generation
INVESTMENT INSIGHTS

APRIL 2015

ENVIRONMENTAL INTELLIGENCE

Unlocking opportunities at the nexus of Big Data and climate change

SUMMARY OF KEY INSIGHTS

> The convergence of two important developments—Big Data and climate change—is transforming the field of environmental intelligence (E.I.)

> A growing number of businesses are integrating E.I. into their practices in order to improve strategic decision-making and operational efficiency (what we refer to as "E.I. solutions")

> E.I. solutions that can be scaled enterprise-wide to serve as a source of competitive advantage are proving most valuable

> Although the market opportunity is still in its nascent stage, we believe that E.I. solutions have the potential to spread rapidly in key verticals—such as shipping, agriculture and supply chains—generating widespread productivity gains

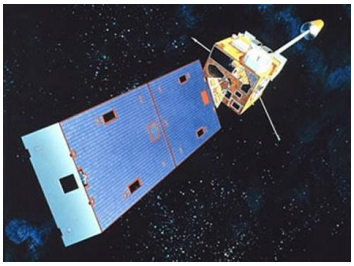
Image sources:
1. GOES12 satellite image of cold front, hurricane, and upper level system over Oklahoma, U.S. National Surface Map and Gempak Satellite Images (5 September 2007)
2. 1681533-poster-1280data, CrackerJack (Calgary: 2014). Accessed on 30 April 2015. http://www.crackerjackworks.com/?attachment_id=2244

ABOUT GENERATION

Founded in 2004, Generation Investment Management is a boutique investment manager with three investment strategies: public equity, growth equity and global credit. Generation seeks to deliver superior investment results [1] by consistently taking a long-term view and fully integrating sustainability research within a rigorous framework of traditional financial analysis.

FIGURE 1

NOAA geostationary operational environmental satellite traditionally relied upon in the U.S. for weather forecasting, severe storm tracking and meteorology research[2]



1. Although Generation seeks to provide superior investment performance, this is an aspiration and there is no guarantee that this goal will be achieved
2. National Ocean and Atmospheric Administration. "Image of geostationary operational environmental satellites." Accessed 27 April 2015. http://celebrating200years.noaa.gov/historymakers/johnson/goes_spacecraft650.html
3. The White House. "FACT SHEET: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation." Accessed on 27 April 2015. www.whitehouse.gov/climate-change.
4. Fisher, Paul (Bank of England). "Confronting the challenges of tomorrow's world." Speech presented at the Economist's Insurance Summit, London, U.K., 3 March 2015

Introduction

The convergence of two important developments—Big Data and climate change—is transforming the field of environmental intelligence ("E.I."). E.I. refers to data and analysis of the earth's climate, geography and populations.

Big Data is a phenomenon of the Digital Age. Over the past decade, the digitalisation of information has made it possible not only to create and store vast amounts of data, but also to analyse these data in high-volume, high-variety and high-velocity formats (the "Three V's" of Big Data). This has vastly enhanced the quality of E.I., both in terms of the data itself and the tools and techniques that make E.I. meaningful. As a result, the use of E.I. data and analysis has grown well beyond the public sector and now forms part of leading Business Intelligence practices.

Climate change is similarly shifting from a distant concern to a top priority for government and business leaders alike. A recent illustration of this was the joint announcement on climate change that President Barack Obama of the U.S. and President Xi Jinping of China made in 2014.[3] There has also been increasing recognition in the business world that climate change should be factored into long-term planning. In early 2015, the Bank of England warned that investments in fossil fuel related industries "may take a huge hit", as the world limits carbon emissions and moves to alternative energy sources.[4] Whether the impacts are direct (e.g. shifting and more extreme weather patterns) or indirect (e.g. regulations, social pressures), they are likely to influence financial performance across a variety of industries. In this context, E.I. is gaining traction as a tool that can enhance business preparedness.

Below we explore the key developments in E.I. and also examine several use cases. In the final section, we identify some of the challenges to the widespread adoption of E.I. and present our views on the overall investment implications.

Big Data: E.I. is becoming more accessible to a wider user group

Before the advent of Big Data, E.I. was costly to collect and cumbersome to use. Obtaining observations on factors such as temperature, wind speed and ocean currents depended on first-generation satellites and sensors that were largely government owned and operated. E.I. data analysis was also limited due to slower computer processing power and the absence of required cloud computing technology for large-scale data aggregation.

Today, this is no longer the case. Key developments across the Big Data value chain (i.e. data collection, processing, aggregation and solutions) have transformed the way that we conceptualise and employ E.I.

FIGURE 2
Big Data value chain[5]

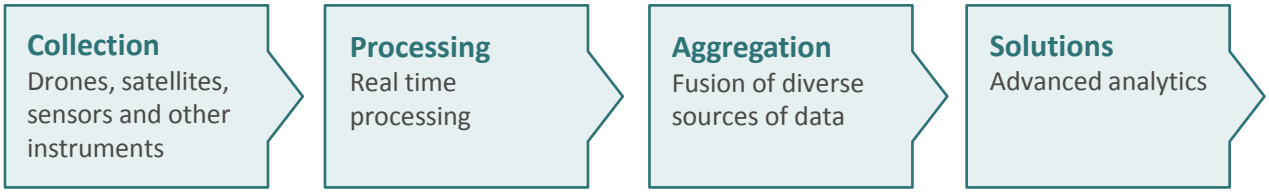
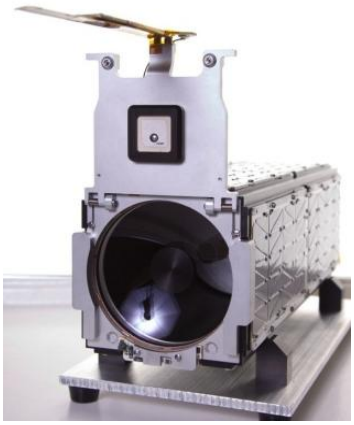


FIGURE 3
Top: Two Planet Labs Dove satellites seen launching into orbit from the International Space Station; Bottom: a Planet Labs Dove satellite close-up[6]



In the area of data collection, instrumentation is now cheap and nearly ubiquitous. Small sensors, such as gyroscope sensors, can be found in everything from smart phones to jet engines, following a steep drop in their unit price. Commercial satellites have similarly exploded in number. With the availability of cheaper materials from mass production suppliers, private companies are able to launch microsatellites without government funding. Commercial drones are also increasingly in operation, monitoring activities on Earth in a futuristic fashion. All three of these instruments—sensors, micro-satellites and drones—are constantly collecting E.I. and contributing to the rapidly growing stock of data observations available.

Moving up the value chain to data processing, the revolution in computing power has also played a catalytic role in the development of Big Data, and by extension, E.I. Supercomputers connected to the cloud allow for more variables to be incorporated into models; this in turn increases the accuracy of predictions.

The cloud has also paved the way for virtual data aggregation whereby datasets stored in different locations can be aggregated and analysed together. We are now able to easily mix diverse types of data to uncover new patterns and relationships (a process that is known as data fusion). For instance, companies can analyse weather data alongside more traditional metrics, such as sales or production time, to identify relationships and make projections.

Data solutions, the final link in the value chain, include any application that combines datasets with analytical capabilities to create valuable insights for decision-makers. A key component of any solution is the format in which the data is delivered to the end-user.

5. Generation IM analysis
6. Space.com. “Planet Labs Photos of Earth from Space (Gallery).” Accessed 28 April 2015. http://www.space.com/22358-planet-labs-dove-satellites-gallery.html

E.I. solutions that incorporate hyper-local and real-time data are proving particularly valuable

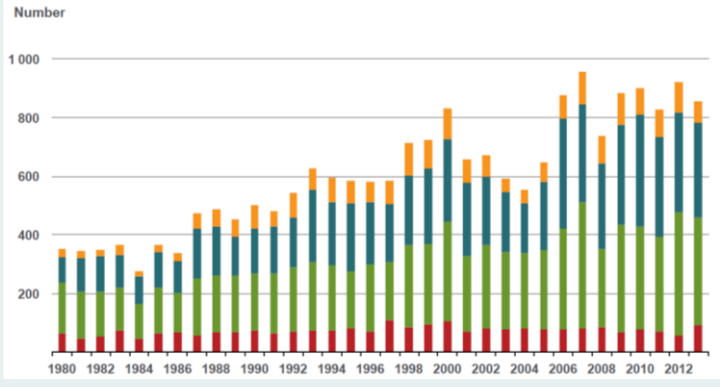
In relation to environmental intelligence, the most prominent forms include visual formats (e.g. interactive maps) and optimisation commands sent to a device (e.g. an optimal logistics route based on weather forecasts, which are sent to a delivery vehicle). E.I. solutions that incorporate hyper-local and real-time data are proving particularly valuable.

Climate change: E.I. is becoming more relevant across various industries

Developments in Big Data are converging with an increased focus and sense of urgency around climate change. In the private sector, both the direct and indirect impacts of climate change are increasingly relevant for companies' financial performance across a variety of industries.

In terms of direct impacts, a significant portion of global GDP is directly tied to climate-sensitive industries and is at risk under future climate scenarios. In the U.S., the government estimates this portion to be one-third[7] and in emerging markets it tends to be even higher, particularly in places with less resilient infrastructure. The magnitude of this risk is growing as large climate-related events are becoming more frequent. The chart below illustrates a pronounced upward trend in the number of loss-generating meteorological, hydrological and climatological events per year from 1980 to 2013 (displayed in the green, blue and yellow bars, respectively). By way of contrast, the number of geophysical events (shown in red) has remained the same.

FIGURE 4
Number of loss generating natural catastrophes worldwide, 1980-2013[8]



It is important to highlight that while the risk of disruptive climate-related events is increasing, the proportion of insured risk remains low. There are various reasons why a high proportion of economic loss is not covered by insurance providers, including:

7. National Ocean and Atmospheric Administration. "Weather." Accessed 28 April 2015. www.noaa.gov/wx.html (Cont.)

"We need a 'Digital Earth'—a multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data"[9]

an inability to model and therefore price certain risks, unaffordable premiums in certain high-risk areas and the lack of supportive legal and regulatory frameworks. As long as these barriers to coverage remain, individuals, businesses and governments will directly absorb the bulk of losses from climate-related events.

In terms of indirect impacts, future government regulations related to climate change introduce uncertainty into business planning. For instance, as the Bank of England warned, it is unclear whether oil and gas companies will actually be able to extract the vast fossil fuel reserves that they hold on their balance sheets. Businesses are also increasingly under pressure from society to take responsibility for the negative externalities that they generate. In this respect, companies that the public perceives to be disproportionately contributing to climate change could see their brand equity decline.

In this context, management teams are exploring numerous ways of building the resilience of their businesses to climate change and as such, are increasingly turning to E.I. solutions.

FIGURE 5
Google Earth[10]

Two dominant types of E.I. solutions are emerging

E.I. solutions (i.e. data solutions that encompass E.I.) offer tools and techniques for improving strategic decision-making and operational efficiency. So far, E.I. solutions based on either visualisation or optimisation have had the most success in terms of their adoption and scalability in the private sector.

> Visualisation solutions

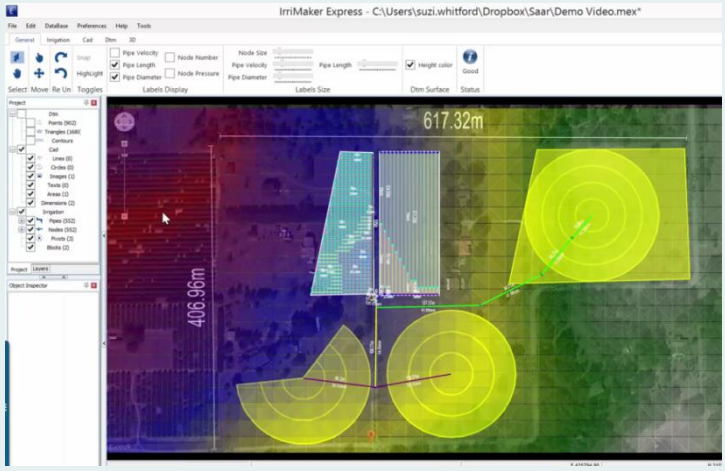
Visualisation solutions package together E.I. data and analysis into impactful, visual forms. This concept emerged in the late 1990s, at a time when increasing amounts of E.I. data were becoming available, but there were few models that could effectively organise these data. What followed was the call for a Digital Earth—"a multi-resolution, three-dimensional representation of the planet...[embedded with] vast quantities of geo-referenced data". [9] In 2001, a software development company, Keyhole, Inc., rose to the Digital Earth challenge, developing a programme called Earth Viewer.

8. Münchener Rückversicherungs-Gesellschaft. "NatCatSERVICE: Loss events worldwide 1980 – 2013." Accessed 28 April 2015. www.munichre.com/site/mram-mobile/get/documents_E-205039058/mram/assetpool.mr_america/PDFs/5_Press_News/Press/natcat012014/1980_2013_events_and_losses.pdf
9. Gore, Al. "The Digital Earth: Understanding our planet in the 21st Century." 31 January 1998. The Fifth International Symposium on Digital Earth. www.isde5.org/al_gore_speech.htm
10. Google Earth. Accessed on 28 April 2015. www.google.com/earth

In 2004, Google acquired the company (for a rumoured price of around USD 30 million) and launched the now highly successful Google Earth (an application that combines recent images from satellite imagery, aerial photography and Geographic Information Systems to create a virtual globe). Although Google Earth was not initially designed for any particular application, numerous innovative uses soon emerged. For instance, users from the agricultural sector have employed the tool to determine optimal irrigation levels in selected areas based on land characteristics and expected rainfall.

While there are endless forms that visualisation solutions can take, the value proposition to users is the same: the presentation of information in an easily understandable, actionable form that contributes to improved decision-making.

FIGURE 6
Screenshot of video from IrriMaker demonstrating an E.I. visualisation solution in the form of an irrigation system planning software; the programme combines Google Earth functionalities, surveyed data, CAD capabilities and irrigation calculation functions[11]



> Optimisation solutions

Optimisation solutions aggregate varied data—including data on the environment, markets, supply chains and systems—to determine optimal actions within a set of parameters. The effectiveness of optimisation solutions has grown significantly alongside the development of the "Internet of Things." This term refers to the interconnection of uniquely identifiable, embedded computing devices within the existing Internet infrastructure. The Internet of Things is allowing users of E.I. to feed optimisation solutions directly into devices, such as vehicles and equipment. This in turn creates "closed-loop" systems that remove users from the decision-making chain in order to further boost efficiency. A simple example of a closed-loop E.I. solution is a sensor-based thermostat that adjusts itself relative to a reference temperature;

11. IrriMaker. "Demo video of IrriExpress." Accessed on 28 April 2015. www.youtube.com/watch?v=y19T-6divkU

FIGURE 7
The Nest Learning Thermostat is an electronic, programmable, and self-learning Wi-Fi-enabled thermostat that optimises heating and cooling of homes and businesses to save energy[12]

a more complex example is an irrigation system that automatically adjusts water output based on soil conditions and weather forecasts. Overall, the primary value proposition of optimisation solutions is to reduce costs.

In the next section, we provide examples of both visualisation and optimisation solutions in practice.

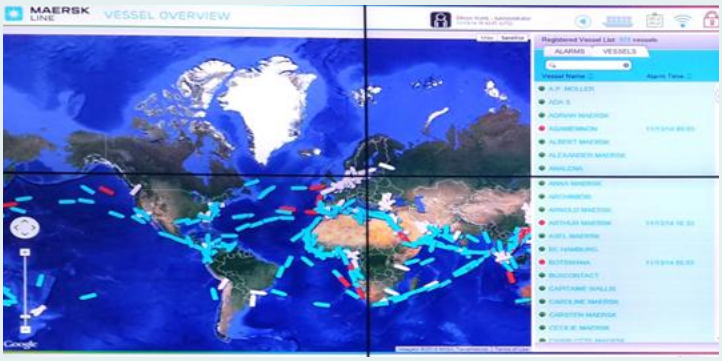
Illustrative examples

E.I. solutions are driving the next level of strategic decision-making and operational efficiency in many industries.

> Reducing fuel costs in the shipping industry

Environmental conditions, such as the development of big storms, rainfall and ocean currents, directly impact the shipping industry. Delays and inefficiencies that occur as a result of unanticipated conditions can be quite costly. E.I. optimisation solutions are helping the industry to manage these risks more effectively. For example, Maersk Line (the world's leading container shipping company) developed a proprietary E.I. solution, known as ECO-Voyage, to optimise its voyage routes.

FIGURE 8
Screenshot of Maersk Line's Global Voyage system that monitors in real-time the position of all the Maersk Line owned and chartered vessels[13]



ECO-Voyage continually analyses E.I. data, such as currents, depths, wind and waves, in order to determine the most efficient power and speed needed throughout a voyage. The sensor-based data come both from third-party providers and the company's own fleet, whereby vessels sailing on the same route "learn" from each other's data as they are fed back through a central server. According to the company, developing "an edge on Mother Nature" has led to fuel savings of 0.5-1.0% per year.[14]

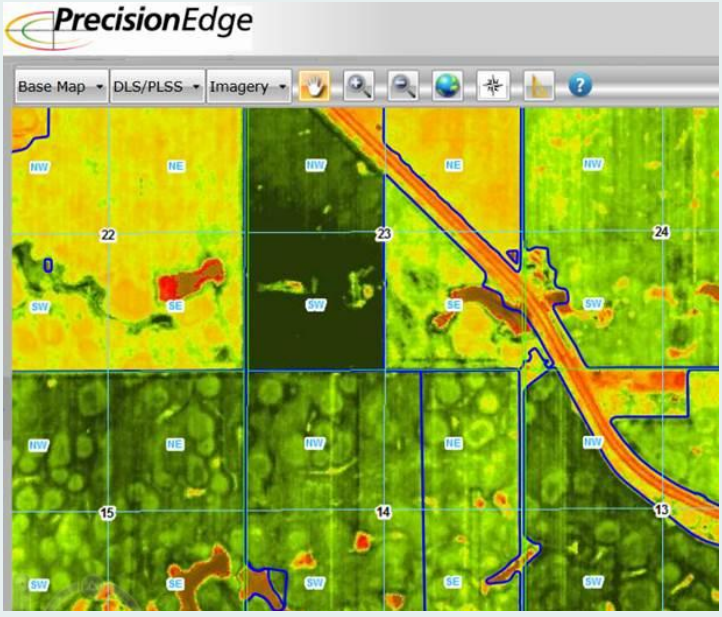
12. Nest. "The Nest Thermostat" Accessed on 28 April 2015. https://store.nest.com/uk/product/thermostat
13. Maersk Line. "Global Voyage Centre" Accessed on 28 April 2015. http://maersklinesocial.com/global-voyage-centre-energy-efficiency-and-route-optimisation/
14. Maersk Martime Technology. "Two Steps Closer to the Optimal Voyage." Accessed on 28 April 2015. www.maersktechnology.com/en/all-stories/voyage-planning?redirected=true

> Closing the yield gap in agriculture

Agriculture is another area where Big Data and climate change are converging in full force. An extensive variety of digital data is now available, ranging from soil diagnostics to spatial variability. In relation to climate change, changing weather patterns are leading to a reduction in the amount of arable land available and are also impacting the types of crops that can be grown. To add to this, exponential population growth, particularly of the middle class, is likely to cause the global demand for food to double over the next 50 years.

It is therefore not surprising that providers of E.I. solutions are concentrating their efforts in this sector. Some have integrated multiple agricultural data sources onto online platforms. Farmers can enter these platforms from their handheld devices and immediately access satellite imagery and analysis of their land based on advanced Geographic Information System functions.[15] The graphic below provides a snapshot of the output from one such platform.

FIGURE 9
Sample output from PrecisionEdge—a platform developed by Farmers Edge that provides farmers with in-depth analysis of spatial data on their hand-held devices, in order to aid in time sensitive decision-making[15]

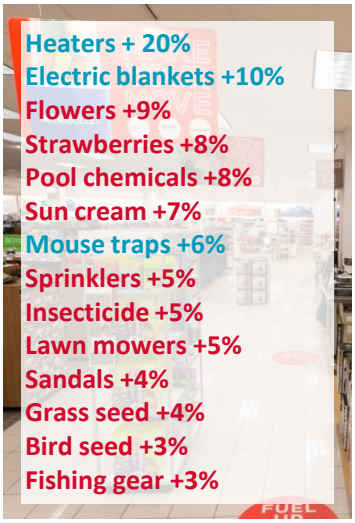


These tools aid farmers in their decision-making about fertiliser use, crop protection, planting times and irrigation, among other inputs. This not only has environmental benefits, such as from the reduced use of chemical fertilisers, but can also translate into significant cost savings.

15. Farmers Edge. "Farming for tomorrow starts today." 2014

Although the full value of E.I. solutions to the sector remains to be seen, Monsanto's 2013 acquisition of Climate Corp (an agricultural platform provider) for USD 930 million[16] does provide an early indication of the value that the market is assigning to agricultural E.I. solutions. Monsanto now offers Climate Corp's E.I. visualisation solutions related to field workability, planting, fertiliser usage and pest control to its agrochemical customers.

FIGURE 10
Kohl's analyses data on the sensitivity of its products to temperature change alongside weather forecasts to inform its inventory stocking decisions.[17]



> Avoiding lost revenue in retail

E.I. solutions can also be impactful when used as a supply chain or inventory management tool. This is particularly true in the retail sector. For example, Kohl's (a large retailer in the U.S.) aggregates weather forecasts with internal sales data in order to predict inventory needs based on seasonality. For every one degree Fahrenheit change in temperature, Kohl's can now estimate what percent increase or decrease its stores are likely to see in the sales of each product. In some cases the sensitivity of sales to temperature change can be as high as 20%. For Kohl's, obtaining accurate E.I. data is therefore key to effectively managing store-specific inventory, which in turn guards against losses from being over or under stocked.[17]

> Risk management in branded consumer goods

The consumer goods industry is also in the early stages of adopting E.I. solutions as a supply chain risk management tool. For instance, Unilever—a company that has built its brand on sustainability—has long faced challenges around sourcing palm oil. Palm oil is one of the top five commodities linked to the illegal logging of carbon-rich peat forests (an activity that not only reduces biodiversity, but also contributes to 10-15% of the world's carbon emissions). Although unsustainable palm oil production is fundamentally inconsistent with Unilever's company values, extensive monitoring of suspicious logging behaviour was nearly impossible until recently.

This changed with the advent of E.I. visualisation solutions. Now, when palm oil producers clear forests illegally, groups that track deforestation are able to follow them in real-time. Unilever helped to found one such group, the Global Forest Watch (GFW) of the World Resource Institute.[18] The GFW receives high-resolution radar and optical data from satellites that are constantly monitoring the world's forests from hundreds of miles overhead.

16. Munshi, Neil. "Monsanto buys Climate Corporation for $930m." *The Financial* Times, 2 October 2013. www.ft.com/cms/s/0/d465abf8-2b61-11e3-a1b7-00144feab7de.html#ixzz3YcKRTpJg
17. weathertrends360. "How does weather trends help my business?" Accessed on 28 April 2015. www.weathertrends360.com
18. Unilever. "Unilever helps launch Global Forest Watch." Accessed on 28 April 2015. www.unilever.com/sustainable-living-2014/news-and-resources/sustainable-living-news/Unilever-helps-launch-Global-Forest-Watch.aspx

When the GFW suspects that illegal logging behaviour is taking place, it is able to call on its partner network of micro-satellite and drone operators (such as Digital Globe and Skybox) to fly over the area to gather more photographic evidence. With this supporting information, GFW can then alert its partners in the media, law enforcement agencies and companies to spread awareness and stop the activity. In the case of Unilever, the company uses these alerts to immediately contact suppliers and terminate relationships when necessary. This advanced monitoring capacity has not only proved helpful in protecting Unilever's brand equity, but also in building a more sustainable supply chain.

FIGURE 11
Screenshot of a tweet sent out by Global Forest Watch to alert users to illegal logging activity in Indonesia[19]

Considering the numerous applications of E.I. solutions, why have we not yet seen widespread adoption?

Although many companies are using E.I. solutions to enhance their efficiency and resource productivity, we have yet to see widespread adoption across any one sector. We believe that there are two primary reasons for this. The first is that monetising data continues to be a challenge. While it is certainly true that vast quantities of data are now available to the private sector, there is still no central marketplace for these data.

19. Twitter. "Global Forest Watch-Fires uses high-res satellite images." 22 July 2014. https://twitter.com/globalforests/status/491782292402995202

This is a legacy of the fact that the buyer base used to be limited to government specialists inside organisations that were able to turn the raw data ("pixels") into actionable information. As a consequence, many of the sources remain fragmented. The second reason is that the E.I. industry is still struggling to prove the value of E.I. solutions on a large scale, given that most analysis of Return on Investment (ROI) is customer specific. Even companies that may be comfortable adopting point solutions often hold back on enterprise-wide deployments, and therefore fail to capture the full potential of E.I. across their operations—precisely where the majority of untapped value lies.

Conclusion and investment implications

Big Data now permeates most aspects of our everyday life. Similarly, climate change is increasingly altering normal business activities, either through climate-related extreme weather events or the impact of new regulation. In this context, we expect the use and strategic importance of E.I. solutions to grow rapidly in spite of the limitations mentioned above.

From an investment perspective, we believe that having an understanding of E.I. can help investors generate superior risk-adjusted returns in two ways:

1. By identifying competitive advantages (and disadvantages) related to E.I. at the company level

In certain industries, we are already seeing evidence that E.I. solutions are altering competitive dynamics. For instance in retail, Kohl's has used E.I. solutions as a tool to bolster revenue; in shipping, Maersk Line has been able to reduce costs; and in consumer goods, Unilever has employed E.I. to protect its brand equity. There are also counter examples of peer companies that are either not yet aware of E.I. solutions or have chosen not to adopt them. We believe that over time this could lead to meaningful sources of competitive advantage or disadvantage.

2. By evaluating potential investments related to E.I. through an informed lens

Several recent market transactions related to environmental intelligence have provided us with an early indication of the value that the market is assigning to E.I. solutions providers.

$930m

VALUE OF MONSANTO ACQUISITION OF CLIMATE CORP (2013)

$500m

VALUE OF GOOGLE ACQUISITION OF SKYBOX IMAGING (2014)

$118m

VALUE OF PLANET LAB VENTURE CAPITAL RAISE (2015)

As mentioned above, in 2013 Monsanto acquired Climate Corp for USD 930 million; in 2014, Google acquired Skybox Imaging (a provider of high-resolution satellite imagery) for USD 500 million;[20] and in 2015, Planet Labs (a company creating an Earth-imaging satellite network) raised USD 118 million in venture capital (Series C) financing.[21] We would expect to see a similar increase in the number of investment opportunities as the strategic importance of E.I. grows over time.

Evaluating these opportunities begins with an informed lens. The first step is about understanding where the target company sits along the value chain (i.e. data collection, processing, aggregation and solutions). In our view, companies operating in the solutions segment of the market have the most attractive profitability profile. In terms of revenues, customers in this segment are typically willing to pay a premium for high value-add solutions. The business model also lends itself to service subscriptions, which tend to produce stable and consistent revenues. In relation to costs, E.I. solutions providers are likely to benefit from a continued fall in the cost of raw data. Within the solutions segment itself, we see the most potential in verticals where E.I. data are highly valuable (e.g. agriculture, commodities, supply chains, transportation) and where companies can scale solutions enterprise-wide.

FIGURE 12

Summary of market advantages for providers of E.I. Solutions and competitive advantages for users[22]

MARKET ADVANTAGE For companies providing E.I. solutions			COMPETITIVE ADVANTAGE For companies using E.I. solutions		
Delivering insight vs. information	On-demand, real-time solutions	User-friendly, visual tools	Improved logistical knowledge	Supply-side savings	Insight into consumer behaviour

In our experience, the rate of adoption of technological change is rarely smooth or in line with market expectations. Although the practice of integrating E.I. into business operations is arguably in its nascent stage, we would not be surprised to see usage spreading rapidly in certain areas, resulting in significant productivity gains. For this reason, we think it is important to understand the potential uses and evolution of E.I. now, in order to navigate the risks and opportunities in this area in the future.

20. Skybox Imaging. "Skybox Imaging + Google." 1 August 2014. www.skyboximaging.com/blog/skybox-imaging-google
21. PlanetLabs. "Planet Closes Larger-Than-Expected Series C Round." 13 April 2015. www.planet.com/pulse/ifc/
22. Generation IM analysis

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