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# trajectory

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## The Insight *Economy*

Cloud-based analytic services have arrived.  
And with them a new generation of companies  
promising not imagery, but insights.

- GEOINT 2017 Highlights
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- 2017 USGIF Membership Directory





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BY MATT ALDERTON

# the insig ec

*Kernel is TellusLabs' suite of agricultural intelligence products that rely on a terabyte-scale satellite and weather database updated every 24 hours with the latest plant health, local weather, and crop conditions to provide a daily outlook on U.S. soy and corn yields from continental to local scales.*

IMAGE COURTESY OF TELLUSLABS





**THE KANGBASHI DISTRICT OF  
ORDOS, CHINA,** looks like a

cosmopolitan city of the future. It's just 14 years old but already has all the trappings of a mature municipality. It has a large public library designed to mimic the shape of books on shelves. Elsewhere are a contemporary and cavernous airport, a spectacular-looking stadium, clusters of towering apartment buildings, spacious plazas and parks, a five-story food court with 400 vendors, an intricate opera house, and perfectly paved streets designed to connect more than 300,000 residents to the places they live, work, and play. Although Kangbashi has the appearance of a modern metropolis, the truth is apparent in the one thing it lacks: *people*.

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onomy





PHOTO BY GETTY IMAGES

*New apartments line an otherwise empty street in Kangbashi New District of Ordos City, Inner Mongolia. Kangbashi is one of hundreds of “ghost cities” throughout China.*

**“It’s not about pixels; it’s about providing insights to customers so they can do something with them.”**

—MATTHEW CHWASTEK,  
DIRECTOR OF PRODUCT  
MANAGEMENT FOR THE  
PUBLIC SECTOR, ORBITAL  
INSIGHT

Kangbashi is one of hundreds of “ghost cities” rumored to dot the Chinese countryside. Erected at the height of China’s real estate boom, they’re pet projects of wealthy local governments that built them to be the center of a virtuous circle: Spending their economic windfalls on megacities, governments believed, would attract inhabitants from outlying agrarian communities, creating new urban centers with which to generate even more wealth. In some cases, that’s exactly what happened. In others—like Kangbashi, which so far has attracted only a third of its expected population—residents never came, leaving many buildings, businesses, and boulevards eerily empty.

These civic specters are especially troubling to hedge funds, banks, and other commercial institutions with stakes in China’s economy. Not only has the Chinese government been opaque about the number and location of ghost cities, but it has also been accused of using them to inflate its GDP, showing more economic growth on paper than actually exists on the ground. In order to get an accurate picture of China’s economic performance, the private sector has had to lean on alternative data sources—including geospatial intelligence.

In 2015, Chinese technology giant Baidu identified 24 potential ghost cities by tracking the GPS location of cellphones; cities that ingested a large

number of cellphone users during the week and expelled them on weekends, it determined, were likely ghost cities.

Satellite imagery can be used to similar ends, according to SpaceKnow, whose China Space Manufacturing Index (SMI) monitors more than 6,000 manufacturing and industrial sites across China for signs of economic activity such as visible inventory and new construction.

“One thing we track is shipping traffic in and out of China’s ports,” said SpaceKnow spokesperson Chikodi Chima. “If the volume of ships in ports goes down relative to the same time period last year, that indicates that fewer manufactured goods are leaving ports and that China’s economy ... has slowed down.”

Drawing those kinds of temporal conclusions from space requires analyzing thousands if not millions of images captured on a regular basis—far more than any human analyst could reasonably process. SpaceKnow and a new generation of likeminded companies are therefore leveraging computer vision and machine learning to digest maximum pixels in minimum time. And in a major departure from legacy players, the product they’re peddling isn’t imagery at all; rather, it’s actionable intelligence derived from it.

“Imagery is a commodity,” Chima said. “What people want are answers.”

How new analytics-as-a-service (AaaS) firms are creating and selling those answers, and to whom, promises to radically alter the course of commercial remote sensing and democratize GEOINT in new and powerful ways.

## ANSWERS ON DEMAND

The traditional commercial remote sensing business might be compared to an expensive game of fetch wherein satellites are the dog and images the newspaper: Customers who want information must order the dog to retrieve the paper, then peruse it page by page in search of a specific article. And if they want to follow a story? They have to repeat the whole ritual again the next day.

“The business model [isn’t ideal],” said Dr. David Potere, co-founder and CEO of TellusLabs. “The classic problem is counting cars in a parking lot. If I want to count cars in 1,000 parking lots I have to pay for a whole strip of data, then take 10 small chips out of it.”

Some customers didn’t even want to own the data in the first place.

“Because the model for so long was literally shipping CDs and DVDs, that’s how things had to be. But now that model is getting flipped on its head,” Potere continued. “People have grown really impatient with any kind of old-fashioned approach where they have to own, hold, or manage data themselves.”

Consumers of satellite imagery want to be able to query a search engine at any time for whatever answer they seek—just like everything else in their lives. AaaS is that search engine.

The workflow is simple and takes place entirely in the cloud: Users tell AaaS providers which geospatial questions their business needs to answer, at which point providers create new algorithms or leverage existing ones to automatically process imagery acquired from their own or partners’ satellites. Using computer vision and machine learning, those algorithms identify and extract relevant features from



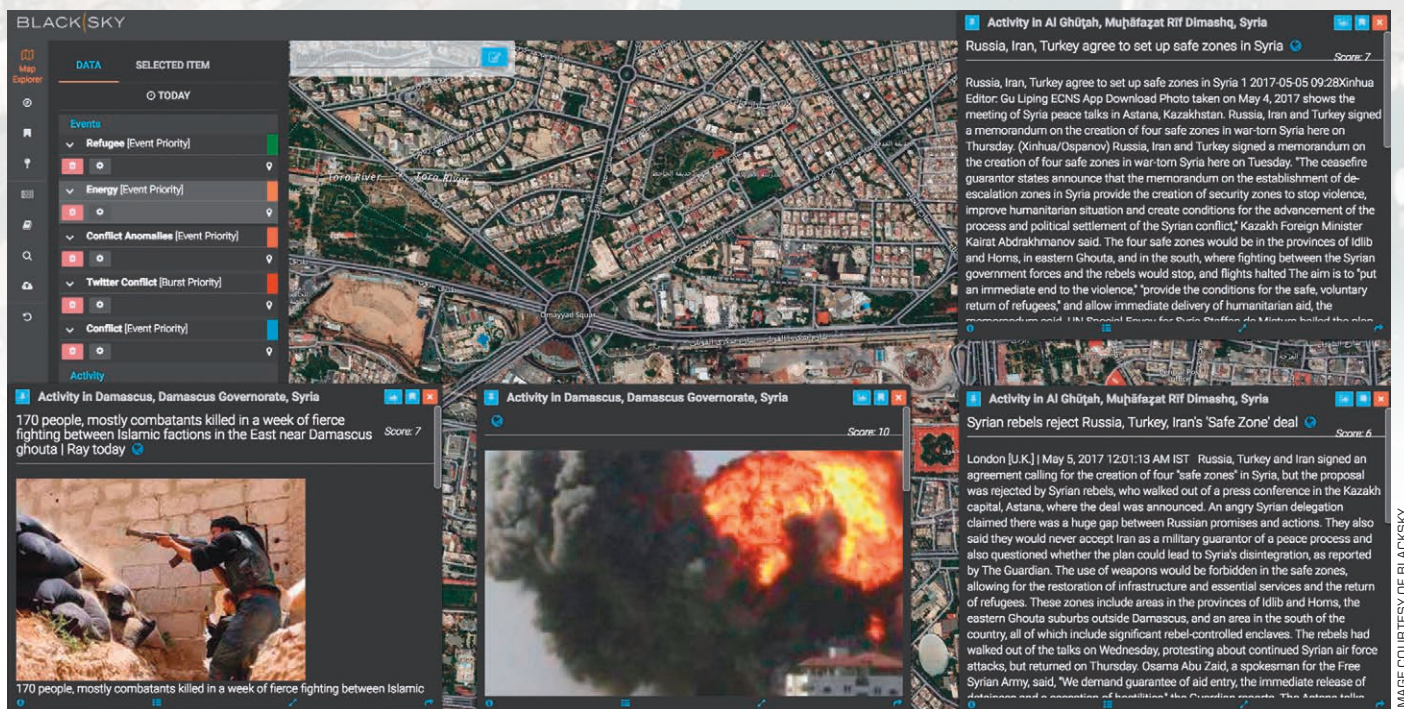


IMAGE COURTESY OF BLACKSKY

The BlackSky geospatial platform provides satellite imagery and relevant information from various sources about a conflict event in Syria.

imagery and interpret them for users, who receive updated intelligence in the form of a semantic dashboard or report.

“While being able to count cars in parking lots is interesting, we provide a consultative solution that fuses those car counts with other data in order to tell our customers how a retailer is performing this quarter,” said Matthew Chwastek, director of product management for the public sector at Orbital Insight. “It’s not about pixels; it’s about providing insights to customers so they can do something with them.”

### BREAKING THE MOLD

Flexibility breeds possibility, according to Potere. “There are a whole bunch of new questions you can ask now that you never would have been able to answer with the old, ship-me-the-pixels approach,” he said.

TellusLabs specializes in answering agricultural questions. Its first product, Kernel, uses open-source satellite

imagery to monitor fields in 2,000 U.S. counties for factors such as plant health, local weather, and crop conditions. Using decades of historic data from NASA, the National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture (USDA), TellusLabs developed machine learning algorithms that process terabytes of data every day in order to predict agricultural yields.

In 2016, for instance, the United States produced 52.1 bushels of soy per acre of planted crop. Kernel predicted a soy yield within one percent of that final outcome as early as September—nearly two months before USDA’s monthly forecasts entered the same one percent range—and in October it predicted the yield exactly.

“To do the kind of agricultural forecasting we’re doing, we need a view that is consistent for every single day of the year for 18 years, and we need it spectrally and longitudinally calibrated so that the red band from 2003 is totally comparable to the image from last night,” Potere explained.

This capability makes GEOINT desirable and accessible to new users who have never before considered the technology. In Kernel’s case, for instance, users include ethanol plants that need to know how much to expect to pay for corn, agribusiness companies that need data feeds with which to operate next-gen farming equipment, and asset managers who need intelligence with which to inform their investments.

Then there are the farmers themselves: Two of TellusLabs’ competitors, Astro Digital and Vinsight, provide field-specific insights to growers, who can synthesize data about crop production, health, and conditions to make better business decisions.

“Knowing what your crop is going to be will help you enter into a contract with a buyer at the right time to ensure you can fulfill that contract,” said Megan Nunes, founder of Vinsight, which currently specializes in

“There are a whole bunch of new questions you can ask now that you never would have been able to answer with the old, ship-me-the-pixels approach.” —DR. DAVID POTERE, CO-FOUNDER AND CEO, TELLUSLABS

## NGA EYES ANALYTIC ASSISTANCE

For the commercial sector, analytics-as-a-service (AaaS) is a game changer. By delivering space-borne intelligence to industries that have never had access to it, AaaS companies can offer customers a competitive edge sharper than a Japanese sushi knife. It's not just the private sector that stands to benefit from AaaS, however; it's also the defense and intelligence communities—including the National Geospatial-Intelligence Agency (NGA), which has placed automation and machine learning at the top of its list of strategic priorities, Director Robert Cardillo reported at this year's GEOINT Symposium in San Antonio, Texas.

"If we attempted to manually exploit all of the imagery we'll collect over the next 20 years, we'd need 8 million imagery analysts," Cardillo said during his Symposium keynote, adding that NGA already collects with a single sensor—every day—the data equivalent of three NFL seasons recorded in high-definition video. "Imagine you're a coach trying to understand the strategy of his opponent by watching a game—every game and every play for three seasons, all in a single day ... That's exactly what we ask our analysts to do when we don't augment them with automation. All this data, combined with dramatic improvements in computing power, represents a phenomenal opportunity."

NGA is counting on AaaS upstarts to help it seize that opportunity, according to Scot Currie, director of NGA's Source Mission Integration Office.

"For the last 40 years, NGA has been applying a rather brute-force approach to dealing with all of our various data sources," said Currie, who called AaaS "the most exciting part of what's happening in industry right now."

"We're extracting value manually out of pixel streams ... That's not something that scales when you talk about moving to the kinds of rapid-revisit suppliers that are coming forth now across the commercial community. So, we've got to look at things like machine learning and algorithm development," Currie continued.

Unlike commercial AaaS customers, many of which lack human resources to analyze satellite imagery, NGA

has a deep bench of human analysts it will continue to leverage going forward. As the volume of commercial imagery swells, the agency sees AaaS as an analytic metal detector that will help analysts sift through sand in search of buried treasure.

"We want machines to do what machines do best," said Currie, adding AaaS will be ideal for rote tasks like counting the tanks and aircraft in a target location, while human analysts will be retained to determine why the military vehicles are there in the first place. "We're trying to get analysts freed up so they can do higher-order thinking to answer broader questions."

NGA analysts will still need pixels. Using their machine learning algorithms for automated change detection, however, AaaS companies will be able to flag for NGA analysts which pixels they should look at and when.

Although he declined to name them, Currie said NGA is already testing some AaaS offerings via its Commercial GEOINT Activity (CGA), a joint program with the National Reconnaissance Office through which the agencies are evaluating new commercial capabilities.

"Between us and CGA, we're building an assessment process that's going to eventually tell us who the best-of-breed is among these new analytic services," reported Currie, who said the most important attribute for AaaS providers to demonstrate is veracity. Until providers can all but eliminate false positives, he said, AaaS will be on NGA's wish list instead of in its toolbox.

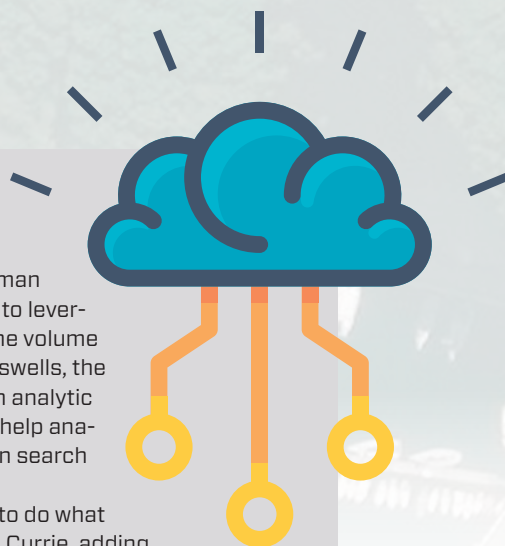
"For us to make the decision to move resources [away from humans and toward machines] we're going to need a fairly significant confidence level ... And quite honestly, what's good enough for [commercial customers] may not be good enough for us."

Its high standards mean NGA may lag commercial industry in AaaS adoption. But even if the agency moves slower, it will forge ahead, Currie promised.

"I've been a part of [NGA's] commercial imagery team since 2010, when I was the first program manager for the EnhancedView contract that started this whole transformation," he said. "We saw [AaaS] happening then, but it was only on the periphery. There was a lot of vision, but that vision is now starting to show up in execution and delivery of real capability ... We're excited to become a stronger part of these commercial offerings and to bring them to our customers."



Scot Currie, director of NGA's Source Mission Integration Office







*Orbital Insight's technology can count objects—such as these planes on the ground in Macau, China—in satellite images.*

analysis for growers of grapes and almonds. “Also, labor. If you know your grape crop is going to be lower than expected, you can hire fewer people to harvest those grapes.”

Such information can enable efficiencies that allow farmers to run profitable businesses growing even low-margin crops.

Agriculture isn't the only AaaS use case. SpaceKnow sees applications in real estate and construction, according to Chima, who said AaaS could help developers identify properties ripe for development. Then there's speculation—the same type of monitoring service SpaceKnow provides around factories in China, Spaceflight Industries is using to monitor fracking across the U.S. and Canada.

“I can see things like how many holes they're drilling and whether they are dry holes; if crews are packing up and going home; if they're starting to lay down pumping equipment,” said Scott Herman, vice president of product development for BlackSky, Spaceflight Industries' AaaS service. “... When we do that kind of day-by-day and week-by-week monitoring across thousands of fracking sites, hedge funds can start placing bets either for or against different organizations long before they ever get their quarterly earnings.”

#### WHY NOW?

Commercial users have always wanted answers. That they're receiving them now is thanks to four converging trends.

The first is the omnipresence of affordable, accessible, unclassified data from smartphones, small sats, and a litany of other low-cost, high-power sensors.

The second trend is the widespread adoption of elastic cloud computing, according to Chwastek, who noted the availability of cloud-based graphics processing units (GPUs), which he called “a key technology responsible for the ability to process imagery.”

Cloud computing has allowed companies to forego the time and expense of building IT infrastructure in order to focus on bleeding-edge software development, resulting in faster, cheaper innovation, echoed Herman.

“Things like imagery-derived analytics and open-source data are not new. What's new are the techniques you can apply against those disciplines and their low cost, which means more people can take advantage of them,” he said. “This is going to open up an addressable market to small and mid-sized businesses that traditionally have not been able to afford [GEOINT].”

Third are advancements in computer vision, natural language processing, and machine learning. When computers are programmed to apply statistics to their raw observations, the outcome is knowledge—deducing not only that an object is a car, but also who is driving it, to where, and for what purpose.

Which leads to the fourth trend: appetite.

“There's a new understanding on the demand side that's going to lead to a revolution in the next three to five years,” Herman said. “Whether it's finding a restaurant in Google Maps or looking at their house from space on Zillow, people have become more comfortable with geospatial technology and are now wondering, ‘Why wouldn't I bring it into my business, too?’”

#### PLATFORMS AND PARTNERSHIPS

Although demand is an important driver, the AaaS supply chain is also compelling. Not just the volume of data, but also where it's coming from—and where it isn't.

Because they want to control the inputs they feed their algorithms, some AaaS companies are investing in their own satellites, imagery from which will serve as fuel for their analytics engines. Spaceflight Industries is one such company. By 2019, it plans to have a constellation of 60 high-resolution commercial satellites in orbit. In the meantime, its BlackSky AaaS service leverages imagery from 20 commercial satellites operated by external partners such as Airbus and UrtheCast. When Spaceflight's constellation is complete, BlackSky will leverage its own data alongside its partners' imagery.

There are several reasons for its approach, one of which is continuity.

“Some analytics companies are doing phenomenal work, but they're completely beholden to third-party content



providers who can kill their business at will just by turning off their content feed,” Herman explained.

Another argument for launching its own platforms is autonomy. Having the freedom to task its own satellites, Spaceflight argues, will give BlackSky the ability to generate more and better data, faster and at a lower cost.

Astro Digital is also betting on its own platforms, and for many of the same reasons. Along with open data from Landsat 8 and Europe’s Sentinel-2, it eventually will consume data from its own Landmapper-BC and Landmapper-HD constellations.

“Why did we need to build our own constellation? Reliability for the commercial space is one reason; if I say I can give you a fresh insight about your business every week or every day, I need to guarantee that I can do that. The existing commercial sensors ... don’t have the capacity to offer that kind of reliability and consistency to a wide swathe of commercial customers,” explained Astro Digital Head of Product Bronwyn Agrios.

Not everyone thinks satellite ownership is so vital. Many—including Orbital Insight, SpaceKnow, TellusLabs, and Vinsight, just to name a few—believe there is more than enough imagery to go around already. Thanks to open platforms, much of it is free. And that which isn’t is becoming more affordable as market forces continue to drive prices down.

“It’s not necessary to own any hardware in space,” said Chima, adding SpaceKnow culls imagery from third-party providers such as DigitalGlobe, Planet, Airbus, and UrtheCast.

Platform ownership might be necessary if traditional commercial imagery providers weren’t willing to partner, but most are open to collaboration.

“There’s a recognition that you can’t do the whole thing by yourself; it’s part of the culture in this space,” said Fritz Schlereth, head of product at Descartes Labs. “Once data partners realize how much more valuable their data becomes to the customer [in the hands of an AaaS partner], they’re very receptive to what we do.”

So much so that they have become key AaaS enablers. Among the companies collaborating with AaaS providers is Planet, which to date has launched more than 233 small satellites it calls “doves.”

“We produce a lot of imagery, and we sell that imagery. But is that the end game for Planet? Absolutely not,” said Alex Bakir, Planet’s vice president of product marketing. “... That is stage one of a multi-stage approach that ultimately will result in a marketplace that’s full of information derived from imagery as opposed to a marketplace that’s drowning in a large amount of unprocessed pictures.”

“Whether it’s finding a restaurant in Google Maps or looking at their house from space on Zillow, people have become more comfortable with geospatial technology and are now wondering, ‘Why wouldn’t I bring it into my business, too?’”

—SCOTT HERMAN, VICE PRESIDENT OF PRODUCT DEVELOPMENT, BLACKSKY

## Google Earth Enterprise Platform

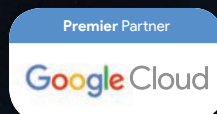
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To enable the kind of marketplace it envisions, Planet plans to spend the next six to 18 months inverting its cloud-based infrastructure to automatically pre-process imagery for external as well as internal use.

"We don't believe that everyone who wants to derive information from imagery should have to build the foundational elements of how to deal with that data set," continued Bakir. "There are a lot of things we can do to encourage the growth of an ecosystem of application developers."

Planet aims to make it easier and more affordable for AaaS companies to do business, creating a win-win scenario.

"You shouldn't have to throw tens of millions of dollars at a problem just to get to a place where you can start to ask the right questions," Bakir said.

DigitalGlobe is similarly engaged in ecosystem construction via its GBDX platform, through which AaaS partners can access its cloud-based satellite image library and run

their proprietary algorithms against it.

"DigitalGlobe is enabling the analysis business, much like Amazon enabled online e-commerce," said Dr. Walter Scott, DigitalGlobe founder, executive vice president, and CTO. "Our industry has a remarkable number of smart people who have the ability to create analytic solutions or new sources of data, and there is tremendous potential to unlock value by allowing them to tap into 'the digital globe.'"

**"DigitalGlobe is enabling the analysis business, much like Amazon enabled online e-commerce."**

— DR. WALTER SCOTT,  
DIGITALGLOBE FOUNDER,  
EXECUTIVE VICE PRESIDENT,  
AND CTO

More than 350 developers already are building new applications and machine learning algorithms using GBDX.

Even as they enable new AaaS partners, legacy providers are building internal analytic capabilities via acquisition. In November, for example, DigitalGlobe acquired privately held Radiant Group, an AaaS company specializing in GEOINT analysis for the U.S. intelligence and special operations communities.

"We now have hundreds of innovative developers and analysts with expertise in big data analytics, cloud computing, and machine learning to solve complex geospatial intelligence challenges," Scott said.

Clearly, the marketplace is moving. Where it's going, however, is anyone's guess.

"Will all the cool technology just get acquired by the legacy players? Or will there be enough upstarts that gain traction to ... create a whole new ecosystem of companies that become household names?" Herman asked.

#### **ANALYTIC IMPEDIMENTS**

Despite the market opportunity, AaaS providers must clear many hurdles in order to realize their full potential.

"[AaaS companies] are shiny objects," Herman said. "They're really interesting and they're attracting venture capital, but if you dig underneath and look at how much

revenue is being generated by legitimate use cases, it's still very limited."

Challenges range from technical to cultural in nature. On the technical side, for instance, Bakir cited interoperability as a major obstacle.

"Application developers are ... pulling data from Planet, Landsat, Sentinel, and DigitalGlobe; it doesn't all look and feel the same, it won't load up in the software the same way, and it may not have been processed in the same way," Bakir said. "That disparity in data sets continues to be problematic."

He added Planet eventually plans to address that problem by bringing popular data sets into its platform, giving AaaS companies a one-stop shop for data acquisition.

"Planet has a massive data set, but there are also massive data sets elsewhere. Getting those data sets to work together is not easy, and moving data around is no longer the solution. So, collocation of data sets is a really big and important problem."

Culturally speaking, the biggest challenge facing AaaS providers is trust: Because their companies and technologies are new, they often lack a track record with which to woo skeptics.

"One thing I hear from sophisticated customers is the need to understand our secret sauce," Agrios said. "They want to validate our analysis and understand how we got to our results."

"It's not enough to be right, or even to be right several times in a row," echoed Potere, who said AaaS companies have to educate their customers by sharing not only their algorithms' outputs, but also their inputs. "The answer isn't the whole story; at this early stage, you have to be in the 'why' business as well as the 'what' business."

#### **THE HOLY GRAIL: CONSUMERIZATION**

AaaS is an infant among industries. As it matures, its prospects are bullish, buoyant, and bold. So much so that AaaS could be the missing link that finally democratizes GEOINT for the masses.

"We would like to see the concept of a query-able Earth where you can ask questions of the changing planet and receive information that makes sense to you," Bakir said. "We would like to see the market move beyond highly technical GIS users and move into business intelligence and then, who knows, maybe even consumers. That's the goal: working with the market landscape as it exists today, but planning for a future where the market is dramatically expanded."

A future where everyday consumers can ask colloquial questions of satellites like they do of search engines? Although it may sound ambitious, so does the idea of using computers to find ghost cities, forecast crop yields, and assess real estate opportunities.

"[AaaS] is primarily a B2B play for the foreseeable future. However—and this is really important—our goal is to reach a point where B2C is a viable part of our product offering," Herman concluded. "The whole industry needs to bake for another three to five years, but there will be attempts at consumer-grade products ... It's one of the holy grails that we're shooting for." 🍷