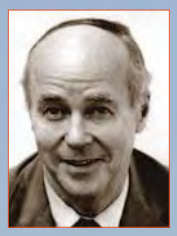
February 2015

AEROSPACE AMERICA



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A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Small sats,

Companies are entering the Earth-observation market with small satellites that can be launched cheaply. The big question, Natalia Mironova explains, is whether these startups will have the staying power to compete with the established commercial-imagery players.

On the afternoon of Oct. 28, Chris Boshuizen and some of his fellow staffers at Planet Labs gathered in a meeting room in their San Francisco offices to watch live video of the launch of an Antares rocket from the Mid-Atlantic Regional Spaceport in Virginia. The rocket's payload — mostly supplies and experiments bound for the International Space Station — included 26 of the company's small Earth-imaging satellites, which Planet Labs lovingly calls Doves.

At 6:22 p.m. Eastern time, just seconds after liftoff, the rocket exploded in a giant fireball, stunning the Planet Labs staffers in San Francisco. But the initial shock quickly wore off, and soon there was even some awkward laughter. Then they shrugged it off.

"It was actually a beautiful explosion in a way," says Boshuizen, one of Planet Labs' co-founders. "It was about the price of a Michael Bay movie all in one single explosion."

Even before the smoke cleared, the Planet Labs team knew what it would do. "We had another production line in process already, so we were like, 'Oops, we better make a few more,'" says Boshuizen.

The reason Planet Labs could bounce back from the loss of 26 satellites has a lot to do with the way this space company, founded in 2010, runs its business: It launches small, low-cost satellites — cubesats — made entirely of commercially sourced parts. Before the Antares explosion, the company had placed 71 Doves in orbit with six launches over 18 months.

"Our system is designed around a large number of satellites and we benefit from the redundancy that comes with having multiple units. They are low-cost, so if we lose a few we actually designed the system to tolerate that," says Boshuizen. "The explosion was more like a dampening of our capability than an existential problem. So, actually nobody here was really stressed about it."

Planet Labs is one of half a dozen companies that promise to put images of the Earth directly in the hands of its customers

by Natalia Mironova

big plans

Two Planet Labs Earth-observation cubesats are deployed from the International Space Station in February 2014.

NASA

— be they researchers at a university, a disaster relief organization or an oil and gas enterprise — and by doing so provide the private sector with geospatial data previously available only to governments. The question is: Which of these companies will have staying power and which will go the way of the busted Silicon Valley startups of the 1990s?

"It's too much too fast. I don't see how the market can support five [or] six satellite imaging companies in the next 10 years. In the next 20 years, maybe," says Joshua Hartman, CEO of Horizon Strategies Group in Washington, D.C., and former chief of finance, system engineering and acquisition for the Low Earth Orbit Program Office at the National Reconnaissance Office. "It will be survival of the fittest. There will be some that won't survive, as we saw happen with the dot-com boom."

Disruptive year

2014 was what Kevin Pomfret, executive director of the Centre for Spatial Law and Policy in Richmond, Virginia, calls a year of "disruption" for the satellite imagery market. The previous decade saw consolidation of the U.S. market. GeoEye, founded in 1992 as Orbital Imaging, purchased Space Imaging in 2006. Then DigitalGlobe, founded in 1992 as WorldView Imaging, merged with GeoEye in 2013, creating a de facto monopoly on commercial satellite imagery in the U.S. There were concerns that the merger would restrict the supply of imagery. In a pre-merger survey of consumers of U.S. commercial satellite imagery, the

DigitalGlobe's 2,800-kilogram WorldView-3, launched in August, will collect images of Earth with a resolution of 31 centimeters.

Ball Aerospace

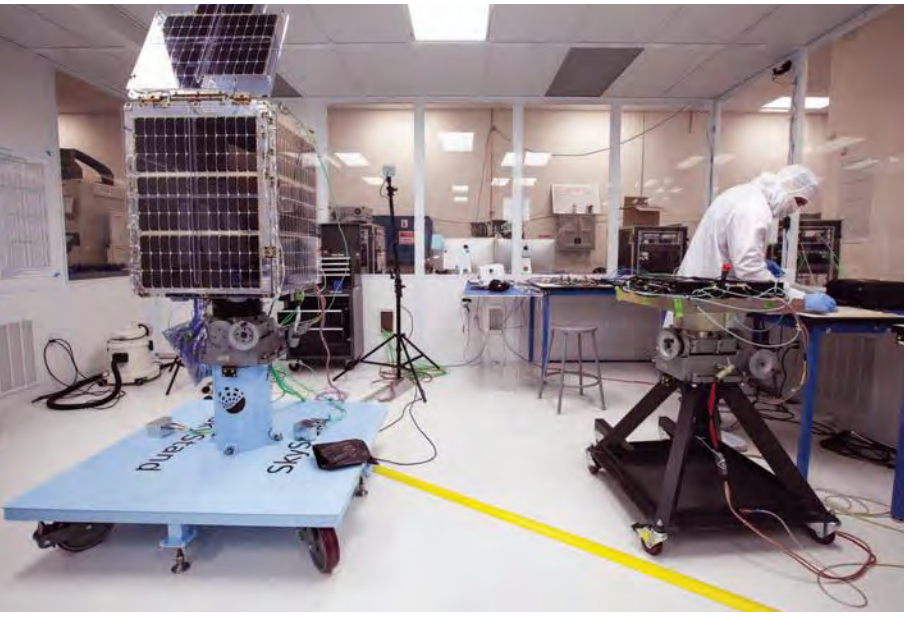
Commerce Department noted that "comments on the potential of a DigitalGlobe-GeoEye merger were almost universally negative."

Just a year later, the landscape has changed dramatically. What no one predicted was the sheer scale of the technological development in satellites and the exponential growth of the abilities of the commercial sector, allowing companies like Planet Labs and Skybox Imaging to become major contenders. Skybox has launched two satellites, of a planned constellation of 24, that provide high-resolution images and video. The company, founded in 2009 in Mountain View, California, was snapped up by Google last year for $500 million. Another company, BlackSky Global, is poised to launch a satellite in 2015. (BlackSky declined to comment for this story, but the company's website promises "high performance 1 meter imaging capability" and "rapid revisit to anywhere in the world".)

"The fact that a company like Google purchased a commercial remote sensing company says there is value in this industry," says Mark Brender, an industry veteran and an executive director of the DigitalGlobe Foundation, which provides imagery grants to support research projects.

Innovation in the commercial satellite imagery sector takes advantage of the recent strides in technology made by "our heroes in the cellphone and laptop indus-

The SkySat microsatellites have a mass of about 100 kilograms, making them affordable for a small company to launch.



Skybox Imaging

try who've miniaturized everything," says Planet Labs' Boshuizen. The startups are able to build cheaper, smaller satellites by relying on cheaper, smaller, components that were not designed specifically for space, but perform well enough there. Boshuizen points out that most of these commercial components can trace their tech pedigree to the early days of the space industry. Whether these commercially sourced parts can stand up to the rigors of space in the long term remains to be seen.

"Space is a very harsh environment and any satellite system must be prepared to operate in that extreme," says Brender.

For its part, DigitalGlobe continues to take advantage of technology and policy developments to acquire higher-resolution images and market them to a wider array of potential customers.

For the company's newest satellite, WorldView-3, launched in August, engineers at Exelis provided an imaging sensor capable of generating black-and-white — or panchromatic — images with a 31-centimeter resolution, which the company says makes it the finest resolution commercial satellite. Until recently, that kind of data could not be made available commercially. U.S. regulations forbade the sale, except to the government, of black-and-white imagery with a resolution of less than 50 centimeters and color (multispectral) imagery of less than 2 meters. But in June the Commerce Department said it would permit the sale of 25-centimeter black-and-white and 1-meter color images. WorldView-3 will also generate 1.24-meter color images.

A huge boon for the established commercial satellite imaging companies was the 2010 EnhancedView contract, under which the National Geospatial-Intelligence Agency committed to buying $7.3 billion worth of imagery over 10 years from two companies: GeoEye and DigitalGlobe. The caveat of this lucrative contract? It had to be renewed every year. What happened next shows the risk of relying largely on the U.S. government as a client. When the NGA canceled the GeoEye portion of the contract in 2012, citing budget constraints, the company floundered and the following year was absorbed by DigitalGlobe. DigitalGlobe continues to be the top dog in the world of commercial satellite imagery, getting a steady cash injection of $25 million per month from the EnhancedView contract. And the company is looking to clients beyond the U.S. government. In 2014 DigitalGlobe acquired Boulder, Colorado-based Spatial Energy, a geospatial data provider serving the oil and gas industry.

Strength in numbers

For the new, smaller companies, the technology is only one hurdle, says Horizon Strategies' Hartman. "For these companies to survive they don't have to only figure out a way to gather quality imagery, they also need to have a solid business model," he says.

Planet Labs might be on the right track. The Dove cubesats are small — 10-by-10-by-30 centimeters; about the size of a shoebox — made with commercially available parts and are relatively inexpensive to build, although Boshuizen declined to say how much each one costs. That makes them easy to launch in large numbers.

"Were using an industrial base that supports manufacturing of all the modern computing devices to build extremely powerful, very low-cost satellites," says Boshuizen. In fact, the manufacturing process is so uncomplicated that just nine days after the Antares launch failure, Planet Labs built two new satellites and readied them to be launched on the next cargo mission to the ISS flown by SpaceX. The cubesats are capable of providing images at 3-to-5 meter resolution.

Planet Labs is currently authorized to maintain a constellation of as many as 67 Doves — up to 56 at an altitude of about 400 kilometers and 11 at 620 kilometers, according to a licensing application that was granted by the Federal Communications Commission in October. The lower-orbiting satellites, to be deployed from the International Space Station, will have lifespans of seven months, due to natural orbital decay. To maintain the constellation, the company plans to launch as many as 500 satellites over 10 years, according to

Skybox Imaging

SkySat-1 collected this color infrared image of Port Fuad, Egypt, in February 2014.

the FCC application. The higher-orbiting satellites are already in place and will last about 17 years. Planet Labs says it plans to expand the constellation over the next 18 months through a series of larger-capacity launches.

Boshuizen says having a large number of satellites gathering imagery around the world produces never-before-seen "big picture" sets of data that will be useful to a variety of clients, from small nonprofits to national governments.

"When you have a high revisit rate and global coverage you can detect change on the planet," he says. "[Our] customers fall on a spectrum — some are extremely sophisticated and have their own data processing teams and imagery experts, other people just want the answer to their question. We'd like to serve everybody in-between those two extremes."

Without getting into specifics, Boshuizen said he doesn't rule out the U.S. government's national security agencies as future customers for Planet Labs.

Like Planet Labs, Skybox Imaging is taking advantage of greater access to technology and launch systems. "We are ardent believers in the power of commodity, commercial electronics to change the cost of doing business in space," the company says on its website. Skybox has built and launched two microsatellites so far, called SkySats. At 100 kilograms each they are larger than cubesats — about the size of a mini-fridge — but small enough to make launches affordable. The SkySats are in 600-kilometer polar orbits and have an expected life of at least four years.

Unlike Doves, which only take still images, SkySats can capture high-definition video in segments up to 90 seconds long at 30 frames per second. The 1.1-meter video resolution "is high enough to observe objects that impact the global economy, like shipping containers, but not close enough to view or identify human activity," the company says. SkySats can also capture 90-centimeter panchromatic and 2-meter multispectral imagery.