliates. Views provided are as of June 2016 and The Goldman Sachs Group, Inc. or its affiliates have no obligation to provide updates or changes.

Interview with Joe Lonsdale

Joe Lonsdale, Founding Partner, 8VC, shares his views on big data and examines some of the companies pushing the boundaries of technology today.

Joe Lonsdale

Joe Lonsdale is a founding partner at 8VC, a San Francisco-based venture capital fund. He serves on several boards including Addepar, OpenGov, Oscar, Illumio, Radius, Hyperloop and Wish. Joe is a co-founder of Palantir, a multi-billion dollar global software company best known for its work in defense and finance. Most recently, he was a founding partner at Formation 8, the precursor fund to 8VC, which manages over 1.5 billion USD and is one of the top performing private funds. Before that, he founded Addepar, a leading wealth management technology platform, and OpenGov. Previously, Joe was an early executive at Peter Thiel's Clarium Capital, which they grew into a large global macro hedge fund.

Q. As we think about big data, what are Smart Enterprise Data Platforms and how are they helping companies improve the way they operate?

A: Smart Enterprise companies leverage the billions of data points that now exist in the world to empower knowledge workers—employees who contribute value by applying knowledge and analysis to data relevant to their tasks to solve complex, non-linear problems. Many of the software platforms that underlie the world's most important industries, such as finance, healthcare and business services were written in the 1970s and 1980s, before the invention of cloud storage, distributed computing and big data analytics frameworks. With the increase in the amount of data in the world and the rise of cheap and fast processing and storage, the delta between what is possible in software and what exists in most

industries is enormous. Smart Enterprise Data Platforms, which are often vertically-focused, integrate heterogeneous big data sets, structure the data in a useful manner, and ultimately help people make more informed decisions. They often have a network effect, powered by shared data across different players in an industry, where the value of the platform increases exponentially with the number of users on it.

Q. What was the catalyst for starting Addepar and how is it helping improve the productivity of financial advisors?

A: We created Addepar because we saw a place where a multi-billion dollar global platform clearly should exist—but did not yet—to fix many of the challenges that exist in the finance industry. We saw the dysfunction in the technology and processes around wealth management as a perfect entry-point into the market to create a data platform that sits at the base of global finance. Addepar not only helps improve private wealth management workflows so that advisors can do a better job at what they currently do, but it also helps build a data-driven and integrated view on top of the many important financial decisions within a client portfolio. These include better connecting financial products and opportunities to relevant portfolios and enabling asset allocators to better understand how their investments relate to others. An example is finding interconnections among new types of tailored benchmarks or dashboards and how much clients are spending on particular fees and services relative to others.

Q. How is OpenGov transforming the way cities and municipalities are evaluating their budgets and resources?

A: Cities allocate trillions of dollars and they mostly run on decades-old technology. We initially started a non-profit group to help California and other governments learn about their allocation of resources. When cities asked to be included and wanted help unearthing their accounting data, we looked into it and realized there were many challenges. We discovered that a for-profit model was the best and most sustainable way to fix the esoteric but massively important area of municipal finance. OpenGov now powers about 1,000 cities across almost every state in the US. It is helping them not only increase transparency, but also to do things like contextual budgeting, with which they can compare their spending to other cities with similar features. Organizing the data to enable these kinds of workflows requires a system that is built in a way to complement the processes the city managers and their staff manage with budgeting and decision making.

Q. You were listed in 2016 as the youngest investor on the Midas List (Forbes) for other investments, but you are still best known for founding Palantir. What inspired you to found it?

A: We founded Palantir in 2003-2004 because we perceived a giant gap between how the defense and intelligence community was harnessing technology to achieve its goals, and what we had seen was possible in Silicon Valley over the last decade. The goal was to build the best technology culture possible, and a core driver of ours was to overcome a false trade-off between civil liberties and strong defense—we believed that a superior system could both "watch the watchers" while also going up against wasteful multi-billion dollar contracts that we saw as horrible examples of

cronyism and the defense-industrial complex in the DC beltway. A few years in, we also started the commercial division, developing products to empower tens of thousands of analysts and core workflows, not only in many areas of defense, intelligence and other parts of government, but also to confront the hardest problems in global finance, energy and healthcare, among others.

Q. How has fintech evolved and what opportunities and challenges do you see?

A: A lot of innovation in our companies comes from a frustration or dissatisfaction with something we perceive as broken in an industry, combined with an inspirational view of how much better it could work. A key part of the vision and mission of many of our companies are hypotheses about better ways the world should be working, and the confidence that with hard work and the best people around us, we can achieve great things and fix the problems we have identified. Many people have written about how to maintain an innovative tech culture, but at a company where the best ideas win, the technologists are empowered to be leaders rather than to report to people on the business side. In a well-run tech company, small, elite groups who have ownership in the company are given the freedom to define and achieve their tasks in line with a broader mission that they have internalized as their own.

Q. Can you speak to other emerging trends beyond finance where big data is being used to help people make better decisions?

A: Big data is the trend in every major industry. We speak about finance and government above, but many areas in healthcare including insurance, personalized medicine, outcome analysis, genomics, as well as other sectors of the economy such as logistics, manufacturing, education, energy, and even consumer, and the sub-sectors for each of those sectors—are undergoing a transformation. Creating the platforms that enable data to be organized and properly used in processes core to each of these industries is the big focus of the current technology wave. Just as consumer-oriented platforms like Facebook and Google became far more impactful and valuable than people expected, we believe that emerging Smart Enterprise platforms will help major industries run in far better ways, creating tens and hundreds of billions of dollars for the entrepreneurs and investors in the most important and best-run organizations in this wave of platform companies.

BIG OPPORTUNITIES IN

BIG DATA

With this abundance of data, it's more important than ever for companies and investors to put this data to work. In recent years, data-driven insights have helped companies revolutionize their respective industries and outperform their peers.

Big Data is Constantly Generated and Consumed

From smartphones to social media posts, people create and consume data every second of every day. Big Data is a popular term used to describe the growth and availability of this data. It also refers to the technologies and analytics that collect, manage and extract useful insights.

In only one hour, we generate…

21.6 million
Tweets
Source: Twitter

8.5 billion
Emails
Source: The Radicati Group

34,200
Websites
Source: Forbes

144 million
Google Searches
Source: Google

Why Big Data Matters

Data-driven insights can help companies make decisions more efficiently and effectively, often leading to outperformance compared to peers.

Companies that utilize Big Data are…

2X more likely to have **top quartile performance**
Source: Bain

5X more likely to make decisions **faster than their competitors**
Source: Bain

Companies simply cannot afford NOT to use Big Data

12% **in revenues may be lost each year** by financial firms who are unable to leverage and manage data effectively
Source: McKinsey Citi Big Data Analysis

Putting Big Data to Work

Big data is not just about having "more data," but rather about having the "right data" and relevant information to inform business decisions. Let's look at some ways in which different industries are leveraging Big Data to drive innovation in their businesses.

Finance

The Opportunity

Banks and investment advisors utilize people to manually sift through thousands of research reports, earnings calls and news data points to generate insights.

The Approach

Big Data analytics companies have developed automated systems that can use natural language processing to convert millions of unstructured data points into more accessible formats.

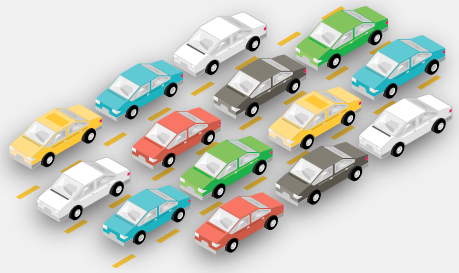
The Impact

Innovations in Big Data have allowed analysts to see complete datasets in record time. Rather than dedicating time and resources to aggregating unstructured data, analysts can now focus on what that data actually means, freeing up time to develop more impactful insights and investment decisions.

13,000+
public companies globally generate
30,000+
hours of earnings calls and
2,000,000+
pages of annual reports

The Opportunity

In the US, the average person spends over 50 minutes a day commuting to work, of which 20% is typically spent in traffic, representing approximately $42 bn a year in wasted fuel. In addition to the costs of congestion, traffic accidents cost tens of thousands of lives globally, with the National Highway Traffic Safety Administration (NHTSA) estimating that traffic accidents cost almost $826 bn annually in the US.



The Approach

Autonomous vehicles leverage 360-degree cameras with a spinning-laser to map exact distances to objects in their vicinity and machine learning computers to interpret surrounding environment and driving rules in real-time.

The Impact

Autonomous vehicles can reduce commute times, allow drivers to utilize their commute more efficiently, and significantly improve the safety of driving

30 hours

Average time spent in traffic jams
by Japanese citizens

20,000,000

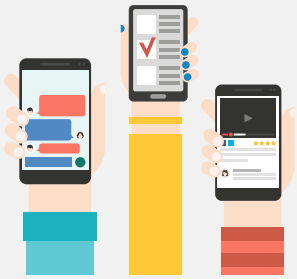
Number of traffic-related injuries
each year worldwide

The Opportunity

Prior to the availability of voter-specific data (demographics, preferences, social media, etc.) candidates have had to use mass-marketing approaches to reach people because it may have been more challenging to identify swing voters and supporters.

The Approach

By analyzing the voter information to craft targeted messages/ads that appeal to different groups of people, you can target efforts on fence-sitters, understanding the constituency in order to fundraise more effectively (email campaigns).



The Impact

Political candidates are able to allocate their resources properly and make deeper connections with voters.

146,000,000+
people from

435
different districts
are currently registered to vote in the US

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