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Changing the world with Big Data

Never before in history has as much data been collected as it is today. There are literally billions of sensors spread across the world, on land, at sea, in the air, and in space, recording anything and everything; data as diverse as traffic patterns, weather formations, remote machine applications on oil rigs and in agriculture, stock room supplies, medicine consumption patterns, etc. The amount of data being collected has seen a new era of Big Data come into being, one which companies and governments the world over are grappling to understand and manage.

Amy Saunders, Editor, Satellite Evolution Group

The year is 2020, and Big Data has become big business. But what exactly does that mean?

A 2016 definition describes Big Data as 'representing the information assets characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value.'

We can take that to mean that Big Data is simply data that is too big for most commonly used software tools to capture, manage and process within a reasonable time period. The actual quantities we're talking about seem a little vaguer; in 2012, Big Data referred to a few dozen terabytes, but today, it means many exabytes. Indeed, the amount of data being collected today is truly staggering.

People often refer to the three Vs of Big Data as a useful way to consider exactly what we're talking about:

- Volume: The quantity of generated and stored data, which determines its value.
- Variety: The type and nature of the data, which may be text, images, video or audio.
- Velocity: The speed at which the data is generated and processed, which for Big Data, is often available continuously and in real time (unlike small data).

Today, Big Data is everywhere. It has become deeply intertwined with machine learning and artificial intelligence, which are expected to be a key enabler of the processing and analysis of data too massive for current processing streams. And while it may sound a lot like inexplicable business jargon – designed to confuse us normal folk about whether or not we're talking about data for data's sake – is expected by many to be key to a whole host of new technologies, services and applications, as well as the continued evolution of the services and industries we know today.

Opportunity knocks

This new Big Data era is opening up some impressive opportunities for companies across the board. According to NSR's *'Big Data Analytics via Satellite, 3rd Edition'* report,

there exists a cumulative market opportunity of US$18.4 billion in the next 10 years for satellite-based Big Data analytics. The fastest growing vertical market, the services sector, is expected to help drive the market, in addition to traditionally strong Big Data markets, including energy, transportation, civil government and military.

"The services vertical mainly consists of financial institutions involved in the securitization of commodities and hedge funds, where large risks are at play. While it took up only about seven percent of the market share as of 2018, it is expected to rapidly grow through the next decade to reach nearly US$640 million (20 percent market share) in revenue opportunity by 2028," said NSR analyst Shivaprakash Muruganandham. The majority of this growth is attributed to the proliferation of Earth observation analytics. "Investment firms looking to gain a competitive edge on the market have driven the use of satellite data across the board: From the counting of cars in parking lots and oil barrels to derived vegetation metrics for crop yield and carbon stocks."

Indeed, Big Data analytics has the potential to really shake up a whole host of markets in the near future - let's take a look at some of the exciting real-world projects going on right now.

Data-driven farms

At the end of 2019, the USDA's Agricultural Research Service partnered with Microsoft and Esri to take the next step towards the data-driven farms of the future. The Data Innovations project incorporates the Internet of Things (IoT) and other technologies to help provide farmers and researchers with real-time data on farm conditions.

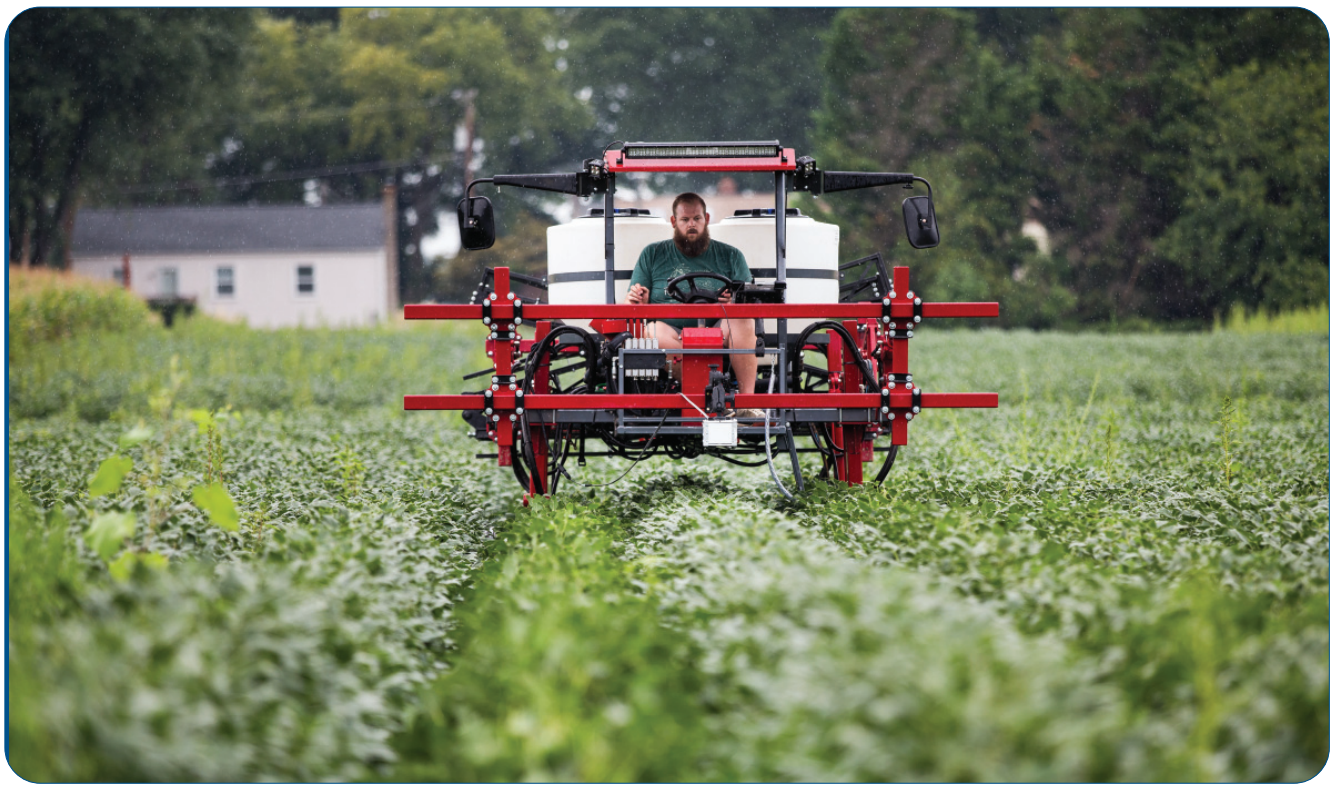
The USDA has deployed sensors, drones and IoT-enabled farm equipment for a public-private pilot programme called Farmbeats at a 7,000-acre farm at its Beltsville Area Research Center. The data then gets beamed up to the cloud, where an AI algorithm provides data visualization to farmers and researchers. The pilot could be revolutionary for USDA researchers, who currently record data points in field books before entering them into a central database.

"We're collecting a lot of data manually and that's killing how much research we can actually get done," said Michael Buser, USDA ARS National Program Leader for Engineering. "We want to go through with this Data Innovations effort to reduce the number of data touches that we have. And by reducing those data touches, we can basically free up the time of our scientists and our technicians."

The project is expected to produce better data, and to help farms around the country operate more efficiently, sustainably, and profitability. While there are many variables that impact farming conditions, tracking key metrics such as disease, insect levels, weeds, water and nutrient dynamics, can help provide farmers with better, actionable information. Moreover, while this single farm pilot project will prove useful, the real value is expected to stem later down the line, when a big-picture view is enabled by tracking the same data from a planned 200 farms across the country. Going beyond the simple recording and analysis of data, through predictive analytics, Microsoft's AI algorithms can in fact combine satellite and sensor information to train a model that can predict metrics for field areas where there are no sensors in place.

Greenhouse gas monitoring

Last year, Descartes Labs announced the development of a methane-detection model designed to help monitor harmful emissions as a means of implementing New Mexico's strategic mitigation policy. Descartes Labs' Data Refinery will utilise Big Data from satellites and other public and private



A highboy tractor equipped with sensors passes through a field at the USDA research farm in Beltsville. Photo courtesy of Microsoft

sources to create modelling and mapping capabilities for the detection of methane.

The Permian Basin, spanning more than 86,000 square miles across Southeastern New Mexico and West Texas, is the highest producing oilfield in the world, and will be the first area that is mapped before the project goes state-wide. Large-scale monitoring of methane is expected to help oil and gas companies improve their management of emissions and guide state inspectors to potential problem areas on an almost real-time basis. It will also help the state meet the environmental benchmark to reduce greenhouse gas emissions by 45 percent between 2005 and 2030. Indeed, methane is a potent greenhouse gas believed to trap 28 times more atmospheric heat than carbon dioxide over 100 years. However, there has been a historical lack of reliable tools for tracking methane detection.

"For New Mexico to reach its methane reduction goals, it's critical to first understand the problem. The Descartes Labs Data Refinery can pull data from satellites, planes, drones, and ground sensors so that inspectors will be able to pinpoint sources and alert well owners to the problem. This is what it looks like when data informs policy," said Mark Johnson, CEO at Descartes Labs.

Protecting the skies

In the summer of 2019, the Canadian Government's contracting arm, Canadian Commercial Corporation (CCC), announced plans to sponsor a new satellite system to provide commercially available data about space to meet growing concerns over debris. NorthStar Earth and Space will utilise Big Data analytics to assess the situation in orbit.

Today, there are around 60,000 pieces of space debris in orbit around the Earth, far more than the number of active satellites in play. With the NewSpace economy valued at an estimated US$1 trillion each year, demand for real-time, accurate information on the space environment is high. Private investors for the project include Telesystem Space Inc. of Montreal and the Space Alliance of Europe, formed by Telespazio and Thales Alenia Space, a joint partnership formed by France's Thales and Italy's Leonardo.

The proposed small satellite constellation would be launched in 2021, featuring a combination of infrared, hyperspectral and optical sensors to assess the Earth's ecosystems and orbit. The system would also utilize Big Data analytics and AI to find the meaning of the vast amount of data and precisely predict potential collisions with debris and other objects in space.

Big future

All of the available market reports indicate that Big Data is going to be huge going forwards. Of course, once we take a look at the impressive applications and try to get a scope of the seemingly endless possibilities, it seems an obvious conclusion to draw. Enhanced efficiencies, superior predictions and cost savings are all benefits which we should soon begin to reap as Big Data analytics becomes more widely applied across the markets.

However, the big turning point will come when AI and machine learning is advanced enough and affordable enough to really turn things around. Until then, we have massive quantities of data being collected and stored, but inadequately processed and analysed. Indeed, this data is actually hindering many companies today; it takes more than just the right tools to analyse the quantities of data we're seeing now – many businesses lack the knowledge base to conduct a meaningful analysis and are becoming bogged down. That's hardly surprising given the quantities of data we're talking about.

Big Data is a big opportunity for some, a hindrance for others, and a challenge for all. ■

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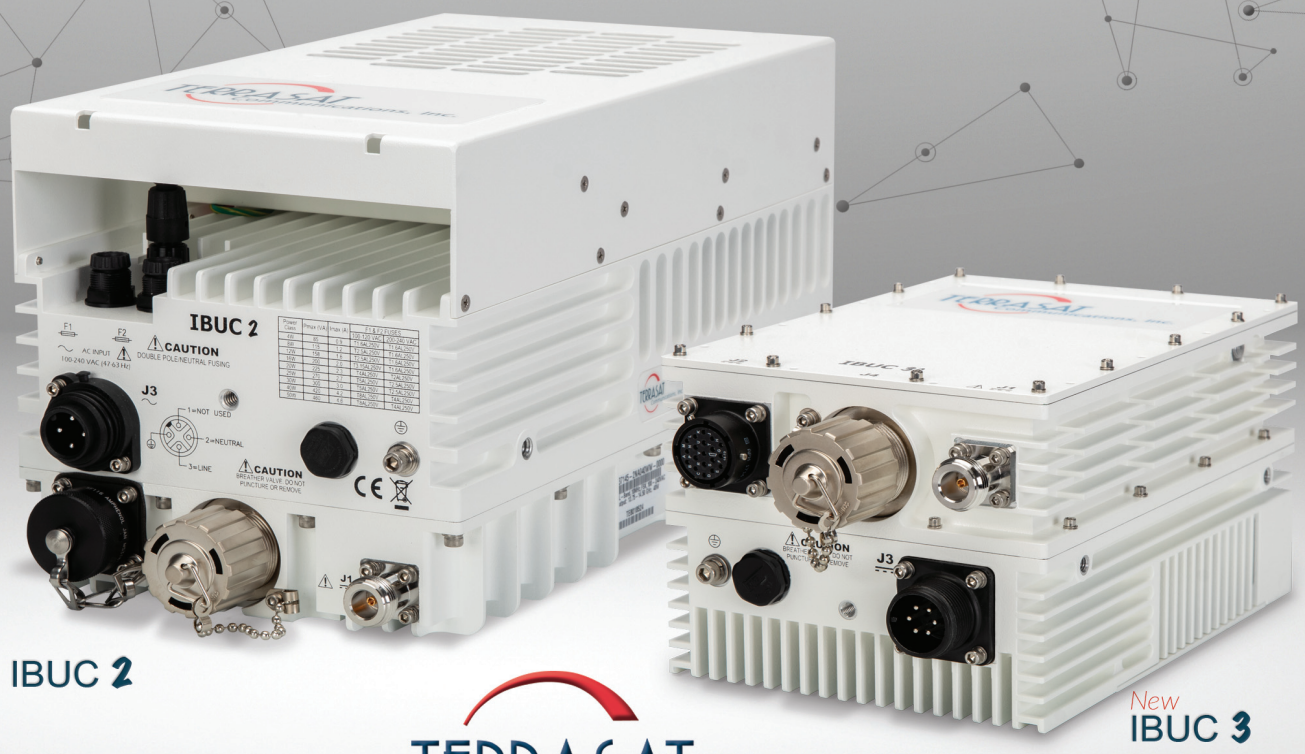

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