



BOEING

Frontiers

www.boeing.com/frontiers

MARCH 2013 / Volume XI, Issue X

A WORLD ABOVE

Boeing's satellite-making business builds on a legacy of leadership and innovation



“We had to be innovative because there isn’t just one solution. We included pilots, regulators and engineers to make the operating environment the safest possible.”

Marisa Jenkins
Boeing Lead Engineer
Runway Situation
Awareness Tools

RUNWAY SITUATION AWARENESS TOOLS

Stories of
innovation
at Boeing



www.boeing.com/stories



18

FAR-OUT PERFORMANCE

Boeing's communications satellite-making business in El Segundo, Calif., has been an industry leader for a half-century. The 5,500 employees with Boeing Space and Intelligence Systems at the El Segundo site design and build complex satellites for both commercial and government customers—and are doing so with ever-greater innovation and efficiency. Meet some of them, and see the cutting-edge work they do, in this photo essay.

COVER PHOTO: IN THE HIGH BAY OF THE EL SEGUNDO, CALIF., PLANT, DAVID GILBERG CLOSES A THERMAL INSULATION BLANKET THAT WILL KEEP A GPS SATELLITE PROTECTED FROM EXTREME TEMPERATURE FLUCTUATIONS IN SPACE. BOB FERGUSON/BOEING

PHOTO: TECHNICIAN CHRIS HOLGUIN MOUNTS HARDWARE TO AN ANTENNA ON A NASA TRACKING AND DATA RELAY SATELLITE. BOB FERGUSON/BOEING

AD WATCH

The stories behind the ads in this issue of *Frontiers*.

Inside cover:



"Runway Situation Awareness Tools" is one in a series of innovation stories told by Boeing employees such as Marisa Jenkins. Learn more at www.boeing.com/stories.

Page 6:



This ad highlights the unique capabilities that allow the V-22 Osprey to provide humanitarian aid and disaster relief to those in need throughout the world. The ad appears in military trade and political publications.

Pages 12–13:



This ad from the "Partners Across Generations" campaign highlights the relationship between Boeing and China's aviation industry. Translation: "The sky is full of the dreams of young students. Boeing is devoted to helping them chase those dreams. From supporting the development of China's modern aviation system to keeping innovation alive, this partnership will transcend time."

Back cover:



This new ad highlights the Boeing 702SP (small platform) all-electric satellite and the advantages this innovative technology brings to Boeing's satellite customers. The ad appears in trade publications.

Publisher: Tom Downey
Editorial director: Anne Toulouse

EDITORIAL TEAM

Executive editor:
Paul Proctor: 312-544-2938

Editor:
James Wallace: 312-544-2161

Managing editor:
Vineta Plume: 312-544-2954

Graphic designers:
Brandon Luong: 312-544-2118
Cass Weaver: 480-216-4539

Photo director:
Bob Ferguson: 312-544-2132

Commercial Airplanes editor:
Don Smith: 206-766-1329

Defense, Space & Security editor:
Diane Stratman: 562-797-1443

Engineering, Operations & Technology editor:
Junu Kim: 312-544-2939

Human Resources and Administration editor:
Len Vraniak: 312-544-2351

Shared Services Group editor:
Beriah Osorio: 425-577-4157

Staff writer:
Eric Fetters-Walp: 425-266-5871

ONLINE PRODUCTION

Web manager:
Wendy Manning: 312-544-2936

Web designer:
Michael Craddock: 312-544-2931

Web developers:
Lynn Hesby: 312-544-2934
Keith Ward: 312-544-2935

Information technology consultant:
Tina Skelley: 312-544-2323

HOW TO CONTACT US:

E-mail:
boeingfrontiers@boeing.com

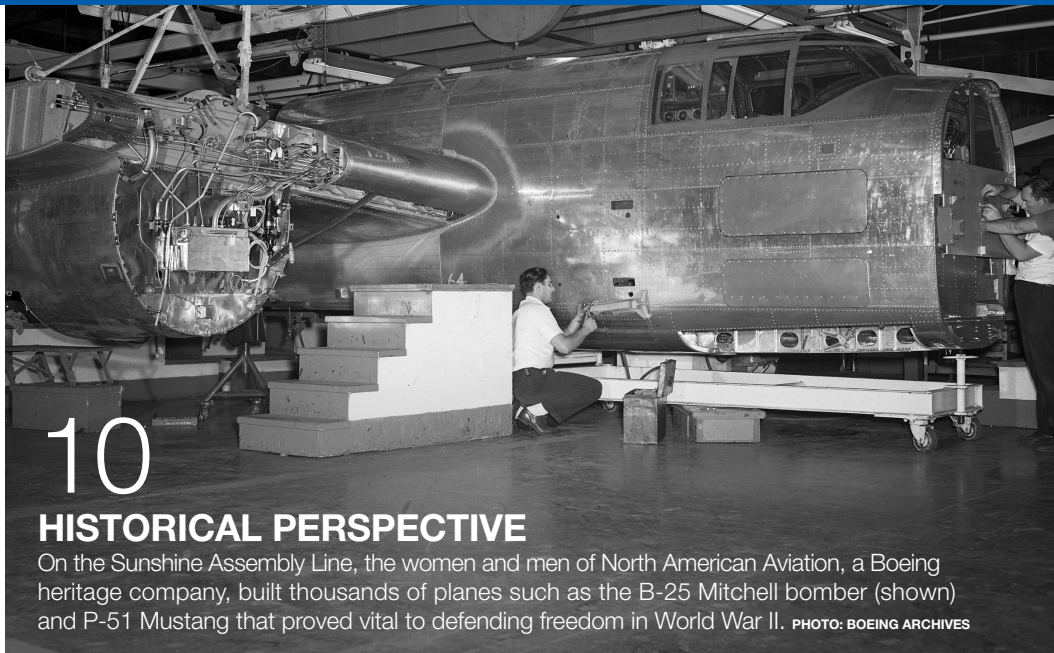
Mailing address:
Boeing Frontiers
MC: 5003-0983
100 N. Riverside Plaza
Chicago, IL 60606

Phone:
312-544-2954

Fax:
312-544-2078

Web address:
www.boeing.com/frontiers
Send all retiree address changes to
Boeing Frontiers, MC 3T-12
P.O. Box 3707
Seattle, WA 98124-2207

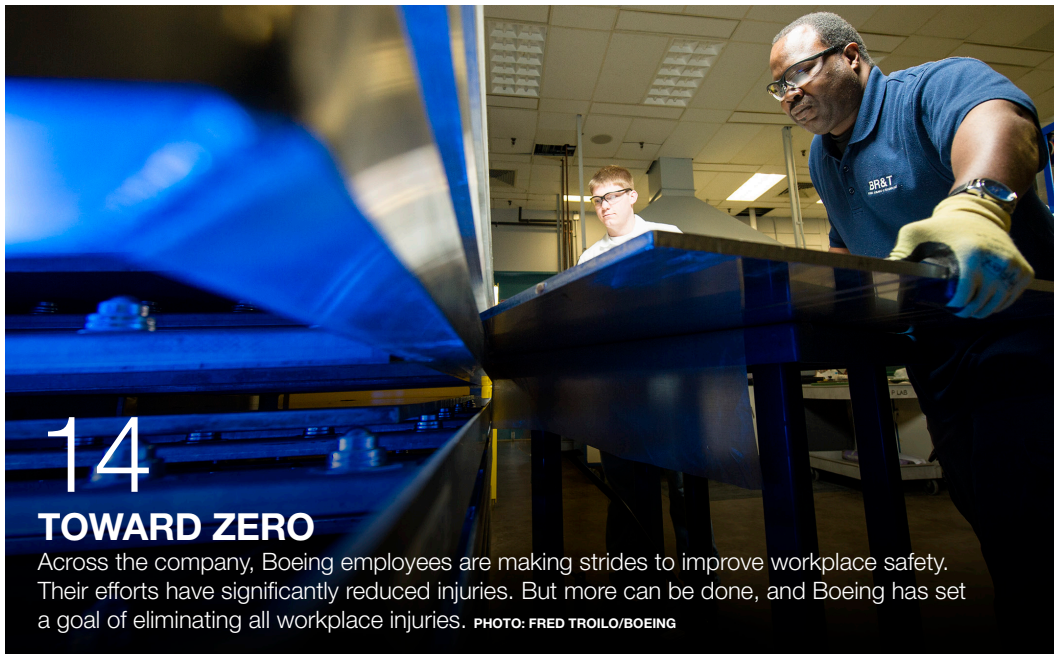
Postmaster: Send address corrections to
Boeing Frontiers, MC 3T-12
P.O. Box 3707, Seattle, WA 98124-2207
(Present addressees, include label)



10

HISTORICAL PERSPECTIVE

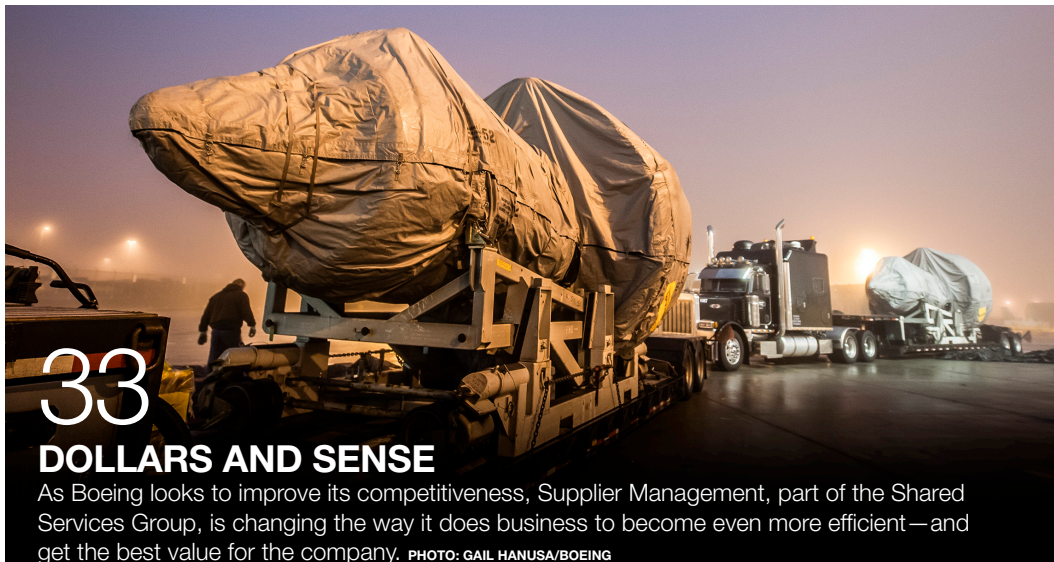
On the Sunshine Assembly Line, the women and men of North American Aviation, a Boeing heritage company, built thousands of planes such as the B-25 Mitchell bomber (shown) and P-51 Mustang that proved vital to defending freedom in World War II. PHOTO: BOEING ARCHIVES



14

TOWARD ZERO

Across the company, Boeing employees are making strides to improve workplace safety. Their efforts have significantly reduced injuries. But more can be done, and Boeing has set a goal of eliminating all workplace injuries. PHOTO: FRED TROILO/BOEING



33

DOLLARS AND SENSE

As Boeing looks to improve its competitiveness, Supplier Management, part of the Shared Services Group, is changing the way it does business to become even more efficient—and get the best value for the company. PHOTO: GAIL HANUSA/BOEING

Inside

07

LEADERSHIP MESSAGE

For Boeing to achieve its goal of zero injuries in the workplace, it needs to break the myth that workplace injuries are simply part of doing business. They are not, says Kim Smith, vice president of Environment, Health and Safety. While significant progress has been made in reducing injuries around the company, people are still getting hurt at work, she says.

08

SNAPSHOT/ QUOTABLES

09

WHY WE'RE HERE

37

MILESTONES

42

IN FOCUS

28

PLANES, SUBS AND MISSILES

Heath, Ohio, may have the look and feel of a small Midwestern town in the United States, but the Boeing site plays a critical role for the warfighter. Heath is a Strategic Fabrication Center where more than 400 employees manufacture, repair and overhaul electronic and mechanical systems for the U.S. Navy, Air Force and allied nations. Their work includes the repair and maintenance of the Minuteman III missile guidance system and the gyro navigator system for nuclear submarines. PHOTO: BOB FERGUSON/BOEING



**DELIVERS HOPE.
WHEN ALL SEEMS HOPELESS.**



COMBAT · HUMANITARIAN · LOGISTICS · RESCUE · SPECIAL OPS

Around the globe, V-22 Ospreys are making a critical difference in humanitarian aid and disaster relief missions—delivering food, water, medical supplies and time-sensitive cargo to those in need. The V-22's unique blend of helicopter flexibility, high speed and long range provides timely aid to remote areas that would otherwise be unreachable, saving lives in the balance.

Bell Helicopter
A Textron Company

BOEING

Safety first, always



Kim Smith

Vice president, Environment, Health and Safety

We can't be satisfied until there are zero injuries in the workplace

Boeing builds the world's safest, most efficient aerospace products. Yet each day, 400 employees are not at work due to workplace injuries. Every year, 1,500 to 1,800 Boeing employees are hurt on the job and miss time away from work.

These are not just numbers; they are members of our team. Each has a story to tell as to how their injuries have impacted their ability to work as well as their home life. Their stories are a reminder that our first priority is creating a safer work environment and we need to protect our teammates the same way we protect our customers.

Those are easy words to say, but not always easy to do. We are increasing production rates, delivering more airplanes and repositioning segments of our business due to changes in our markets. Hundreds of new employees join us every day, and experienced employees are taking on new roles at sites and programs across the enterprise. These are great opportunities for us and we are performing at extraordinary levels. At the same time, we can't allow that to be a reason for our team to suffer injuries at work.

For us to achieve our goal of zero injuries, we need to break the myth that workplace injuries are a part of doing business—because this is simply not true.

We don't have to look far to find sites and programs that have distinguished themselves by breaking this myth. (See story on Page 14.) Multiple teams across the enterprise have logged more

than 1 million hours without a single lost-time injury; several have extended that level of performance to 2–3 million hours worked. This proves we can achieve outstanding safety performance in a heavy manufacturing environment.

But far too many people are still getting hurt. Last year, we experienced painful tragedies—multiple life-threatening accidents and, in December, we lost a member of our Boeing team. We must do more to protect ourselves and one another by changing our mindset to one where we are all responsible for safety, and working without risk of injury is every employee's expectation.

This will require leadership—from every member of our team—to insist on safety first in everything we do; courage to speak up and take action on unsafe conditions without hesitation; and, above all, action by all leaders and all functions to eliminate hazards from our factories, flight lines and offices.

The people of Boeing do amazing things. The same focus and dedication that make us leaders in aerospace will make us leaders in workplace safety. If we apply that same spirit to ensuring safety is paramount—critical to everything we do—we can break the myth surrounding safety in the workplace. We will create a culture where we are not satisfied until ours is a zero-injury workplace. ■

PHOTO: BOB FERGUSON/BOEING

A good day to fly

From the flight deck of a Boeing 787 Dreamliner, Engineering test pilot Mike Bryan gives a thumbs-up after completing a more than two-hour flight on Feb. 9 from Boeing Field in Seattle. Boeing Test & Evaluation partnered with Commercial Airplanes to conduct limited flight testing on ZA005 following approval by the Federal Aviation Administration. During the flight, the crew monitored the performance of the main and auxiliary power unit batteries to gather information that could be used to better understand the recent 787 events that are under investigation.

PHOTO: PAUL GORDON/BOEING



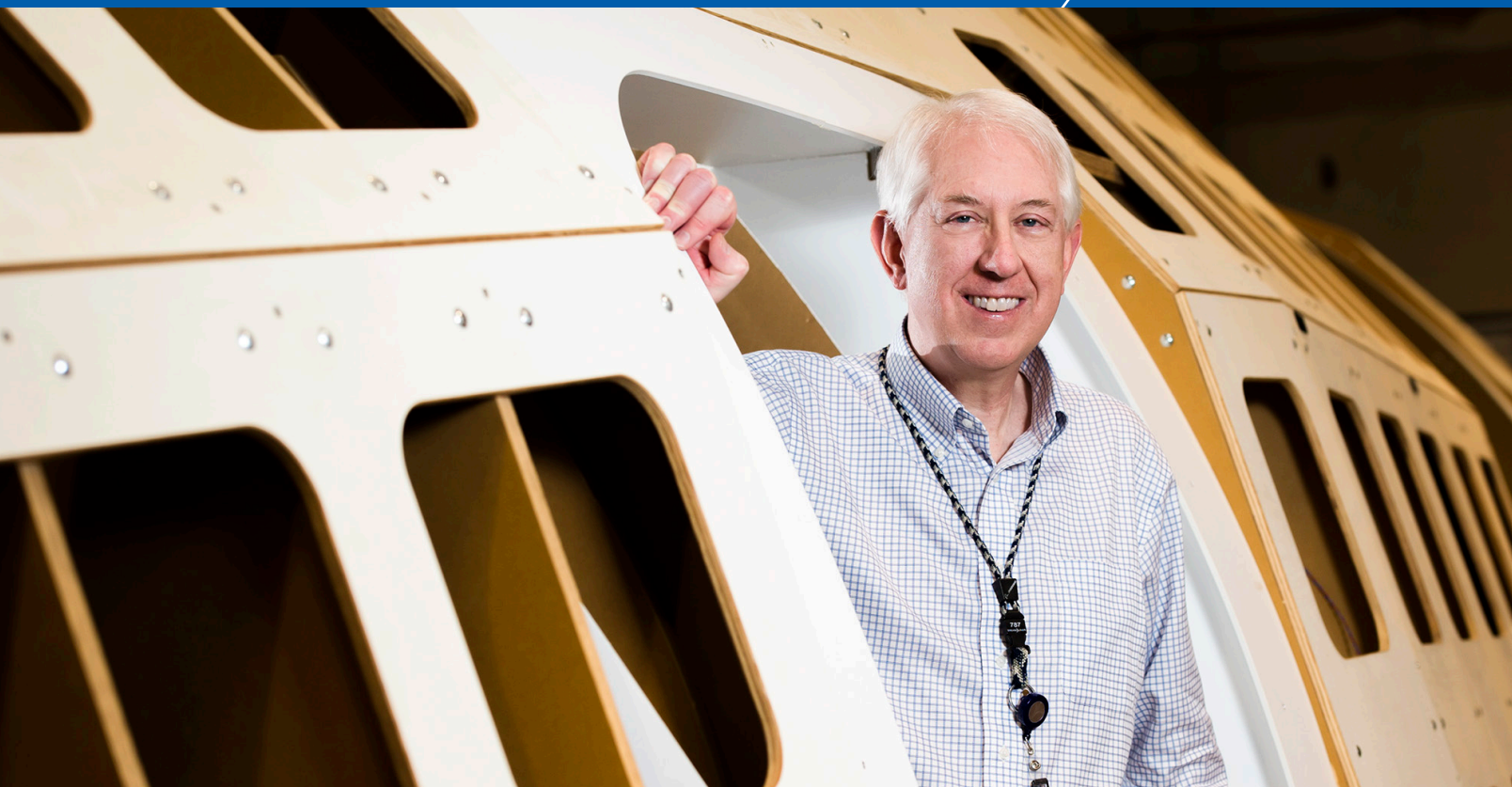
QUOTABLES

“Six years ago, when we started sustainable biofuel work, people thought we were crazy. But we’ve continued to prove them wrong.”

– Billy Glover, vice president of Boeing’s Global Business Development and Policy, part of Commercial Airplanes, speaking to employees in Renton, Wash. He noted there have now been more than 1,500 commercial passenger flights that were powered using biofuels. *Boeing News Now*, Feb. 13.

“We may not build the big military planes that some of Boeing’s larger sites are known for, but the work done here plays an important role in defending freedom.”

– Mark Miklos, chief engineer and mission assurance manager at the Boeing site in Heath, Ohio. See story, Page 28.



Words that work

This employee uses creative ways to help teams work together as ‘One Boeing’

By Geoff Potter and photo by Ed Turner

Dave Noll serves as a senior Organization Effectiveness consultant and recently advised the “One Boeing” team developing the KC-46A tanker for the U.S. Air Force. In this Frontiers series for employees to talk about their jobs, Noll, shown at the Tanker Validation Center in Everett, Wash., explains how he helps teams work together more effectively.

One of my strengths is that I’m an “airplane guy”—I spent my first 10 years at Boeing working in operations, on both the military and commercial sides, everything from 777 landing gear to anti-submarine warfare. I went to graduate school at night, through the Learning Together program, and then did a career change in the late '90s to organizational effectiveness consulting. So I bring my operational knowledge to the groups I support.

Work cultures can be complex, so I try to keep my advice simple and practical. The biggest thing for me is helping leaders see things from a different point of view, so it changes how they approach a problem.

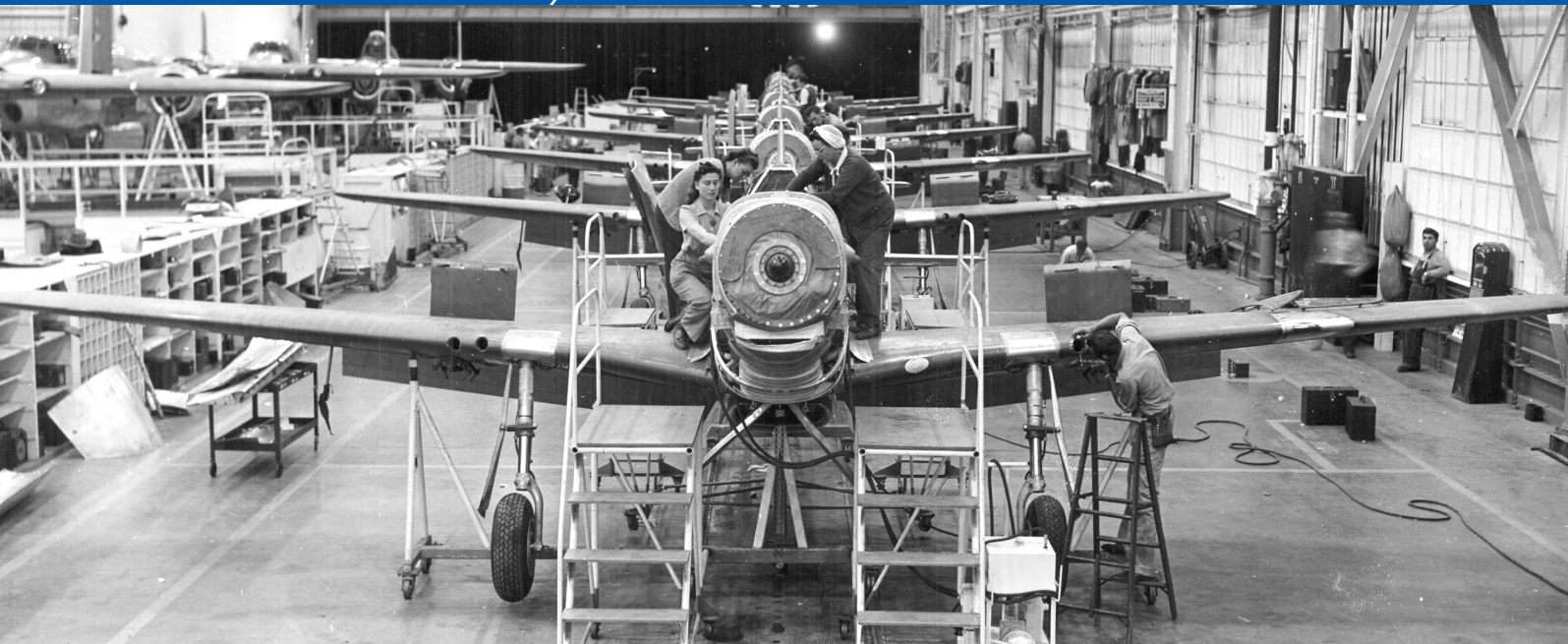
I like using analogies—coming up with a story that serves as a framing device, a depersonalized way of looking at a situation. They help take the emotion out of a challenge so you can focus on practical solutions. When you have a good metaphor, the conversation takes off.

On the tanker program we used a housing development metaphor to help understand the different business unit cultures on the team. The analogy was that Boeing Defense, Space & Security programs often build custom houses for a single customer, while Commercial Airplanes programs build housing developments for many customers. Each culture is designed to be successful in its specific environment, but misunderstandings or even breakdowns can occur if one culture is used in the other environment. The metaphor made sense to people—they began to see their teammates’ behaviors and perspectives were perfectly natural for their backgrounds.

Sometimes we hold workshops to help members of a team better understand not only their peers but also themselves—their individual personality and temperament and how they handle problems. That can help them be more open to listening to others’ points of view. Those who tend to be drivers are able to slow down and listen to others, and those who are more analytical can make decisions faster and move on. If others on the team compensate for your blind spots, it improves the decisions the team makes.

That’s what One Boeing is all about: people who bring their history and knowledge and perspectives together to develop the best solutions. If you accept people’s differences and understand people’s viewpoints, you can take advantage of the strengths that we all bring. ■

geoffrey.potter@boeing.com



Working on sunshine

The men and women of the Sunshine Assembly Line helped meet wartime aircraft needs

By John Fredrickson



In 1935, during the Great Depression, the 75 men and women who worked for North American Aviation in Dundalk, Md., packed their cars and headed West in a caravan.

They each received a small sum of money for travel expenses—and a personal promise.

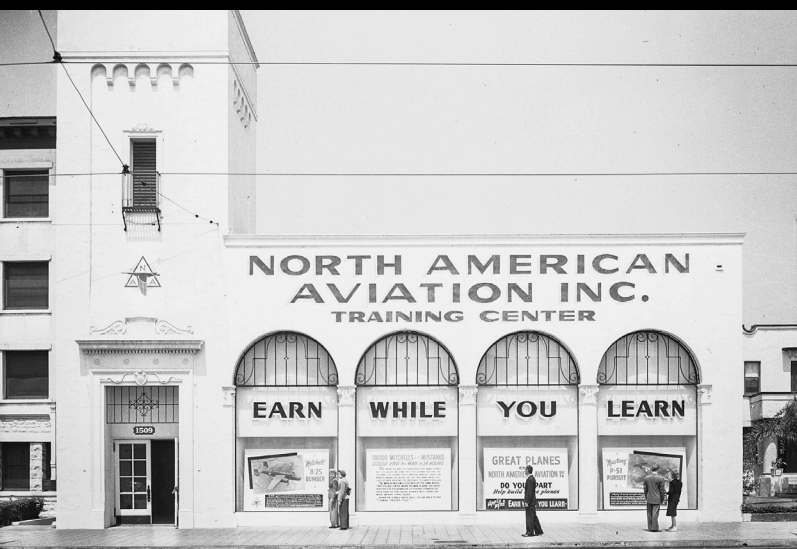
The promise—that once they arrived in sunny Inglewood, Calif., they would get to build airplanes—had been made by their leader, James “Dutch” Kindelberger. He had visited the area and leased property for his fledgling new company at Mines Field, what is today part of Los Angeles International Airport.

And make airplanes they did, by the thousands, on what would become known as the Sunshine Assembly Line. Their output included two of the most storied aircraft of World War II—the B-25 Mitchell bomber and the P-51 Mustang fighter.

With the outbreak of war, airplane manufacturers faced an acute labor shortage at the same time as demand for military planes skyrocketed. The solution was to woo people from other demographics previously seldom found in aviation manufacturing.

New workers poured in from all walks of life, from all over the United States. Some arrived fresh from school. Others came from agriculture, homemaking, retailing, service industries and other lines of work. They were drawn to the higher wages and better benefits, though the work could be difficult. Many relocated and then wrote home to proudly declare they had found jobs “Working on the Sunshine Assembly Line”—a reference to the balmy Southern California climate and tasks performed outdoors under camouflage nets.

At its peak, the North American wartime workforce swelled to 91,000 employees.



PHOTOS (Clockwise from top far left): The P-51B production line; inside the North American Aviation Training Center; a P-51B under the camouflage-covered flight line; employees at work; a view of the training center; recruiting. BOEING ARCHIVES

In 1940, North American opened an additional plant in Kansas City and another near Dallas. North American built more aircraft than any other U.S. company between 1938 and 1945—in excess of 40,000 airplanes. Employees at the Inglewood facility built about 1,000 AT-6 trainers, as well as about 3,200 B-25s. But the plant focused on production of the P-51 Mustang, which earned a lasting reputation for escorting Boeing B-17s all the way on long-range bombing missions to Germany. Inglewood built more than 10,500 Mustangs.

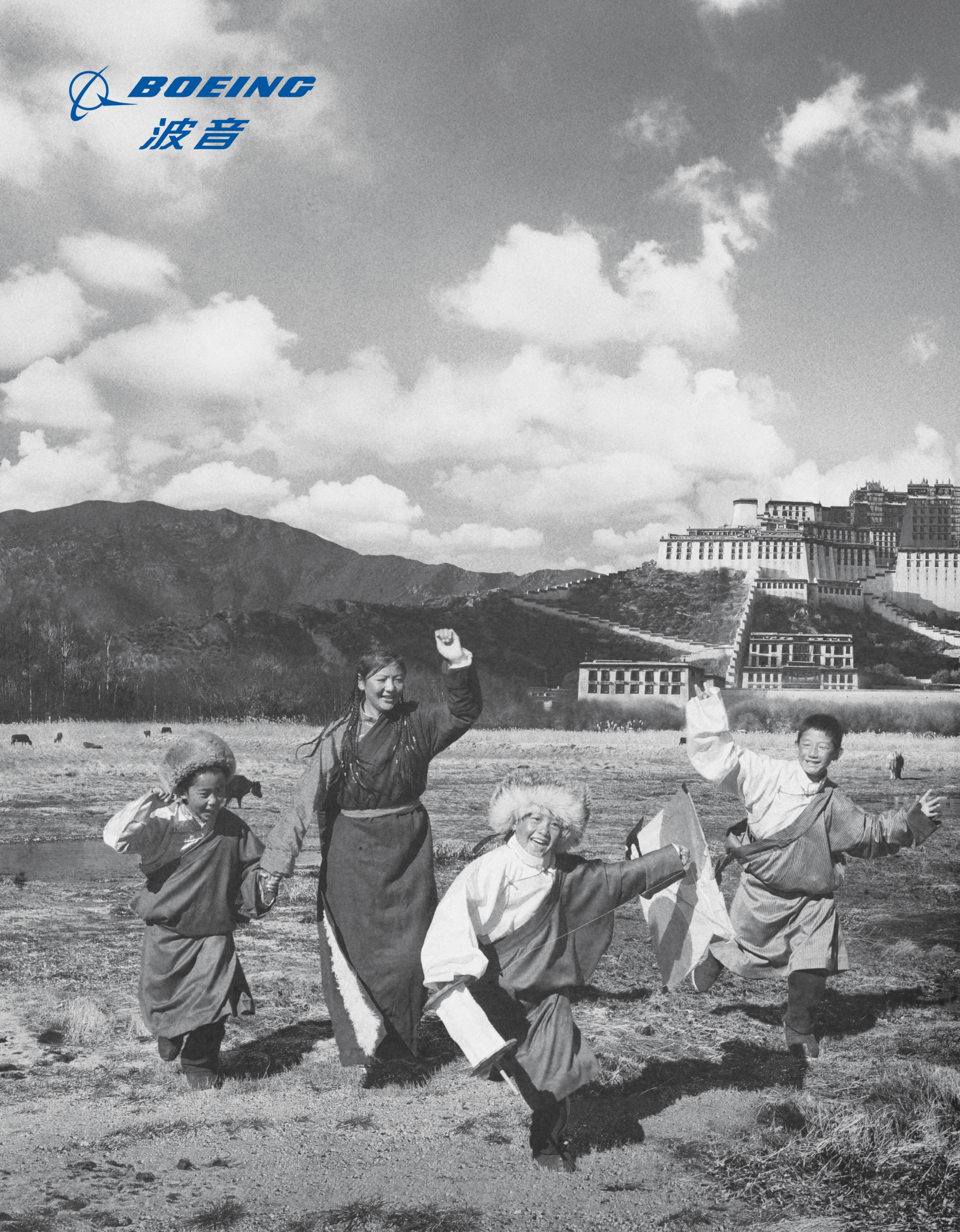
At its peak, the North American wartime workforce swelled to 91,000 employees, then plummeted to 5,000 in 1946 before stabilizing with the rapid development of jets for the Korean War and later the Cold War.

North American Aviation later merged with Rockwell. Boeing acquired the aerospace units of Rockwell in 1996.

Recently, more than 300 photographs of the Sunshine Assembly Line were recovered by the Boeing Archives. They provide a rare look at a unique time and place in the history of aircraft manufacturing, when the men and women of North American found a way to meet critical wartime aircraft demand. ■

For more information, contact Mike Lombardi at michael.j.lombardi@boeing.com

BOEING
波音





飞越时代的伙伴

无论哪个时代，孩子眼中的天空总是充满梦想。“放飞梦想”波音航空科普教育活动致力于帮助孩子们为梦想插上翅膀，持续创新。从支持中国现代化航空体系的建设，到帮助青少年放飞梦想，波音一直珍视我们飞越时代的伙伴关系，带着不变的承诺，飞向未来。

TARGET ZER

Employees
improve workplace
safety on the way
to zero injuries

By Patrick Summers





With a high-tech, computerized bolting tool he affectionately called the “yellow monster,” mechanic Dan Lingle tightened a long line of fasteners on the lower panel of a 737 wing.

The hand-held electronic tool is attached to a tall, yellow, adjustable base that rolls across the factory floor. Lingle can program a built-in computer to automatically apply the right amount of torque to bolts of any size.

“This new tool is light-years ahead of what we used before,” he said. “It does a lot of the work electronically; I don’t have the same muscle fatigue. It’s a huge process improvement.”

After 19 years in wing-body join at the 737 factory in Renton, Wash., Lingle has felt his share of stress and strain. Surgery in 2011 on a torn rotator cuff and other muscle injuries kept him off the job for three months.

The electronic bolting tool is one example of how continuous improvement, collaboration and personal responsibility for safety are driving a significant reduction across the company in lost work time due to injuries.

Boeing has made progress in reducing workplace injuries and raising awareness about safety, but accidents in 2012 led to several serious employee injuries and one fatality. Improving workplace safety and enterprisewide efforts to eliminate all injuries are top priorities. Across the company, employees are taking an active role in creating a safer workplace, one day at a time.

Over the past five years, Boeing has cut the number of workplace injuries by 17 percent—noteworthy progress. But that’s not enough, Boeing leaders say.

“We must transform Boeing into a leader in workplace safety, just as we are in product safety,” said John Tracy, chief technology officer and senior vice president of Engineering, Operations & Technology.

As employees increasingly eliminate safety hazards from the workplace, a team of senior Boeing executives is defining key steps to accelerate elimination of workplace injuries altogether. The goal of the task force is in its name: Go for Zero.

The task force is led by Kim Smith, vice president of Boeing Environment, Health and Safety. It will make recommendations to the Boeing Executive Council in April. Boeing employees can

learn more about the team in the Feb. 10 Go for Zero article in Boeing News Now.

Meanwhile, safety awareness and improvement activities are making a difference at Boeing sites across the enterprise.

At the production facility in Ridley Township, near Philadelphia, John Ellmore is an H-47 Chinook Final Assembly inspector and safety chairman for UAW Local 1069.

He said the site identified and resolved more than 200 potential hazards in 2012 through systematic safety inspections and listening to employee concerns. Safety improvements range from refurbishing aircraft work stands to new inspection processes for safety equipment designed to mitigate the possibility of a serious injury.

“Employees and site leaders work together to increase safety awareness, and it’s made a noticeable difference during the last five years,” Ellmore said. Injuries that result in lost work time have been slashed nearly 60 percent—even as production rates increased. Employee teams are active in monitoring progress and identifying other areas for improvement.

“Identifying safety risks and taking action are key,” said Obie Jones, director of operations, Boeing Military Aircraft Operating Executive organization. “Because we trust one another, we can look for and solve potential issues and move on. It’s good for everyone.”

It’s a similar story of safety improvements for Boeing Research & Technology, the company’s advanced research group, where injuries that result in lost work time were cut by 20 percent in 2012, according to Mark Burgess, chief

PHOTOS: (From far left) A customized chair allows painter Greg Bracelen to work underneath a 737 fuselage without the strain of bending or reaching in awkward positions; the task of tightening strut links was moved from inside the 737 wing to outside, helping eliminate work in a confined space for mechanics such as Mike Dawley; mechanic Dan Lingle in 737 Final Assembly uses an electronic bolting tool that reduces muscle and joint stress and fatigue. **MARIAN LOCKHART/BOEING** Sealer Tami Wagner places a safety cone to alert 737 final assembly workers to potential trip and fall hazards. **JIM ANDERSON/BOEING**



engineer for Engineering, Operations & Technology.

“Boeing is doing excellent work to continually reduce the risk of injuries in our factories, but a researcher sitting at a laboratory workbench needs to be just as mindful of his or her safety,” Burgess said.

The research group includes 162 laboratories, with employees at all major sites and many smaller facilities across the company. They conduct monthly safety assessments of each lab and quarterly inspections of each office environment. Its geographically dispersed sites share lessons learned and best practices through safety meetings and a newsletter that every employee receives.

A key safety project is Lean Labs, which has helped improve safety in 25 labs since 2011. Improvements include designing variable workstations with adjustable desks and chairs, and placing heavy or awkward objects on wheeled or hydraulic carts for easier movement.

“We don’t go into labs and tell employees how to do their jobs better. We point out waste and help them not work as hard,” explained Bill Mountain, Lean Labs leader.

The 737 safety program is based on the principle of continuous improvement, and “it permeates the whole environment,” said Les Weige, director of 737 Environment, Health and Safety. “It also means we empower each employee to take an active role in creating a safer workplace.”

In Wing Laydown, for example, an employee team led the process to relocate the task of torquing a strut link from inside the wing’s confined space to outside, eliminating the need for employees to contort themselves into awkward positions. Another employee team designed a better wire bundle installation process that reduced stress and ergonomics injuries to electricians’ hands and wrists. And numerous tool and process changes are reducing the risk of ergonomics injuries in the 737 paint hangars. Safety education also is being expanded to include online videos.

Safety leaders say it’s vital that employees know their safety concerns are being heard and addressed.

“We don’t let safety issues get pushed into the shadows,”

said Bill Easley, a 737 safety manager.

Safety improvement progress, he added, is tracked and visible through several major systems, regular safety meetings and factory walks.

Eric Lindblad, vice president of Manufacturing Operations for the 737 program, said creating a safer work environment also means watching out for a co-worker’s safety.

“It’s not only about me,” Lindblad said. “It’s equally important to check and see if the people around us are doing things in the safe way. Safety has to be part of everything we do every day, all day.”

Dave Pasillas, mechanic in 737 Wing Laydown, agreed. “No one can force you to be safe. You have to make that decision on your own. When team members together make a decision to look out for each other, we come together stronger than before.” ■

patrick.a.summers@boeing.com

For more about safety, see story on Page 7.

PHOTOS: (From far left) Adjustable workstations in the Boeing Research & Technology composite laboratory at the Ridley Park site near Philadelphia help technicians such as John Delconte reduce ergonomics injuries. **FRED TROILO/BOEING** A small light attached to his face mask helps mechanic Mike Dawley better see the task at hand and reduce potential safety risks. **MARIAN LOCKHART/BOEING** Lab engineer Ben Lavalée, background, and technician Ed Palmer slide large plates onto a rack equipped with ball bearings that reduce the strain of moving heavy objects at the Ridley Park composite laboratory. **FRED TROILO/BOEING** Electrician Monica Sherman covers a rail track to reduce the risk of trip and fall injuries in 737 Final Assembly. **MARIAN LOCKHART/BOEING**

**“WE MUST
TRANSFORM
BOEING INTO
A LEADER IN
WORKPLACE
SAFETY, JUST
AS WE ARE
IN PRODUCT
SAFETY.”**

*– John Tracy, chief technology officer
and senior vice president of Engineering,
Operations & Technology*



OUT OF THIS WORLD

Boeing's satellite-making business continues to build on a legacy of great accomplishment—and innovation

By Eric Fetters-Walp and Diana Eastman
Photos by Bob Ferguson

Design and build a satellite that's durable enough to survive the violent shaking and noisy roar of a ride atop a rocket. Once it arrives at its orbital destination, it must survive inhuman temperature changes, extreme radiation and collisions with debris while orbiting at almost 7,000 mph (11,300 kilometers per hour).

And all of its sophisticated electronics and moving parts better work reliably for at least 15 years—because they can't be fixed 22,300 miles (35,900 kilometers) above Earth.

"We only get one attempt to do it right. Once it's on orbit, it's got to work," said Anthony Pirozzi, director of Spacecraft Integration, Test and Launch at Boeing's Satellite Development Center in El Segundo, Calif.

That's been the mission since Syncom, the world's first geosynchronous communications satellite, was built at the El Segundo plant 50 years ago.

Today, the expertise of the 5,500 employees at the El Segundo site in designing

and building satellites for both commercial and government customers has enabled Boeing Space and Intelligence Systems, part of Defense, Space & Security, to grow its business in recent years despite fierce global competition.

"We have contained costs and improved our efficiency in order to become more affordable," said Craig Cooning, vice president and general manager of Space and Intelligence Systems.

"We also expanded our product portfolio to introduce an unprecedented two satellite designs in three years—including the industry's first all-electric satellite—and we have renewed our pursuit of the commercial market," he said. "We have been rewarded with a steady amount of new business, resulting in more than 20 satellites ordered over the past four years."

Boeing's legacy of communications satellite development began in El Segundo in 1961 when Howard Hughes formed Hughes Space and Communications Co. as part of Hughes Aircraft. The plant was

formerly operated by General Motors and had been the birthplace of the Nash Rambler. Instead of cars, the Hughes plant produced satellites that changed the world and how people live, travel and communicate. Following Syncom, the newly established factory built Early Bird, the first commercial communications satellite.

Boeing acquired Hughes Space and Communications in 2000.

All of the complex spacecraft built at the satellite facility, some of which end up larger than school buses, begin with tiny pieces assembled in the Microelectronic Circuits Laboratory.

Emma Chisholm, a microwave circuit technician, said the assembly process has changed as much as the satellites. She used to manually, with much patience, fit together wires, microchips and other electronics. But now she can direct a machine to do most of that precision work.

"We've come a long way," said Chisholm, who's worked at the site 33 years. "This is a field that, when I was in high school,

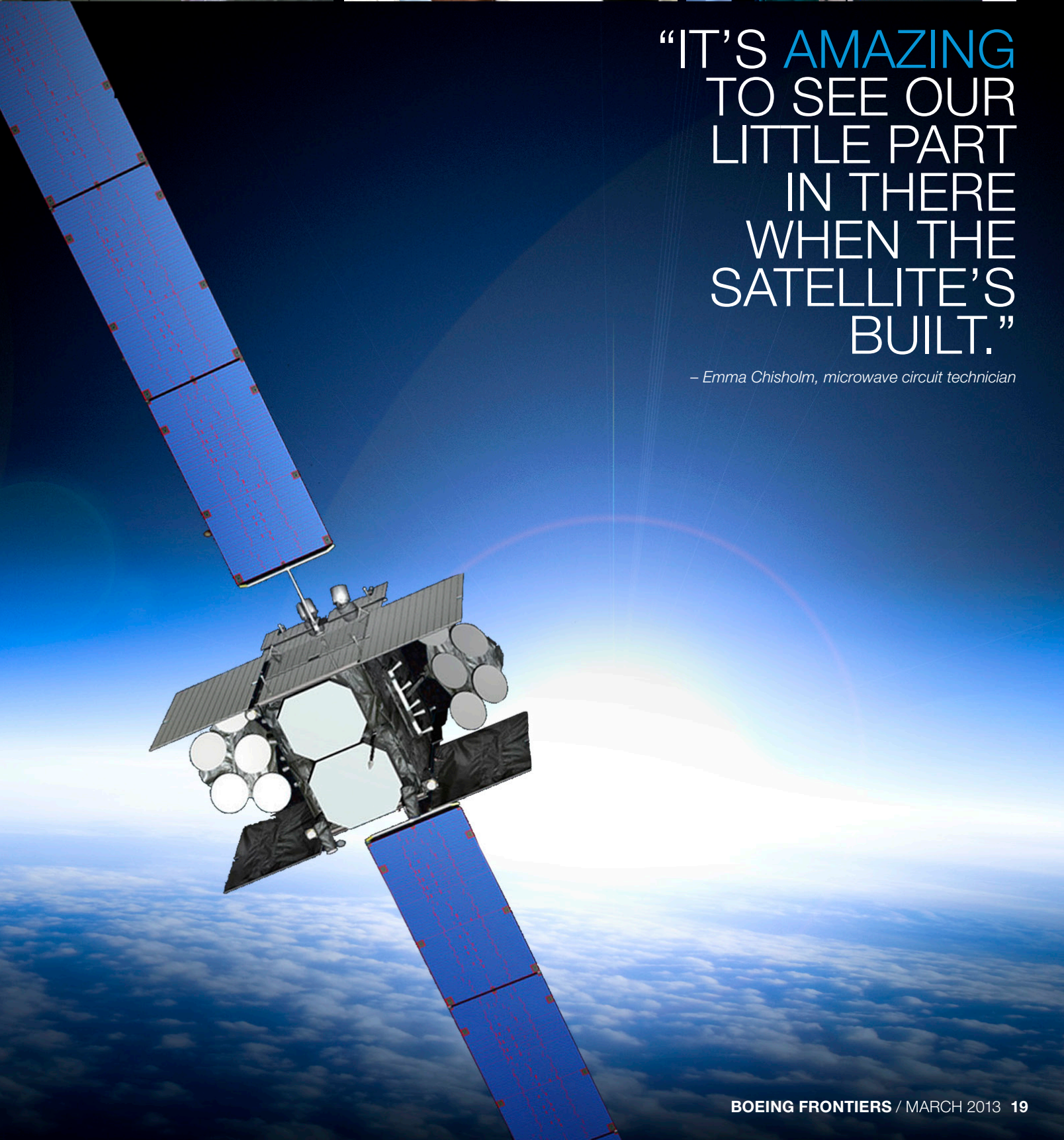
PHOTO ILLUSTRATION: (Above) An artist's concept of the Wideband Global SATCOM satellite, a Boeing 702 high-power communications spacecraft built for the U.S. Defense Department. **BRANDON LUONG/BOEING; SATELLITE PHOTO: BOEING; BACKGROUND: SHUTTERSTOCK**

PHOTOS: (Insets, from left) Varen Keshishi, left, and Steven Wong evaluate acoustic test requirements; Doris Brown assembles small electronics; Michael Langmack, left, and Grace Leung design satellites to customer specifications. **BOB FERGUSON/BOEING**



“IT’S AMAZING
TO SEE OUR
LITTLE PART
IN THERE
WHEN THE
SATELLITE’S
BUILT.”

– Emma Chisholm, microwave circuit technician





I never thought I'd be in. But I love it, and it's amazing to see our little part in there when the satellite's built."

A spacecraft's two main parts are assembled separately before being joined in the satellite assembly area. The "bus" contains the propulsion engines, avionics and stability controls, solar wing controls and power systems. The "payload" is the half of the satellite that generates revenue for its owner and contains the computers, antennas, reflectors and other equipment that perform its mission.

"The electronics are getting more advanced, so you can do more things with the payloads now in half the space it used to take," said Jeff Riglin, who's worked 22 years for Boeing. He's a technician in the facility's high-bay area, where satellites are completed and spend their final months before being moved out for launch.

Before leaving the factory, however, each satellite goes through rigorous testing. Thermal vacuum chambers simulate on-orbit conditions; large vibration tables can re-create intense shaking; and the acoustic chamber subjects the satellite to the roaring noise it will experience

riding atop a rocket. Deployment of the solar wings, moving antennas and signal transmitters also are tested.

Alejandra Ramirez, a Quality Assurance engineer in the Satellite Development Center, adds her critical eye to make sure everything's put together right. While growing up not far from the factory, she showed an early knack for mechanical things.

"I grew up with guys—brothers, cousins, neighbors—and they used to call me a Miss Know-it-all because I liked to fix things," said Ramirez, who interned during college at Boeing and came to work full time six years ago.

As a quality inspector, Ramirez admitted she's not always everyone's favorite co-worker, "but it's better if we find a problem rather than the customer."

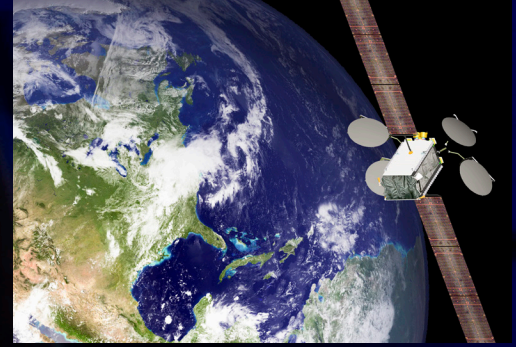
Once a satellite arrives at its launch site, it is inserted into a rocket and blasted into space. Employees with Space and Intelligence Systems help shepherd many satellites into service from the Mission Control Center in El Segundo. That's where employees work in shifts around the clock to make sure the satellite ends up in the right orbit and is operating flawlessly before

DID YOU KNOW

- One-fourth of the approximately 290 commercial satellites in orbit worldwide were built at Boeing's El Segundo, Calif., site.
- The satellite factory—part of which was built in 1948 as an American Motors Corp. factory to produce Nash Rambler cars—covers 1 million square feet (93,000 square meters), or just more than 22 U.S. football fields. It is the world's single-largest satellite factory.
- The factory's high bay, the 60-foot-high (18-meter-high) area where satellites go through testing and final assembly work, is 1,000 times cleaner than a typical household interior. The environment is strictly controlled 24 hours a day, every day of the year.
- Boeing satellites typically weigh about 6,500 pounds (3,000 kilograms) in orbit, about the same weight as a Chevrolet Suburban sport utility vehicle.
- The "wingspan" of a Boeing 702 satellite's solar array, when fully unfolded, extends 135 feet (41 meters), or 10 feet (3 meters) longer than the wingspan of a 757 jetliner.
- The exterior of a satellite in orbit can exceed 200 degrees Fahrenheit (93 Celsius) when in the sunlight. In the shadow of Earth, the satellite's surfaces can plummet to 200 degree below zero Fahrenheit (-129 Celsius).

PHOTOS: (Below) Integration and test employees deploy and inspect a solar-power array on a 702 satellite. **(Insets, from top)** Bobby Dorsey monitors placement of electronic parts; Gregory Thomke, left, and James Colln assemble a payload panel module; Angela Mather inspects a wire harness. **BOB FERGUSON/BOEING**





“THE ELECTRONICS ARE GETTING **MORE ADVANCED**, SO YOU CAN DO MORE THINGS WITH THE PAYLOADS NOW IN HALF THE SPACE IT USED TO TAKE.”

– Jeff Riglin, senior mechanical technician

it's handed over to the customer.

It takes a roomful of engineers and an ample supply of M&Ms, the candy that's traditionally on hand for every launch. Franz Kerekes, mission systems engineer at the Mission Control Center, said the goal is to have an uneventful launch and placement into orbit. But the team learns more when an issue arises.

“The most interesting time is when there's an issue and you have to try to figure out what happened,” he said. “There's a sense of purpose and passion from that, and you get to see some really smart people shine.”

In a nearby building, other engineering teams have piqued customer interest with two new satellite designs—the 702MP (medium power) and the all-electric 702SP (small platform). These satellites are part of an aggressive effort by Space and Intelligence Systems to expand its commercial satellite business.

“What we've been able to do is bring a smaller, less expensive satellite to the market,” said Michael Langmack, a mechanical design engineer, adding that Boeing is able to take advantage of smaller, innovative technology in the new designs. For example, the all-electric 702SP uses only electric thrusters, meaning it takes more time to place into orbit than one with fuel-powered thrusters, but customers are willing to wait in exchange for the cost savings that result from the absence of fuel, which adds weight and mass to the spacecraft.

The Space and Intelligence Systems

market strategy also includes offering customers hosted payloads, in which a second payload is added to a commercial satellite. Buying space on an existing satellite is an economical choice for government and business users because they can get into service faster and at less cost. And a hosted payload means additional revenue for the commercial satellite owner. Space and Intelligence Systems first built hosted payloads 20 years ago, but reintroducing them at a time when government budgets are shrinking has helped attract new orders.

Related technology also is progressing 30 miles (50 kilometers) north of El Segundo at Spectrolab, a wholly owned Boeing subsidiary overseen by Space and Intelligence Systems and based in Sylmar, Calif. For the past 57 years, it has improved solar cell efficiencies, delivering more than 3.5 million gallium-arsenide solar cells. Mark Gillanders, a Spectrolab program manager, said the amount of solar power converted by the cells into electricity has improved from 12 percent to an industry-leading 30 percent or more since the 1970s.

In Spectrolab's recently expanded facility, photovoltaic solar cells are grown on germanium wafers under exacting conditions, similar to the traditional process for making semiconductors. After the wafers are turned into individual solar cells, they are affixed and wired onto solar panels, which comprise the large wings that power satellites. Between making cells to meet Boeing's increasing satellite orders and introducing cutting-edge



PHOTOS: (Right) From the Mission Control Center in El Segundo, Calif., engineers Franz Kerekes (clockwise from left), David Choi, Stacia Long, Galen Stevens, Hiral Desai and Robert Whitehill can monitor a satellite's position in space. **(Insets, from left)** Mission engineers Shen Qu, foreground, and Doug Chin check telemetry data from a satellite; Greenwich Mean Time clocks keep teams in sync as they execute time-critical actions on the spacecraft. **BOB FERGUSON/BOEING**

GRAPHIC: (Top right) Artist's concept of the all-electric, 702 small-platform satellite. **JOHN RANKIN/BOEING**





products for other customers, the business is growing, said Jim Hanley, Spectrolab's panel operations manager.

"We're counting on big things here," Hanley said.

As Space and Intelligence Systems employees prepare to celebrate the 50th anniversary of Syncom later this year, they are looking forward to future successes.

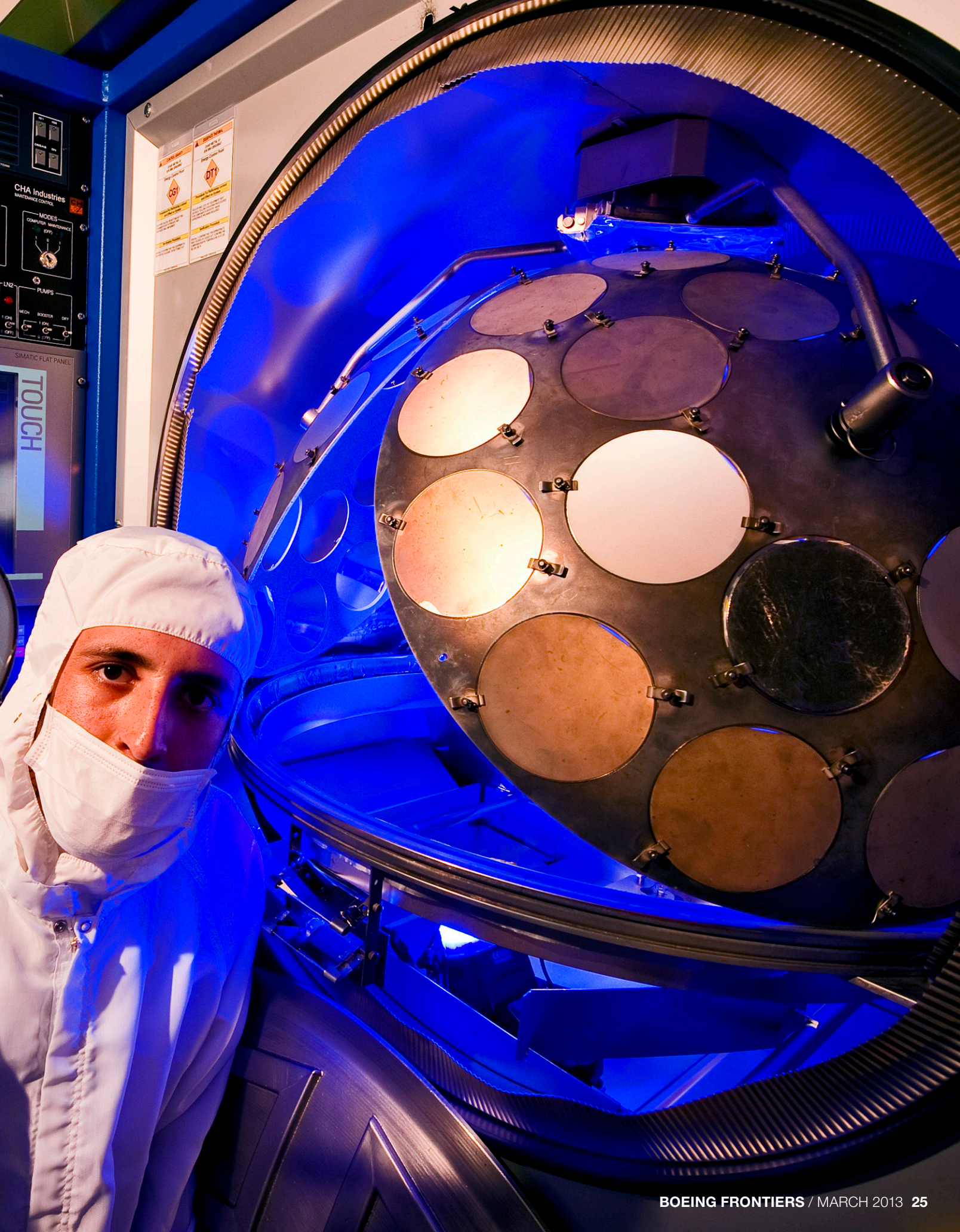
"It's amazing to see the evolution of the technology and to see what we can offer our customers as their needs evolve," said Tiana Preston, manager of Payload Integration.

Pawel Gwizdala, a supply chain management analyst who joined Boeing last year, said the growth in orders is promising for new employees like him.

"We are selling different satellites to

PHOTOS: (Right) Spectrolab manufacturing technician Michael Basura displays a solar cell wafer after it received a metal coating. **(Insets, from top)** At Spectrolab, Veronica Anguiano, left, and Harold Milinkovich review solar array drawings; Enrique Guevarra holds a solar cell; Alicia Valenzuela, wafer manufacturing supervisor, inspects a photomask used in wafer production.

BOB FERGUSON/BOEING



CHA Industries
MAINTENANCE CONTROL

MODES
COMPUTER MAINTENANCE (CM)

PUMPS
1 ON
2 OFF

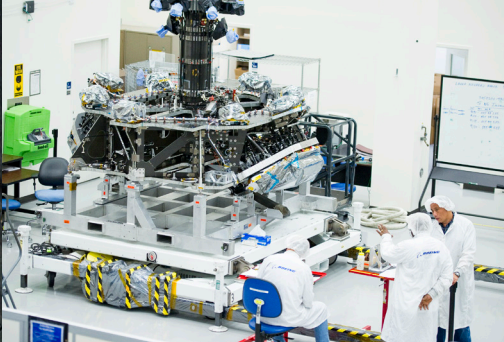
BOOSTER
1 ON
2 OFF

SIMATIC FLAT PANEL

TOUCH

WARNING
HOT SURFACE
DO NOT TOUCH

CAUTION
ELECTRIC SHOCK
DO NOT TOUCH



new customers and repeat customers—some we haven't sold to in a while—and we constantly get announcements over the intercom about a new order or the latest launch," Gwizdala said. "Small and all-electric satellites are the future, and no one else can compete with the different satellites we have designed."

Deran Bell, a solar array manufacturing supervisor in the Satellite Development Center, said that after 20 years with Boeing, he never tires of seeing the complex, multimillion-dollar spacecraft come together in the factory.

"It still amazes me on a daily basis that the parts we put together all form a satellite,"

Bell said, noting that the world would not be the same without the Boeing-built products. "Think about all the things that would shut down if it weren't for satellites." ■

*diana.b.eastman@boeing.com
eric.c.fetters-walp@boeing.com*

PHOTOS: (Below) Employees check the battery inside a Wideband Global SATCOM satellite. **(Insets)** At any time, more than a dozen satellites are in construction throughout the factory. From left, the payload module of a 702 satellite is assembled; employees check test instructions. **BOB FERGUSON/BOEING** Reflectors (above right) are opened and then stowed on two spacecraft. **JOSHUA HILL/BOEING**

ABOVE & BEYOND

Boeing's current satellite programs include the following:

Wideband Global SATCOM, or WGS

WGS is the highest-capacity military satellite communications system fielded by the U.S. Department of Defense, based on the 702HP (high power) platform. When Boeing was initially awarded the contract, WGS was intended to be a "Gapfiller" of only three satellites. Four such satellites are on orbit, with six more ordered.

Global Positioning System – Perhaps the best-known satellite system in the world, GPS provides worldwide navigation for the military, civilians and commercial services. Boeing has been the prime contractor for GPS programs since 1974 and is under contract to the U.S. Air Force to build 12 next-generation GPS Block IIF satellites, three of which already have been launched.

Tracking and Data Relay Satellites

NASA has ordered three next-generation tracking and relay satellites to provide crosslink communications capability between Earth-orbiting spacecraft and control-and-data-processing facilities on the ground. The

company previously built the three satellites in the TDRS H, I and J series for NASA's Goddard Space Flight Center. Boeing has supported NASA's key programs for more than four decades.

Asia Broadcast Satellite and Satélites Mexicanos

– The two companies jointly placed an order last year for four 702SP (small platform) telecommunications satellites, the first for the lightweight, all-electric propulsion spacecraft. The order includes options for four more 702SP satellites.

Inmarsat – Based in the United Kingdom, Inmarsat placed orders in 2010 for three Boeing 702HP satellites, which will provide high-data-rate mobile communications services. The satellites will join Inmarsat's fleet of 10 geostationary satellites in providing a wide range of voice and data services around the globe, as well as carry Ka-band hosted payloads.

Intelsat – The world's leading provider of fixed satellite services and a longtime Boeing customer, Intelsat became the first to order the 702MP (medium power) satellite, with a four-satellite purchase in 2009. With two already

on orbit, the 702MPs are adding new capacity to Intelsat's satellite fleet to distribute video, network and voice services from Asia and Africa to the Americas and Europe.

Mexican Satellite System, or MEXSAT

– Mexico has ordered a complete telecommunications satellite system consisting of two Boeing 702HP satellites, a satellite from Orbital Sciences Corp. for fixed satellite services, two ground stations with a spacecraft operations center in Mexico, and related equipment. The MEXSAT system will relay civil voice and data communications in urban and remote areas throughout the country by the end of 2014.

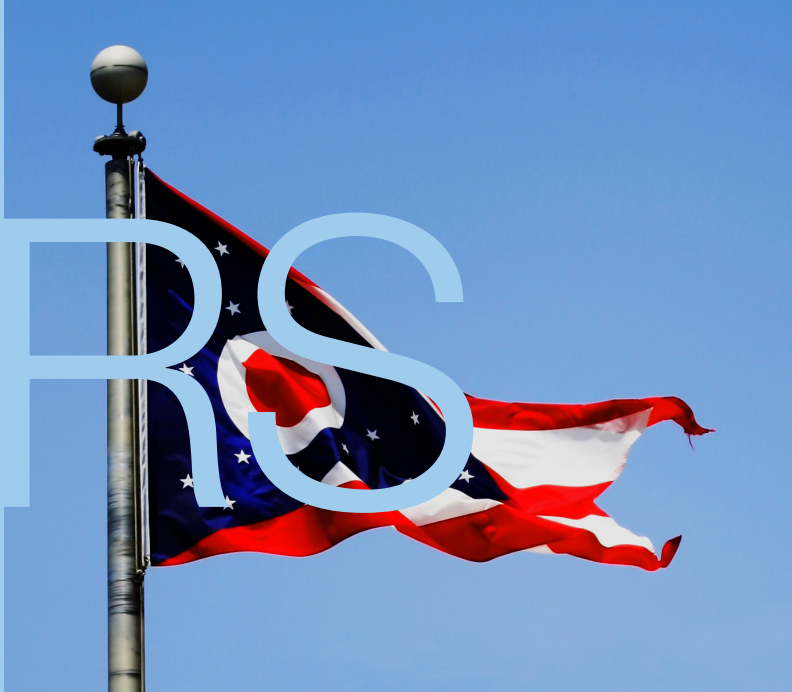
SES – Continuing a relationship spanning more than 25 years, SES returned to Boeing in 2012 and ordered a 702HP satellite to provide Ku-band direct-to-home and maritime communication services. A world-leading satellite operator based in Luxembourg, SES also signed an option for a second satellite. The new satellites will join the SES fleet of 52 geostationary satellites that provides a far-reaching infrastructure that enables its customers to reach 99 percent of the world's population.

"IT STILL **AMAZES** ME ON A DAILY BASIS THAT THE PARTS WE PUT TOGETHER ALL FORM A SATELLITE."

– Deran Bell, solar array manufacturing supervisor

STARS

in a supporting role



Small Ohio site's employees play big role building, servicing and upgrading complex missile, submarine and aircraft systems

By Diane Stratman



Heath, Ohio, offers the simpler life that is typical of many Midwestern towns in the United States. It has that friendly small-town feel where folks might relax on the front porch on warm summer evenings, locals are eager to give the scoop on the best produce around, and where a traffic jam is getting stuck behind a slow-moving farm tractor.

By contrast, Heath is also home to a Boeing facility where more than 400 employees perform highly complex work on sophisticated aircraft, missile and submarine systems. The site is Boeing's designated Strategic Fabrication Center where employees manufacture, repair and overhaul various electronic and mechanical systems for the U.S. Navy, Air Force and allied nations.

"People are often surprised that in a factory that borders soybean and corn fields, work is being done on many of the military's most complex electronic and mechanical systems," said





PHOTOS: (Left) The Ohio state flag. **THINKSTOCK (Middle row, left)** Employees at the Boeing Heath site maintain the gyro navigator used on U.S. Navy nuclear ballistic missile submarines such as the USS *Rhode Island* (shown). **U.S. NAVY (Employee portraits, from top)** Product repair and modification technicians Christina Rhodeback, Andrew Taylor and Curtis Puryear. **BOB FERGUSON/BOEING**



Daryl Dickerson, an engineer who tests and repairs electrostatically supported gyroscopes at Heath. They are used in navigation systems for the Navy's nuclear Trident submarine fleet.

"We are keenly aware that the work we do, among other things, plays an important role in deterring the nuclear threat to our country," Dickerson said.

Boeing technicians at the Heath site also test, repair and calibrate almost every type of military aircraft guidance and navigation system. They keep in perfect working order inertial navigation units for Boeing fighters, bombers and transports used by the U.S. and allied militaries, as well as the Lockheed F-16, C-130 and Northrop B-2. They do the same for the U.S. Air Force's Minuteman III intercontinental ballistic missiles.

"We may not build the big military planes that some of Boeing's larger sites are known for, but the work done here plays an impor-

tant role in defending freedom," said Mark Miklos, chief engineer and mission assurance manager. "It's work that can't adequately be taught in a classroom, more like that of a craftsman who learns not just how to do a job but is trained over years to do it with precision and exacting attention to detail."

Ellen Power, recently named Heath Center director, stressed how critical the work done at the site is.

"The people at this site are dedicated and committed to providing quality products to the warfighter," she said. "In the short period that I have been here, I have seen this dedication through the pride and ownership every person puts into the products they repair."

In June, Heath was named the modification and repair depot for the Navy's Trident Navigation System for the Trident missile, a submarine-launched ballistic missile. That's part of the work Dickerson does.

The U.S. Navy's Ohio-class submarines have been patrolling



STARS

in a supporting role

the world's oceans carrying Trident missile systems for more than 30 years, serving as a deterrent against enemies," noted Don Brown, program manager, Integrated Shipboard Systems.

"As the only location repairing the navigation gyros for the nuclear fleet ballistic missile submarines, we're helping maintain the most accurate inertial navigation system ever deployed," Brown said.

A Heath team also maintains the U.S. Air Force's Minuteman III intercontinental ballistic missiles and builds a sophisticated system for the missile that collects data during flight tests.



Technician Kevin Miller leads the assembly, disassembly and modification of intercontinental ballistic missile systems, and he's also maintained guidance systems for the Fairchild A-10, used for close air support of ground troops, and the Lockheed F-16 fighter.

"Every day, I go to a job that reminds me of the men and women who are out there on the front lines risking their lives for me, my teammates, our friends and families," Miller said. "Ground troops obviously need air support for successful missions. It's properly maintained guidance systems that provide that support. And its Heath employees who keep those guidance systems in perfect working order."

Dennis Wolfe, an aircraft technician who repairs gyros, inspects bearings and rebuilds rotors, echoed that same sense of pride in what Heath employees do.

"I always think about the pilot who climbs into one of the aircraft that we support. He or she is thinking about the mission at hand,





PHOTOS: (Clockwise from far left) Daryl Dickerson, product review engineer. BOB FERGUSON/BOEING The Heath site is responsible for all repair and maintenance of the Minuteman III intercontinental ballistic missile guidance system, an element of the nation's strategic deterrent forces. U.S. AIR FORCE Becky Aberegg, product repair and modification technician; Eric Murillo, left, product review engineer, monitors the performance of a displacement gyro at a calibration station as product repair and modification technician Peggy Cannon looks on; Cheryle Wilson, product repair and modification technician. BOB FERGUSON/BOEING



“The work done here plays an important role in defending freedom.”

– Mark Miklos, chief engineer and mission assurance manager



not about gyros, bearings or rotors. That’s our job,” Wolfe said.

The Heath team also performs production, repair and spares work on subsystems for Boeing’s Airborne Warning and Control System (AWACS) aircraft, which provide surveillance, command-and-control and communications functions for U.S. and allied tactical and defensive missions.

Doug Clark, a technician who builds, repairs and assembles the antenna systems and electronics for AWACS aircraft, said he’s proud not only of the behind-the-scenes role he and his team play in the country’s defense but of the reputation Heath has with its military customers.

“We do a great job for our customers,” Clark said. “We consistently provide them with the products they need, often ahead of schedule and below budget.”

Meanwhile, Heath provides Clark and other employees a quality



STARS

in a supporting role

of life that's also very important to them.

"With so much high-tech responsibility on their shoulders, "Heath's small-town feel comes in handy," Clark said. "The hustle and bustle of the big city just isn't here, no real traffic jams, a lot of rolling hills and countryside."

Added Christopher Devillers, a repair and modification technician, "We're a very tight group here at Heath ... everyone knows just about everyone else. In fact, some might even be neighbors." ■

diane.l.stratman@boeing.com



PHOTOS: (Employee portraits, from top) Product repair and modification technicians Earlene Morton; Todd Armentrout, communicating from within a clean room work area; and Dennis Wolfe. **BOB FERGUSON/BOEING (Middle row, right)** Employees in Heath, Ohio, perform production, repair and spares work on subsystems for Boeing's E-3 Airborne Warning and Control System aircraft, such as the NATO aircraft shown. **BOEING**





Supply in demand

Supplier Management transformation cuts costs and improves efficiencies

By Antonella Bellman

Last year, more than 1,000 jet aircraft engines left the GE Aviation plant in Peebles, Ohio, on flatbed trucks that headed west toward Washington state.

From the foothills of the Appalachian mountains, the engines were transported some 2,400 miles (3,900 kilometers) to Boeing's commercial jetliner plants in Renton and in Everett, where they are used on all the company's 7-series jets—737, 747, 767, 777 and 787. It's a trip that typically takes about four days. Those engines, worth millions of dollars each, include the GE-90-115B, the world's most powerful commercial jet engine, each delivering some 115,000 pounds of thrust (510 kilonewtons) for the 777.

Making sure all the engines get to the Boeing plants on time is essential for the company to maintain its production schedules and meet customer demands as production rates go up. But getting components needed for assembly to Boeing factories takes more than simply contracting with a transportation service. It takes a team of employees from Supplier Management and Supply Chain Logistics, both part of the Shared Services Group, who know the ins and outs of the freight and logistics industry.

"While we don't purchase the engines that go onto Boeing planes, we are responsible for finding and contracting with freight

PHOTO: After a four-day trip from Peebles, Ohio, GE aircraft engines arrive just as the sun comes up in Everett, Wash.

GAIL HANUSA/BOEING



“Approaching our suppliers as One Boeing allows us to leverage savings, improve quality and be more efficient.”

– Delores Alexander, IT leader for Supplier Management

companies that have the ability to transport large equipment, such as jet engines,” said Daniel Yoo, freight category leader with Supplier Management. “We partner with Supply Chain Logistics to ensure we select the right supplier so products arrive undamaged and on time, and we get the best value for Boeing.”

As Boeing looks for ways to improve its competitiveness, the Supplier Management organization is undergoing a transformation and changing the way it does business to become even more efficient—and get the best value for the company. These changes include reducing the number of suppliers with which Boeing does business.

Boeing purchases fall into two types: items that are a part of the Boeing products that get delivered to customers, and the items and services that help move Boeing products out the door to customers. Supplier Management purchases the latter, known as non-production goods and services.

The 275 employees in Supplier Management purchase such things as factory tooling equipment, safety gear for employees, information technology software used on Boeing computers, hand tools—even the pens Boeing employees use every day.

Purchasing all of Boeing’s non-production goods and services is a big job that involves the efficient management of billions of dollars in annual company spending.

Using an approach known as Strategic Contracting & Category Management, purchases are grouped into categories—IT applications and hardware, freight, facilities services, travel, and maintenance,

repair and operating supplies. Category leaders are responsible for bringing together employees from various Boeing organizations to create a purchasing strategy for their area. Together, they analyze data and determine what to buy from the more than 30,000 suppliers in Boeing’s database, based on the needs of the company.

Once a decision is made, the team has several purchasing methods to get the best possible price for Boeing. Today, almost 80 percent of Boeing’s contracted spending is done through competitive bidding—an increase of nearly 30 percent over one year ago.

In the past year, the IT category team has been able to significantly reduce costs for the company by going to market as “One Boeing.”

“By working together as one company instead of as fragmented groups, the team was able to consolidate our contracts and receive enterprise volume discounts,” said Delores Alexander, IT leader for Supplier Management. “Approaching our suppliers as One Boeing allows us to leverage savings, improve quality and be more efficient.”

Supplier Management will begin implementing another phase of its strategy this year—reducing the number of suppliers doing business with Boeing.

For example, the Maintenance, Repair and Operating supplies category has thousands of suppliers. But 90 percent of Boeing’s purchasing is with only 10 percent of them.

Bobby Fales, the category leader for operating supplies, explained the need for streamlining.

“We currently have 200 screwdrivers in our online catalog,” he explained. “By reducing the number of items available for ordering, we make it easier and faster for employees to find what they need.”

Doing business with fewer vendors helps Boeing build relationships with suppliers, so they become partners, working together to reduce costs from sourcing to delivery to the internal use of non-production goods.

When it comes to getting airplane engines delivered on time, working with fewer, key suppliers has other advantages, Yoo said.

“We’ve designated some suppliers as ‘core carriers,’ which means they have the right equipment and skilled drivers to safely transport Boeing goods,” Yoo said. “In turn, these core carriers can invest more in their business with the confidence that Boeing wants—and needs—them to succeed.” ■

antonella.bellman@boeing.com

PHOTOS: (Above left) A forklift purchased through Supplier Management makes it easy to transport an engine into the Everett, Wash., factory for assembly onto a Boeing 777. **GAIL HANUSA/BOEING (Right)** Jack Stendahl, left, and Gil Molinari, both with Propulsion Systems in Commercial Airplanes, load an engine into an engine buck purchased through Supplier Management. An engine buck is used to move the engine in the factory to the production line so it can be installed on a 737. **MARIAN LOCKHART/BOEING**



UN 34002000 P-7
SN 31573725

UN 34002000 P-7
SN 31573725

CAUTION
DO NOT OPERATE
UNLESS PROPERLY
EQUIPPED

FWD →

FORK LIFT

3 MPH
MAX
SPEED



SPREADING ITS WINGS

With new Boeing 737s on the way, SilkAir looks to expand its reach

By Wilson Chow

From its beginnings as a leisure carrier serving a handful of exotic destinations, SilkAir has grown to become one of the leading regional airlines in the world.

SilkAir, the regional wing of Singapore Airlines, now operates 300 weekly flights to 42 destinations in a dozen countries, with Singapore as its hub. Last year alone, SilkAir added to its network Darwin, Australia; Wuhan, China; Hanoi, Vietnam; and Visakhapatnam, India.

That growth is planned to continue this year and beyond.

"With the positive long-term prospects for the Asia-Pacific air travel market, SilkAir is aiming for double-digit annual capacity growth over the next 10 years," said SilkAir Chief Executive Leslie Thng.

To take advantage of the opportunities in Asia, SilkAir will soon begin its most important transformation. The airline will

transition from its fleet of Airbus airplanes to Boeing. In November 2012, the airline ordered 23 Next-Generation 737-800s and 31 737 MAX 8s worth \$4.9 billion at list prices.

The first 737s are set to arrive in early 2014.

"The purchase of these new Boeing planes will enable us to spread our wings further to even more destinations and increase capacity on existing routes," Thng said.

The 737-800 has more range and can carry more passengers than the plane it is replacing, Thng noted.

Additionally, SilkAir passengers will experience the Boeing Sky Interior in the 737s. It features modern sculpted sidewalls and window reveals, LED lighting that enhances the sense of spaciousness, and larger pivoting overhead stowage bins.

"This year looks to be an exciting one for SilkAir as we gear up and lay the groundwork for the arrival of our new Boeing aircraft," Thng said. "Our vision is to be the world's leading regional full-service network airline." ■

wilson.chow@boeing.com



"The purchase of these new Boeing planes will enable us to spread our wings further to even more destinations and increase capacity on existing routes."

— Leslie Thng, SilkAir chief executive
PHOTO: SILKAIR

GRAPHIC: An artist's concept of a 737 MAX 8 in SilkAir colors. **BOEING**

The Silk road

1989 – Begins operations as Tradewinds the Airline, operating McDonnell Douglas MD-87 aircraft

1992 – Tradewinds renamed SilkAir

2005–2008 – Only regional airline to break into *Travel & Leisure* magazine's coveted list of world's Top Ten Airlines in 2005, 2006, 2007 and 2008

2007–2008 – Winner of "Best Foreign Route" Airline (outside the U.S.) Award in *Conde Nast Traveler's* Annual Readers' Choice Awards in 2007 and 2008

2011 – Named Regional Airline of the Year by Centre for Aviation

2012 – Orders 23 Next-Generation 737-800s and 31 737 MAX 8s and begins a fleet transition to Boeing airplanes

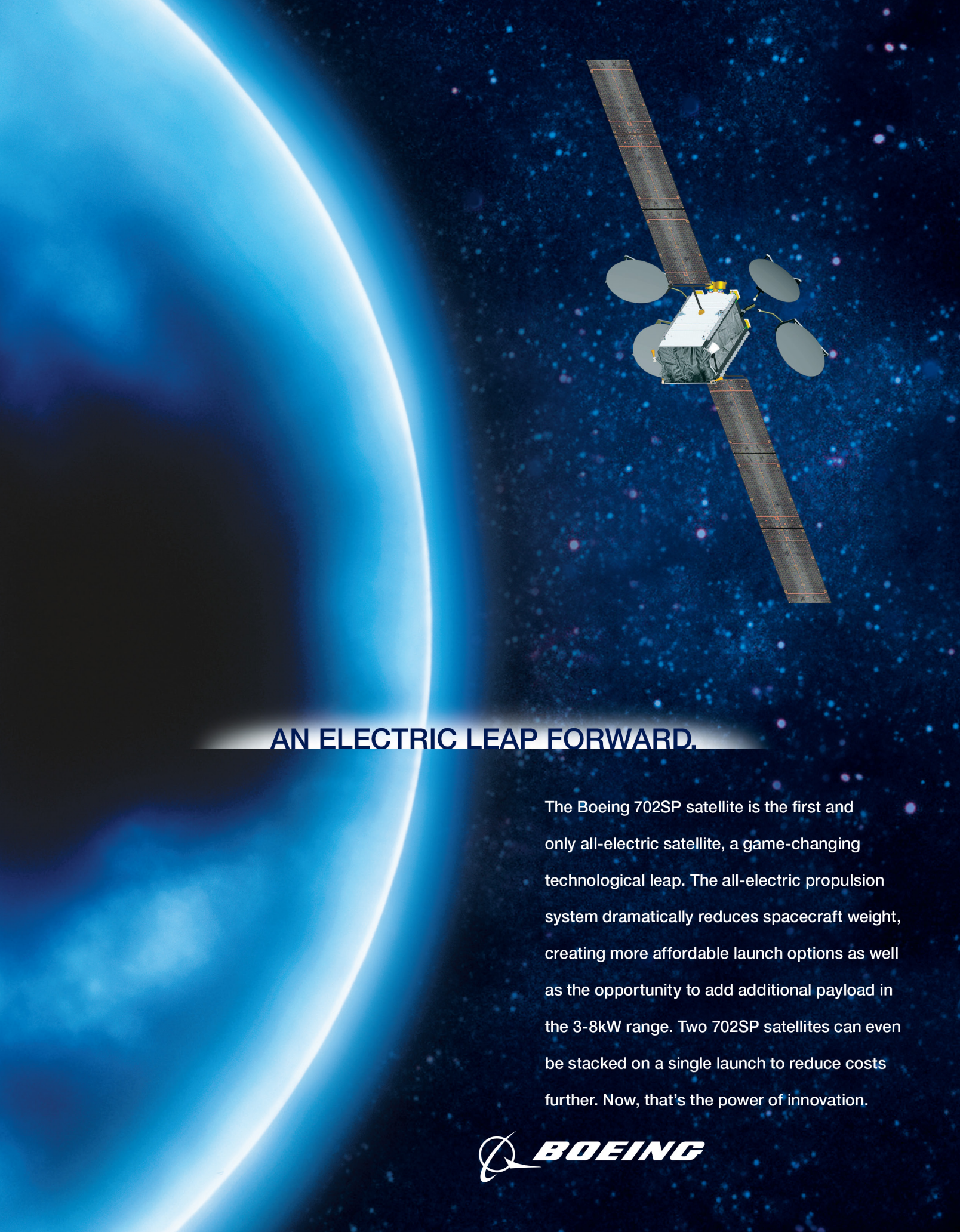
Flight of the Osprey

A U.S. Air Force CV-22A from the 71st Special Operations Squadron at Kirtland Air Force Base in New Mexico performs a training flight earlier this year over central New Mexico. The CV-22 is a special operations version of the Bell-Boeing V-22 Osprey. Another version, the MV-22, is operated by the U.S. Marine Corps. The V-22's unique tilt-rotor configuration gives it the capability to cruise like a fixed-wing aircraft and take off and land vertically like a helicopter. The Osprey has been used extensively on military missions in Afghanistan and Iraq.

PHOTO: JIM HASELTINE/HIGH-G PRODUCTIONS







AN ELECTRIC LEAP FORWARD.

The Boeing 702SP satellite is the first and only all-electric satellite, a game-changing technological leap. The all-electric propulsion system dramatically reduces spacecraft weight, creating more affordable launch options as well as the opportunity to add additional payload in the 3-8kW range. Two 702SP satellites can even be stacked on a single launch to reduce costs further. Now, that's the power of innovation.

