

High-tech paradise

Boeing provides critical supercomputing, space surveillance and customer support in Hawaii

By Lynn Farrow

Photos by Bob Ferguson

Boeing Hawaii Site Executive Jerry Cornell admits there's a typical response when he tells people Boeing has facilities on both Maui and Oahu in Hawaii—surprise and envy. "Their next question is, 'How do I get a job there?'" he said.

But it's not the turquoise waters, white sands or tropical breezes that draw most Integrated Defense Systems employees to Hawaii—although that helps. It's the work: the challenges and satisfaction of successfully identifying and tracking man-made objects orbiting high overhead; conducting top-level research; or performing sophisticated modeling and simulation on a high-powered supercomputer.

Most Boeing employees in Hawaii reside on the island of Maui and work side by side with their customer, the U.S. Air Force Research Laboratory's Directed Energy Directorate, on critical research, space surveillance and supercomputing projects. From high atop the 10,000-foot (3,050-meter) Mount Haleakala, Boeing and AFRL employees peer into deep space using the U.S. Department of Defense's largest telescope, the 3.7-meter

(12-foot) Advanced Electro Optical System housed at the Maui Space Surveillance Complex observatory. The telescope employs sophisticated sensors enabling it to track man-made objects in space and perform object identification data collection. Other equipment at the MSSC includes telescopes ranging in size from 0.4 to 1.6 meters (1.3 feet to 5.3 feet). The site's

work goes on 24 hours a day, seven days a week.

Getting to the job—located at the top of the dormant volcano—and back is not your typical daily commute. Company-owned vans pick up employees at three different sites on Maui at 5:30 a.m. for the 90-minute, 47-mile trip, and take them back down at 4 p.m. The ascent is gradual, thanks to 32 switchback turns.

Working 10-hour days atop a 10,000-foot mountain when you live at sea level can be physically arduous. First-timers to the top get a standard safety brief on the major temperature difference from the base to the peak (as much as 30 degrees Fahrenheit, or 17 degrees Celsius) and how to recognize the onset of hypoxia, a lack of oxygen reaching the tissues of the body. Going from sea level to the thinner air of almost two miles high can cause a person's speech to become slurred and thinking processes to become slower, not to mention headaches, muscle fatigue and a frequent need to sit. To help counter these effects, everyone "on top" has a supply of bottled water, extra food and is quick to point out the locations of oxygen stations and disposable masks.

Dan Thiel, a project manager, has worked at the top of the mountain for 20 of his 25 years with Boeing. His duties at the observatory include collecting images of spacecraft passing overhead in orbit. "Seeing through the atmosphere is one of our core competencies," he said. "Maui is the third-best viewing location on the planet because of ideal atmospheric conditions year-round. The island's dry and clean air, relatively stable climate and minimal scattered light from surface sources are perfect conditions to peer into space and see what's going on."

The work of Thiel and his team ranges from collecting images of the Hubble Space Telescope to performing space shuttle-related tasks. One of his most memorable moments occurred in 1995 during a cooperative mission with NASA.

"From the observatory, we directed a laser to illuminate Space Shuttle *Discovery* as it passed over Mount Haleakala with its cargo doors open," he explained. "The pass occurred at night, so the shuttle wasn't illuminated by the sun. The astronauts held a very high-intensity beacon—think of it as a million-candle-watt flashlight—in the shuttle's window. As we transmitted beams up to the shuttle, the astronauts sent back signals from their beacon.

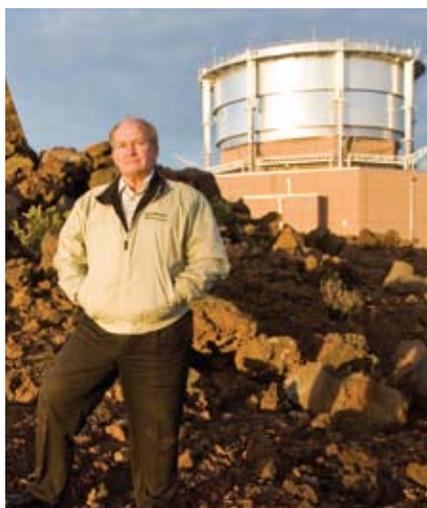
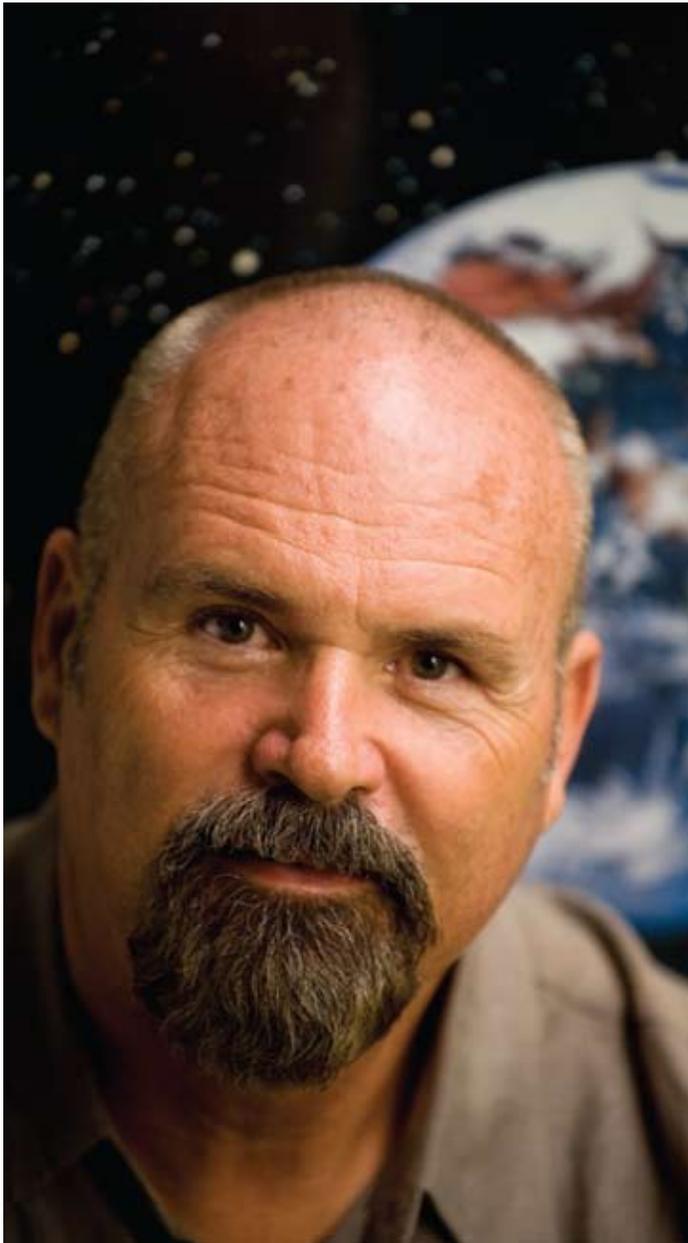


PHOTO: Jerry Cornell, Hawaii site executive, on Mount Haleakala.

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PHOTOS: (TOP) “Where else can you say your job is to look at the stars and the planets—the grand tour as we call it,” said Dan Thiel, a Boeing project manager who works at the Maui Space Surveillance Complex observatory. **(ABOVE)** Steve Gima, top, and Dean George, high-performance computing systems service engineers, inspect the Dell PowerEdge supercomputer, affectionately known as Jaws.

In this way, with 250 miles between us, we were able to illuminate the cargo bay with just a laser and successfully track the shuttle in the dark!”

The telescopes used at MSSC are high-tech—and incredibly powerful. “These are not like the telescope most people think of, mounted on a tripod and pointed at the Big Dipper,” Janki Patel, a project manager, explained. “When we talk about the size of a telescope, we’re referring to the aperture or diameter of the primary lens or mirror of the telescope. The aperture size defines the light-collecting capability of the telescope. Our biggest telescope is 3.67 meters. That’s about 12 feet.

“Instead of an eyeball, we put a camera on the telescope to collect and record what the telescope sees. When the objects we’re viewing are not illuminated by sunlight, we use lasers to illuminate them. We use our telescope to track the object while it’s being illuminated and collect data from the object—everything from its size and distance from Earth to how fast it’s moving.”

Although Boeing employees in Hawaii admit they love their beautiful surroundings, they also face challenges unique to an island setting. “This is not necessarily an easy place to live,” Patel said. “You are basically a captive consumer when you live on an island, and supply is a lot less here. Take buying a house for example. On the mainland, if you don’t like what you see where you’re at, you have the option to move further out. Can’t do that on an island. Your options are definitely limited.”

Thiel agreed. “Housing, food and gas prices are always high. You can feel very isolated from friends and family on the mainland. Just getting from one place to another on the island can be difficult. We’re talking about 138,000 people, all concentrated into a very small part of a 727-square-mile (188,300-hectare) island,” he said.

JAWS

Back at sea level, Boeing and the University of Hawaii work together at the Maui High Performance Computing Center in Kihei, providing advanced hardware, tools, training and network connectivity to Defense Department researchers. Boeing conducts research and development programs on one of the world’s most advanced computation platforms, named Jaws (after a famous surf spot and not the shark). Jan Wine is an integral part of a management team that provides more than 32 million hours of computing time yearly, supporting cutting-edge applications in four key areas:

- Modeling and simulation (for example, modeling wind flows around a newly designed jet)
- Image processing and information analysis (e.g., taking a satellite image that comes from the MSSC and improving the quality of the image using high-performance computing and software engineering)
- Systems and software integration
- Large-scale data management

“High-performance computing is powering breakthrough discoveries,” Wine said. “For example, some of our current projects include modeling and simulation of high-impact weather conditions in the battlespace, modeling and simulation of turbulent flows around aircraft for future aircraft design, and enhancing laser beam qualities for warfighters.”



PHOTO: “High-performance computing is powering breakthrough discoveries,” said Jan Wine. He is an integral part of a management team that provides millions of computing hours yearly, supporting cutting-edge applications in modeling and simulation, image processing, system and software integration, and large-scale data management.

STORM ON THE MOUNTAIN

The weather also can turn extreme in Hawaii. In December 2007, a fierce storm battered Oahu and Maui for three days. Driving rain and sustained winds exceeding 105 miles per hour (169 kilometers per hour) knocked out power to tens of thousands. On Mount Haleakala, there was not even generator power.

“The site literally shut down,” said Maj. Jeff Brach, AFRL director of operations on Maui. “We stood up an emergency operations center in the dead of night in Kihei to make sure the team on top was safe.”

During the storm, six members of Cornell's team went up the mountain to stabilize, repair and prevent further damage to the MSSC. Working together over the next several months, Brach and Boeing employees not only repaired the system but also brought one of the sensors online in record time to support a national requirement. “This was definitely an accomplishment we were very proud of,” Brach said.

Cornell says this kind of working together in good times and bad is what contributes to the tightknit feeling among Maui employees. Although the Maui site population has decreased over the years, their 2008 Boeing Employee Survey scores jumped a whopping 35 percent from the 2005 survey. Also, the site's contract award fees have seen a 26 percent improvement over the past three years.

In Hawaiian culture, the paddle is a strong symbol of teamwork, because each person's pull in the canoe is just as important as the next's. And, as Cornell puts it, “This Maui team knows how to paddle together!” ■

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Can't judge a manuscript by its cover

This Boeing scientist helps uncover secrets of ancient documents

When you live in a place where you can swim ocean waters or relax under palm trees year-round, where do you go and what do you do to get away from it all?

Keith Knox resorts to old deteriorated manuscripts.

Knox is the chief scientist for Boeing Laser Technical Services in Hawaii. His work is imaging science—that is, the collection, analysis and visualization of images. Knox leads a team of Boeing scientists who analyze the images obtained from space via the Maui Space Surveillance System. Owned by the Air Force Research Laboratory and located on the 10,000-foot (3,048-meter) summit of Mount Haleakala on Maui, the surveillance system tracks man-made objects in space and plays a critical role in the defense of the United States.

During his non-work hours, Knox has taken his lifelong expertise at analyzing images and applied it to something he and others consider culturally important. For the past five years in Hawaii and for 10 years prior to that in New York, Knox has spent much of his free time working with university colleagues to uncover writings on ancient manuscripts that have deteriorated over time.

Their prize achievement so far has been the Archimedes Palimpsest—a copy of some of the 2,300-year-old writings of mathematician, physicist and engineer Archimedes, who lived in the third century B.C. and is considered one of the world's greatest thinkers.

Archimedes is most noted for his mathematical treatises and contributions made to the understanding of fundamental physical phenomena. Through the medium of geometry, he was



PHOTO: Keith Knox, chief scientist for Boeing Laser Technical Services in Hawaii, analyzes the images obtained from space via the Maui Space Surveillance System. Off the clock, he contributes his time and expertise to help uncover writings on ancient manuscripts.

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Maintaining

greatness

IDS Oahu employees repair, maintain and train on Boeing aircraft

They may work on an island of tropical flowers, fiery sunsets, and majestic peaks and waterfalls, but Boeing employees on Oahu know the work they do is not only difficult—it's critical. In fact, it can be lifesaving for pilots, aircrew, and the soldiers and marines who fly in combat zones on aircraft repaired and maintained in Oahu by Integrated Defense Systems' Global Services & Support employees.

The site supports Boeing aircraft and platforms including:

- C-17 military jet transport (known for its ability to carry large combat equipment and troops across international distances)
- C-40B jet (a specially configured 737 that provides safe and reliable travel for U.S. combatant commanders and other top-ranking government officials)
- CH-47D Chinook helicopter (a versatile, twin-engine, tandem rotor heavy-lift helicopter used to transport personnel and military and humanitarian supplies)
- Tomahawk Cruise Missile Planning System (an all-weather submarine- or ship-launched land-attack cruise missile)

"People think when you work in Hawaii, you're out on the beach surfing," said Ron Sampson, Boeing C-17 base manager at Hickam Air Force Base. "For me, a flight line is a flight line, and it's definitely hard work." Sampson and his team of 10 are responsible for maintenance issues that fall outside the scope and capability of U.S. Air Force maintainers on C-17s that fly in and out of Hickam, as well as a fleet of eight C-17s at the base.

"When a C-17 takes off from here it faces a seemingly endless expanse of ocean with nowhere to land for a long, long distance. Pilots and flight crews have to be confident that when they get into a C-17, it's going to fly safely and land where it's supposed to. Instilling that confidence is our job. We designed and built this aircraft. We're the experts when it comes to repairing it."

TRAINING FOR THE UNEXPECTED

Ensuring pilots maintain proficiency on the C-17 aircraft is the job of Larry Leonard, site manager for the C-17 Aircrew Training System, and his team of 14 subcontractors. Pilots are required to complete a minimum of two simulation sessions per quarter on the C-17 Weapons System Trainer. Training focuses on instrument procedures and real-world operational and mission



PHOTO: "When a C-17 takes off from [Hawaii] it faces a seemingly endless expanse of ocean. ... Pilots and flight crews have to be confident that when they get into a C-17, it's going to fly safely and land where it's supposed to," said Ron Sampson, Boeing C-17 base manager at Hickam Air Force Base, Hawaii.

scenarios, such as safety malfunctions during various weather and environmental conditions.

C-17 pilots are trained to face any and all emergency situations. "For example, you could be flying a simulated mission assisting earthquake victims when suddenly the aircraft has pressurization problems, the weather turns bad and, just to make things interesting, one engine stalls," Leonard said. "The simulator is perfect for keeping pilots safely prepared and trained for any type of scenario."

Another high-profile jet based at Hickam is the C-40B, a specially configured 737 equipped with state-of-the-art avionics and onboard communications systems. It is the job of Keith Dye, Boeing C-40B site manager, and his logistics support and services team to ensure the aircraft are fully mission-capable at all times.

Last year the team's Fully Mission Capable rate was 99.6 percent, meaning the planes were almost always ready to go. In his five years with Boeing, Dye and his team have had a 100 percent departure reliability rate, meaning there have been no departure delays.

A few miles from Hickam, at Wheeler Army Airfield, a lone field service representative, Galen Cajjal, is passionate about his

job: maintaining and repairing the CH-47D Chinook. When a Chinook returns from a combat tour, it is put through an extensive maintenance and repair process.

“Overseeing repairs is a perfect fit for me, and very gratifying,” Cajigal said. “I joined Boeing last April because I wanted to pass along what I’ve learned in 26 years flying the Chinook as a senior inspector. There are a lot of young soldiers flying this aircraft, so I want to help them out.”

“We tear the Chinooks down, thoroughly clean and overhaul them, change out components, then put them back together again with a new paint job,” said Chief Warrant Officer Jason Franzen, one of the U.S. Army’s maintenance test pilots, who works closely with Cajigal. “When I served in Iraq with the [B Company, 214th Aviation Regiment] ‘Hillclimbers,’ we flew these Chinooks more than 12,000 hours in 15 months. Every aircraft made it back safely to home station. There is nothing more satisfying than that. To have been part of a group of professionals that kept these aircraft flying safe for that duration in combat is an honor.”

STAYING CONNECTED

Jim Pasquino and Dave Brostrom run the IDS business development field marketing office in Honolulu. They are a key interface between Boeing and the U.S. military.

“Oahu is unique because you have three four-star general commands, three three-star commands, and numerous two- and one-star headquarters all located within a few miles. All of these have commands throughout Asia, making Oahu a critical element in understanding customer requirements.

“When Boeing business unit representatives come to Honolulu to talk to these commands, their visits are coordinated through this office so there are no schedule conflicts. Because we talk to state and local government, U.S. military, and international customers, we stay cognizant of current and emerging requirements and provide that information to the appropriate Boeing business unit,” Brostrom said.

– Lynn Farrow



PHOTO: Chief Warrant Officer Jason Franzen, left, and Boeing’s Galen Cajigal work together to maintain and repair Boeing CH-47D Chinooks at Wheeler Army Airfield on Oahu in Hawaii.

able to elucidate the principles for such basic devices as the pulley, fulcrum and lever. He is also credited with the discovery of the principle of buoyancy. His research into volume and density was fundamental to the development of theories of hydrostatics, the branch of physics dealing with liquids at rest.

By the 12th century A.D., this parchment manuscript copy containing Archimedes’ theorems was in the hands of a monastery. There (during a time when parchment was hard to obtain), monks unbound and washed the pages containing the theorems so that they could be reused for liturgical text. The pages were scrubbed with natural acid and pumice stone, and prayers were literally penned on top of scrubbed-off writings.

Fortunately, even though the ink was scraped off, it left stains behind that are barely visible to the naked eye. That’s where Knox and his expertise in sophisticated imaging techniques come in. Since 1998, he and two university colleagues have been working with the Baltimore-based Walters Art Museum to apply advanced image processing techniques to uncover the erased images. “The challenge was to sort out which lines of handwriting were faded 10th-century Archimedes text and which were 13th-century markings of a monk,” Knox said.

The team used X-rays as well as ultraviolet, infrared and visible light to “excite” and then “relax” the stains left behind on the parchment. Under ultraviolet illumination, the manuscript fluoresces and the erased characters show up as dark images that can be easily seen and interpreted by scholars. The multispectral image processing software that Knox created made the Archimedes text pop out on a computer screen in red-tinted pixels, while the prayer book text remained black. Over the past 10 years, Knox and his team imaged the entire 174-leaf manuscript, digitally enhanced the images and made them available electronically to scholars worldwide. From these images, scholars have discovered that Archimedes understood the fundamental principles of calculus 1,900 years before they were rediscovered by Isaac Newton.

Knox says he loves his pastime. And he loves his work at Boeing. “I enjoy the discovery of new information,” he said. “My whole life is geared around extracting information from things that are less than optimal for observation. Whenever you can extract really interesting or rare data from something that on the surface doesn’t seem to have anything of value—that’s a thrill!”

– Diane Stratman