



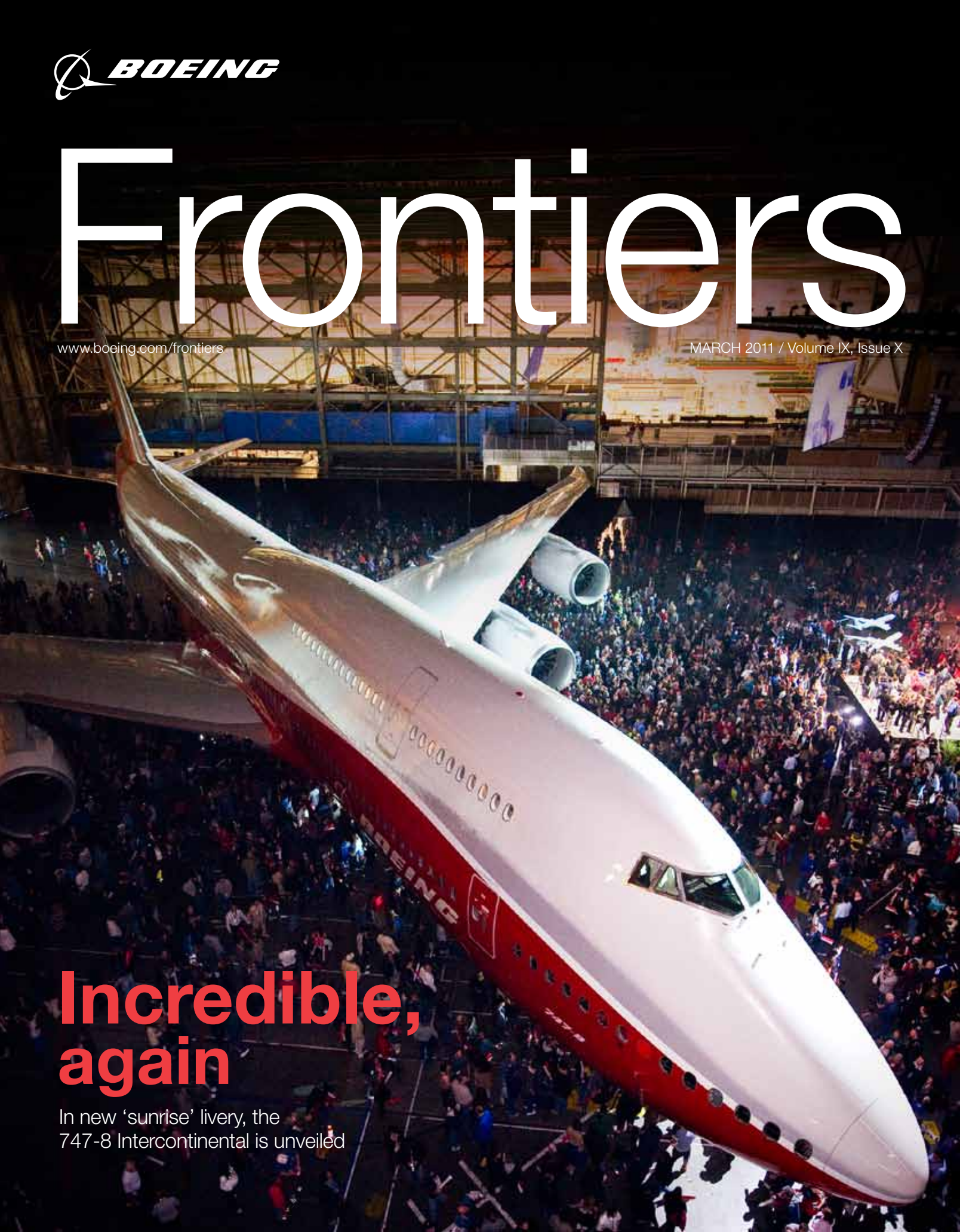
Frontiers

www.boeing.com/frontiers

MARCH 2011 / Volume IX, Issue X

**Incredible,
again**

In new 'sunrise' livery, the
747-8 Intercontinental is unveiled





Stacking the deck against American workers.

The World Trade Organization has rendered a final decision on European claims of U.S. government assistance to Boeing.

In a sweeping legal victory for the U.S., reports are the WTO has rejected all but a fraction of the EU's claims – some

\$2.6 billion worth. This stands in stark contrast to the WTO ruling last summer that found Airbus had received

\$20 billion in illegal European government subsidies to fund its family of commercial airplanes, including

\$5 billion in launch aid for the A330/A340 aircraft, which is the basis for the EADS/Airbus Tanker.

To date, illegal subsidies to Airbus have cost the U.S. tens of thousands of jobs and billions of dollars in lost exports.

Left unchecked, the cost to America and American workers will continue to rise.

On behalf of 151,000 Boeing employees and thousands of our suppliers in 50 states, we thank the U.S. government

for continuing to press the case for fair competition and a level playing field.



For more information visit boeing.com/WTO

Welcome to the family

The newest member of the Boeing commercial airplane family, the 747-8 Intercontinental is the biggest Boeing jetliner ever. At 250 feet (76 meters), it's about 18 feet (5.6 meters) longer than the 747-400. The Intercontinental features a new wing, engines, cockpit and interior. The upper passenger deck also is longer. The Boeing team that designed and developed it over five years overcame numerous challenges—and in the end delivered an incredible new airplane.

COVER IMAGE: THE FIRST 747-8 INTERCONTINENTAL IS UNVEILED TO 10,000 EMPLOYEES AND GUESTS LAST MONTH INSIDE BOEING'S EVERETT, WASH., PLANT. BOB FERGUSON/BOEING

PHOTO: AFTER THE UNVEILING CEREMONY, EMPLOYEES AND RETIREES, ALONG WITH FRIENDS AND FAMILY, SURROUND THE NEW 747-8 INTERCONTINENTAL JETLINER, WHICH SPORTED A LIVELY "SUNRISE" LIVERY. BOB FERGUSON/BOEING



Ad watch

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

Inside cover:



This ad spotlights the recent World Trade Organization ruling on European claims of U.S. government assistance to

Boeing. In a significant legal victory for the U.S., the WTO in January denied most of the EU claims. In contrast, a separate WTO ruling last summer found Airbus received about \$20 billion in illegal government subsidies.

Page 6:



This ad was created to support Boeing's bid for the Ground-based Midcourse Defense contract,

which is being re-competed. It highlights the proven experience of the Boeing-led team working with the Missile Defense Agency and is running in key regional, military and trade publications.

Page 14:



This ad celebrates the 2 million flight-hour milestone reached by the C-17 program in December. Two million

flight-hours equates to 1.3 billion miles (2 billion kilometers), or the equivalent of a C-17 flying to the moon and back 2,360 times. This ad appeared in *Flight International* and key military trade publications.

Back cover:



Part of a campaign illustrating Boeing's commitment to success through its partnership with India, this ad shows

the traditional Indian competition of boat racing, symbolizing teamwork and the sharing of common goals.



Frontiers

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

Art and design director:
Brandon Luong: 312-544-2118

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:
Geoff Potter: 312-544-2946

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

Staff writer:
Eric Feters-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)

table o



Teaming up

When the new 747-8 Intercontinental was unveiled last month, it was the culmination of a lot of hard work and long hours by Boeing teams from across the company. From the start they worked together as one and, as a result, were able to overcome many challenges and accomplish something special.

PHOTO: ED TURNER/BOEING



Bright from the start

It's a little-known fact, but Boeing subsidiary Spectrolab has long been the global leader in airborne searchlight systems, with a market share of almost 100 percent. Spectrolab's Nightsun searchlights are widely used by law enforcement and the military, including the U.S. Coast Guard. The California-based company first developed the lights to test its primary product: spacecraft solar cells.

PHOTO: BOB FERGUSON/BOEING



Dream flights

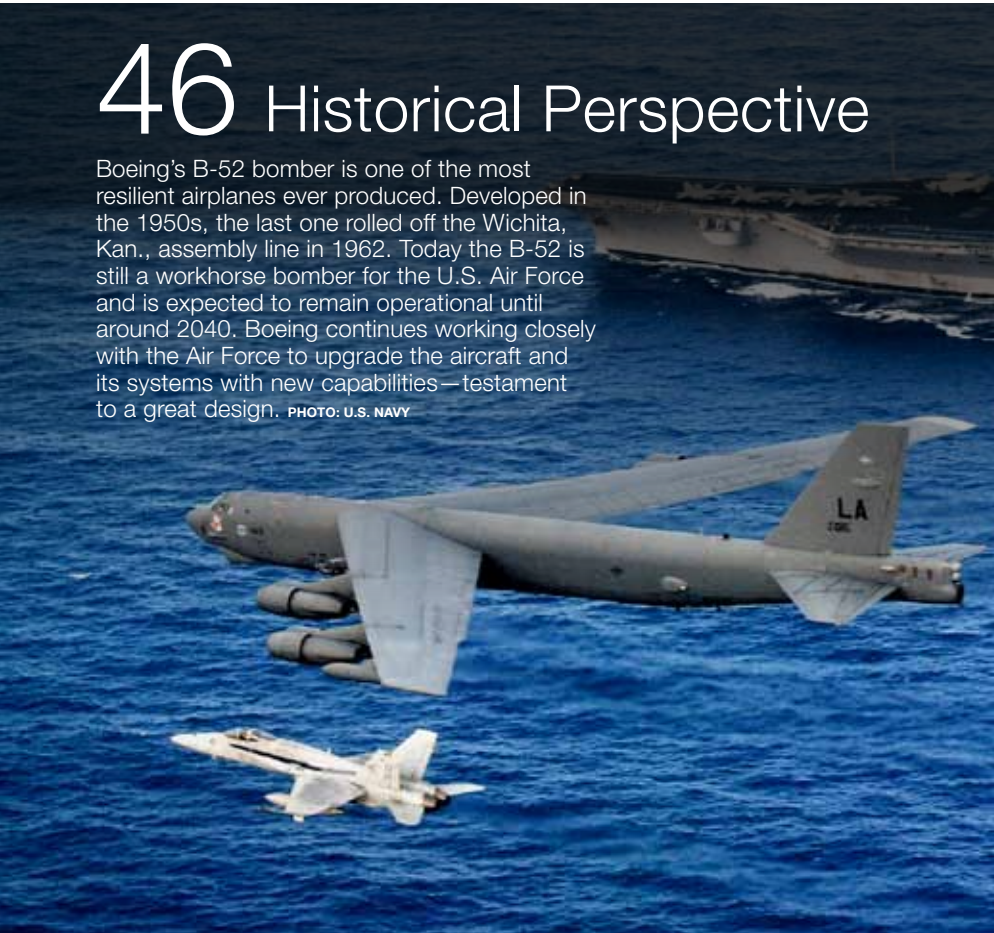
The 787 Dreamliner program has had its share of challenges, but the new jetliner now is racking up a solid list of accomplishments. As part of its flight-test program, the 787 has undergone a series of exacting tests in locations around the world, from the extreme cold of the North Pole to high-altitude airport testing in Bolivia. And the Dreamliner is performing as expected every time.

PHOTO: KEVIN BROWN/BOEING

f contents

46 Historical Perspective

Boeing's B-52 bomber is one of the most resilient airplanes ever produced. Developed in the 1950s, the last one rolled off the Wichita, Kan., assembly line in 1962. Today the B-52 is still a workhorse bomber for the U.S. Air Force and is expected to remain operational until around 2040. Boeing continues working closely with the Air Force to upgrade the aircraft and its systems with new capabilities—testament to a great design. PHOTO: U.S. NAVY



INSIDE

07 Leadership Message

The key to Boeing's future rests with its employees—one of the most talented work forces in the world. To help the company remain competitive, employees must continue to learn and develop, according to Rick Stephens, senior vice president, Human Resources and Administration. And managers must create an environment where employees can grow personally and professionally as they deliver Boeing's game-changing products and services, he says.

08 Snapshot/Quotables

09 Why We're Here

52 Milestones

58 In Focus

38



Partners Down Under

Boeing and its heritage companies have enjoyed a long and important relationship with the Commonwealth of Australia, and the partnership serves as a model for the company's international operations and sales. Australia is home to Boeing's largest operation outside the United States and has become an important growth engine for both Boeing's Commercial Airplanes and Defense, Space & Security businesses.

PHOTO: ASSOCIATED PRESS



EXPERIENCE ON A SCALE WITH GMD.



Ground-based Midcourse Defense (GMD) has over 180 uniquely configured and operational assets at 11 sites that stretch across 10 time zones. Since the start of the program, Boeing has worked side-by-side with the Missile Defense Agency on this complex and far-reaching program. Now, together with Northrop Grumman, the GMD One Team brings an unrivaled breadth of experience, ensuring that GMD is ready, reliable and affordable.

The game-changer: You

Employees are the key to Boeing's future and must continue to learn and develop

Competition in the marketplace is not new for Boeing, but the game is changing at a fast pace. As we raise production rates on commercial jetliners and seek new growth opportunities in the defense and security markets, it's easy to focus only on getting the job done. Much harder is taking the necessary actions to ensure Boeing's long-term competitiveness.

Why is this important? We don't have to look very far to find companies that once were market leaders and now are just one of the pack. As our industry continues to evolve, we must help employees understand this new environment because they are—and always will be—our competitive advantage.

Boeing has one of the most talented work forces of any company and invests more than \$21 billion annually in its people, with competitive salaries and excellent benefits. But now more than ever, we must create an environment where employees can continue their professional and personal growth as they deliver the game-changing products and services our customers expect.

Leaders have the responsibility to paint a picture of the future so all employees see their role. Leaders also must inspire others to innovate—while sustaining outstanding day-to-day work performance. By sharing business realities, listening and having candid conversations, we can build trust and create an environment where employees take the right actions, ones that solidify our industry-leading position.

In this company, we need people who have a passion for technology and innovation and an ability to work with others in a complex environment. To support this, Boeing offers its employees a wide variety of opportunities to learn and develop, such as the Learning Together Program, mentoring, on-the-job training, rotational assignments and more. Employees who take advantage of these opportunities create value for themselves, for our customers and for our company.

Boeing also continues its strong effort to prepare the future work force for tomorrow's jobs and careers by advocating and supporting improvements in education at all levels, particularly in the science, technology, engineering and math, or STEM, disciplines. Many employees—as well as retirees—do their part to help inspire the next generation of innovators. They



“We need people who have a passion for technology and innovation and an ability to work with others in a complex environment.”

– Rick Stephens

Senior vice president, Human Resources and Administration

PHOTO: MARIAN LOCKHART/BOEING

participate in skills-based volunteering to capture the imaginations of young people about the possibilities offered by technical careers—and in doing so, can enhance their own personal development. (See story on Page 10.)

To sustain and extend our leadership position, we must equip ourselves with the skills, talents and attributes required to compete successfully today and tomorrow. Each of us must make a commitment to lead in competing for our future. Are you ready? ■



A THOUSAND 767s ... AND COUNTING

Past and present 767 employees, retirees, suppliers and airline customers last month celebrated the rollout of the 1,000th 767 to be produced at the Everett, Wash., plant. The 767-300 ER (Extended Range) was delivered to All Nippon Airways. The event took place in the new, more efficient 767 production bay. PHOTO: GAIL HANUSA/BOEING

Quotables

“We bet our future on the 787 and we have a lot of faith in the Boeing people.”

– Jeff Smisek, president and CEO of the merged airlines United and Continental, in an interview at the Commercial Airplanes senior leadership meeting in Seattle, Feb. 9.

“Every commander said, ‘Hey, you’ve got it right.’”

– Lt. Col. Brad Killen, U.S. Army product manager for the Boeing CH-47F Chinook helicopter, who traveled to Afghanistan to see what users thought about the F model. As reported in the Jan. 20 issue of Defense Daily.

Making deals

fly

Selling jetliners requires sound financial analysis—and making sure the deal is good for Boeing and the customer **By Hannah Wong**

As a senior financial analyst in Commercial Airplanes with the Revenue Management group, Hannah Wong performs a variety of analyses and is responsible for working with engine manufacturers and forecasting revenue for the Next-Generation 737. In this *Frontiers* series that profiles employees talking about their jobs, Hannah provides a behind-the-scenes look at some of what her team does to help the company be successful selling commercial jets.

PHOTO: MARIAN LOCKHART/BOEING

Each time Boeing announces a new airplane order, chances are that someone from my team has been working on that sale for months.

I support the financial analysis for these sales campaigns. When we're engaged in an active sales campaign with a customer, my team is responsible for figuring out what it will mean financially for the company. The financial analysis I create is used by decision-makers who authorize our sales proposals. We also feed it back to the airplane programs so they can forecast what our financial position will be going forward.

The way it works, generally, is that a Boeing customer team develops a campaign strategy. It's important to know the key players and leaders for the customer,

and to understand on what basis the customer will make a decision to buy airplanes, what Boeing can bring to the table that the competitor cannot, and what our strategy is for closing the deal. As analysts, we are brought in to help examine specific financial terms. When the data are ready, we call a meeting to discuss the details with sales, contracts, marketing, finance and airplane programs. The sales team is then ready to go talk to the customer.

Each day at work is different, and I like that. I'm challenged to be creative and to "find a way" to help Boeing be successful. The deal can't just make sense for the customer—it has to make sense for Boeing, too. So it's my job to analyze the ideas and concepts in a sales strategy

and provide good financial data for those who make the decisions for Boeing. This requires me to ask: Is this offer good for the company and the customer? Does this campaign create opportunities or does it create risks? Sometimes you just have to use good judgment.

Naturally, it can be challenging at times to balance so many different priorities, but I really believe any tension around a sales process ultimately ensures the best possible outcome for everyone involved—for us and our customers. The best part of my job is seeing it all come together in a successful sale. ■

hannah.l.wong@boeing.com



Inspiring the future

Boeing volunteers and mentors help young people prepare for the high-tech jobs of tomorrow

By Tim Houston and Peter Pedraza
Photos by Ron Bookout

As an engineer with Boeing's Phantom Works organization, Allyn Maslin gets to work on some of the company's coolest, cutting-edge programs.

He also mentors local schoolchildren in building model airplanes.

"This is a great way for these young adults to get practical exposure to the field of engineering and a real sense of what their options are career-wise," Maslin said of the Boeing Engineering Challenge, which was launched three years ago by the Education Relations Human Resources team in St. Louis to further complement existing community outreach efforts.

The experiential learning program connects kids from 10 area high schools with Boeing mentors who spend five months working in teams to build model gliders that compete against one another for awards.

"I love what I do as an engineer and I've always liked helping people learn, so the Boeing Engineering Challenge is a great fit for me," Maslin said.

Many Boeing employees probably can remember a teacher who made a difference in their life, or a moment when an educator taught them something about the world or themselves that opened new possibilities and frontiers. Boeing employees create these moments every day—through their work as volunteer mentors. And these grass-roots efforts play an immeasurable role in preparing young people for the high-tech jobs of tomorrow—and potentially for careers at Boeing.



“Kids really enjoy interacting with engineers and seeing the practical side of concepts they’ve covered in class.”

– Barb Vogelsang, math department chair at Fort Zumwalt South High School in St. Peters, Mo.

The Boeing Engineering Challenge is but one example. There are others, such as the Washington Aerospace Scholars, a distance-learning program that culminates in a summer residency focused on solving hands-on engineering challenges with mentors at Seattle’s Museum of Flight.

While the immediate goal of the Boeing Engineering Challenge is to build a winning glider, along the way students learn to defend design concepts, test prototypes and think critically, applying classroom math and science lessons to situations Boeing engineers deal with daily.

Barb Vogelsang, math department chair at Fort Zumwalt South High School in St. Peters, Mo., has seen how the program can spark student interest in technical careers.

“Kids really enjoy interacting with engineers and seeing the practical side of concepts they’ve covered in class,” Vogelsang said. “Many leave the program with real-world skills, like working in teams and sticking to schedules, along with a clearer interest in technology as a career.”

Boeing retirees in the Seattle area also are instilling a sense of wonder and appreciation for science and math among young people. Retired engineers from the Bluebills—one of Boeing’s largest retiree organizations—mentor teenagers enrolled in the Washington Aerospace Scholars program.

Bluebill Dick Cihak has spent 17 of the 20 years since he retired from Boeing as a Museum of Flight volunteer. Interacting with students on group tours came naturally to him, so he jumped at the chance four years ago to branch out and share his enthusiasm for engineering with the students in the scholars program.

“I had seen the statistics on the declining interest in science, technology and engineering among school kids and knew we could do better,” explained Cihak, who worked on the Apollo program and shares stories of his experiences with the students he mentors.

“I’m pleased to say that many of the students get hooked on the profession once they start into the challenges and see how exciting and creative work in science and technology can be.”

In fact, 77 percent of the program’s college-bound graduates responding to a recent survey indicated they intend to pur-

sue a degree in a technology-related field.

Such grass-roots, skills-based volunteering is a powerful complement to the company’s financial support of education worldwide. In 2010, Boeing invested about \$50 million toward external education programs, with more than \$30 million directed toward science, technology, engineering and math, or STEM, programs to inspire the engineers, scientists and technologists of tomorrow.

These efforts, combined with the continued growth and development of current employees, are helping create a work force that Boeing can draw upon to keep its technological edge and deliver the level of innovation its customers expect.

Or as mentor Maslin put it: “If we can get these kids thinking about engineering and excited about working in technology, we can help supply the technical expertise Boeing needs to stay on top.” ■

timothy.houston@boeing.com
peter.p.pedraza@boeing.com

PHOTOS: (Far left) Barb Vogelsang, left, a teacher at Fort Zumwalt South High School in St. Peters, Mo., coaches students on getting their glider ready to compete in the Boeing Engineering Challenge. **(Above, from left)** Boeing’s Lauren Vaughn takes students through a technical review of their glider designs prior to the competition portion of the Boeing Engineering Challenge; more than 150 students from St. Louis-area high schools took part in the Engineering Challenge this year; Boeing Defense, Space & Security employees Tom Brandt (foreground) and Bill Rodewald helped students they mentored get excited about careers in science, technology, engineering and math.

Better together

Boeing teams across the company joined forces for the 747-8 Intercontinental flight-test program

By Jennifer Hawton and photos by Ed Turner

Essentially, it's a custom-designed and -built flying laboratory.

The wings alone, spanning 225 feet (69 meters) contain more than 820 pieces of test and evaluation equipment, 257 strain gages and 593 sensors, all of which gather millions of data points for engineers.

Building a flight-test airplane is not an easy job. And the new 747-8 Intercontinental was no exception. But this test airplane was built faster and with fewer defects because Boeing teams from different business units joined forces—another example of the benefits Boeing and its employees get by working together.

"It was the best example I have ever witnessed of the factory and Boeing Test & Evaluation working together to accomplish the overall goals of rolling out a test-ready



“We started with fewer than 20 people on our team, but we knew we would be impacting thousands of people.”

— James Jenkins, Boeing Test & Evaluation flight-test factory integration manager

flight-test aircraft,” said Andy Hammer, 747-8 test program manager.

Traditionally, Airplane Program employees in the factory build the airframe while Boeing Test & Evaluation employees design, build and install test instruments after final assembly. But for the 747-8 Intercontinental, the airplane program and test and evalua-

tion teams came together, working off one plan, to build the two flight-test airplanes.

“We started with fewer than 20 people on our team,” said James Jenkins, Boeing Test & Evaluation flight-test factory integration manager. “But we knew we would be impacting thousands of people. The success of the 747-8I was going to be

dependent on the work that our entire Boeing-wide team did.”

Working together from the start was key to the team’s success. The integrated team worked through all build scenarios to drive efficiency and a better understanding of each other’s work statement and priorities.

The team learned a lot from the work done on the 747-8 Freighter, said Dave Dessenberger, Boeing Test & Evaluation flight-test manufacturing manager. “We started our 747-8I meetings about a year before major assembly, rather than the norm of starting meetings only two months before assembly,” he said.

The benefits of all the pre-planning included less rework than is typical on most programs. In a rarity at Boeing, the 747-8I plan changed little throughout the build process. By allowing plenty of time for the unexpected, and keeping in touch, the integrated team was able to stick to the initial plan with very few delays.

“It really has to do with the open communication and the ability to be truthful, across the organizational and functional divides,” Dessenberger explained.

Some processes were streamlined. For example, the team was able to shorten the time needed to perform a metron calibration, a process that precisely measures control surface positions. This same kind of calibration had taken three days for another program to complete.

“We did it in only 36 hours on the Intercontinental because we had planned every part of it, and the factory and test teams were working together to make sure this critical test got completed,” said Steve Brown, Boeing Test & Evaluation lead flight-test instrumentation engineer for 747-8I, and the team lead responsible for designing and installing all the instrumentation.

“Deputy Test Program Manager Brian Johnson and his team really accomplished something special,” said Paul Nuyen, vice president, 747 Manufacturing and Everett Site Support. “They worked as one team through many challenges.” ■

jennifer.d.hawton@boeing.com



PHOTOS: (Far left) From left, Scott McCain, factory industrial engineer, James Jenkins, flight-test factory integration manager, and Nick Martin, factory final assembly industrial engineer. **(Left)** From left, Jesse Robinson, factory final assembly industrial engineer, Steve Brown, flight-test instrumentation lead, and James Yin, final assembly build integration leader.



TWO MILLION HOURS IN SERVICE TO MILLIONS.

We're proud to celebrate an impressive milestone: more than 2 million flight hours for the C-17, the world's most capable airlifter. The C-17 is unmatched in its ability to support troops and deliver humanitarian aid almost anywhere, anytime. We congratulate C-17 crews and support teams around the globe for making the C-17 an invaluable asset to the world.

 **BOEING**



Mabuhay miles

Philippine Airlines marks 70 years of service—and keeps growing on the wings of new Boeing jets *By Kathrine Beck*

Board a Philippine Airlines flight anywhere in the world and you're already experiencing Filipino traditions of hospitality and *bayanihan*—community spirit, cooperation and camaraderie.

Airplane interiors feature a tranquil coastal theme, inspired by the nation's islands and blue Pacific waters. Philippine culture is expressed through a combination of native Malay traditions with Spanish, American, Chinese and Arab influences: Economy class is called Fiesta Class, and business class is Mabuhay—what Filipinos say to welcome guests.

Philippine Airlines plays a vital role in its home country—a large archipelago with more than 7,000 islands, where roughly one in 10 jobs is supported by travel and tourism. The airline also connects many overseas Filipinos with family and friends back home,



“We’re committed to enhancing our service... including the addition of new efficient Boeing airplanes.”

— Jaime Bautista, president and chief operating officer of Philippine Airlines

PHOTO: PHILIPPINE AIRLINES

and it's an increasingly important carrier in the fast-growing Asia Pacific region.

This month, the airline celebrates its 70th birthday. It first took to the skies on March 15, 1941, using a Beech Model 18, with daily flights between Manila and the highland city of Baguio.

In 1946, Philippine Airlines became the first Asian carrier to cross the Pacific, operating a Douglas DC-4. That trip from Manila to Oakland, Calif., launched a long partnership between the airline and Boeing's heritage companies. Philippine Airlines also was the first Southeast Asian carrier to serve Europe, with flights, by May 1947, to Rome, Madrid and London.

In the early 1960s, the airline entered the jet age on the wings of a Boeing 707. Now its Boeing fleet consists of five 747-400s and two 777-300ERs (Extended Range). And it has four more 777-300ERs on order, with two scheduled for delivery in 2012 and two the following year. With the addition of the 777-300ER to the fleet, Philippine Airlines will enhance its trans-Pacific service with a wider, more comfortable cabin, an advanced passenger entertainment system and greater fuel efficiency, beginning with the Manila-to-Vancouver route this month and other trans-Pacific routes in the very near future.

“Philippine Airlines’ 70th birthday comes at a great time for the airline as it introduces new services and equipment upgrades,” said Rob Laird, vice president, East and South Asia Sales for Boeing Commercial Airplanes.

After seven decades of pioneering achievements, Philippine Airlines has earned its nickname “Asia’s First.” Today, the airline serves 25 cities in 14 countries, as well as 20 domestic destinations. It is scheduled to introduce new routes such as Manila-to-Delhi as part of its route expansion program.

“We’re very proud of our heritage and we’re committed to enhancing our service for today’s passengers, including the addition of new efficient Boeing airplanes to our fleet,” said Jaime Bautista, the airline’s president and chief operating officer. ■

kathrine.k.beck@boeing.com

PHOTO: (Above) A Philippine Airlines 777-300ER (Extended Range). GAIL HANUSA/BOEING

Leading

PHOTO: More than 4,000 Spectrolab searchlights, mounted on helicopters, boats and in fixed applications, are used by law enforcement, fire and rescue, and news organizations worldwide.

LOS ANGELES COUNTY SHERIFF'S DEPARTMENT



ing light

Spectrolab searchlights have been spotting trouble for 35 years

By Diana Eastman

When the sun goes down, these lights go up ... into the sky.

Every night, all over the world, military, police, fire, medical and news helicopter crews rely on an indispensable tool to get their jobs done: the Nightsun searchlight. Made by Boeing subsidiary Spectrolab, the high-intensity lights are credited with helping fight crime, protecting borders and saving lives.

"The Nightsun searchlight is arguably the most widely used and recognizable commercial product that most people—including Boeing employees—don't know is made by Boeing Defense, Space & Security," said Greg Campbell, vice president of Spectrolab Illumination Products.

"We're the global leader in airborne searchlight systems, with a market share of almost 100 percent."

Spectrolab, located in Sylmar, Calif., produced its first searchlights in 1969 for military use in Vietnam and they quickly caught on with police departments. Today, there are an estimated 4,000 of the company's searchlights in operation in 195 countries.

From its mount on a helicopter flying at 500 feet (150 meters), a searchlight can provide a tight spotlight about the size of two cars, or a wider view all the way up to an area covering a full city block. It gives the user, looking through binoculars, the ability to recognize and track a target a mile (1.6 kilometers) away.

Sgt. John Haughey of the Los Angeles County Sheriff's Department said the Nightsun, during crime scene searches, enables the aircrew to see details such as footprints in wet grass, shattered window glass and broken fences, helping officers track a suspect's path of travel. The department's 14-helicopter Aero Bureau also uses its Nightsuns to assist vehicle and foot pursuits as well as during search-and-rescue operations.

"With foot pursuits, we want to keep suspects under the light to keep the pressure on. They know that they are being watched



"There are lights that are still operating after 25 years, outliving the helicopters they're mounted on."

— Greg Campbell, vice president of Spectrolab Illumination Products



by law enforcement and they are going to run out of steam,” said Haughey. “For vehicle pursuits, we use the searchlight to keep a light on the vehicle, and with stabilized binoculars, we can also look inside the vehicle to see what the suspect is doing.”

The Nightsun is designed to work with the aircraft’s systems. One model can switch between visible white light and infrared, which is invisible light for covert surveillance with night vision goggles. Also, when used in conjunction with a Moving Maps system, it can be programmed to “find” an address as the pilot is flying to the scene, which reduces the crew’s workload and distractions.

The brightest Nightsun, the SX-16, produces 30 million to 50 million candela (a typical 100-watt bulb produces about 120 candela), or intensity of light powerful enough at close range to bubble paint or asphalt.

At the heart of each searchlight are a xenon arc lamp, specialized optics and high-voltage electronics.

“We make our searchlights to operate in extreme environments, from the desert to the Arctic Circle, and they’re very durable,” Campbell said. “The average service life is seven to 10 years, but there are lights that are still operating after 25 years, outliving the helicopters they’re mounted on.”

The Spectrolab team works closely with customers to design improvements, and new models and enhancements are being added soon that are smaller, lighter-weight and more powerful.

In the coming year, the L.A. Sheriff’s K-9 Unit is planning to perform suspect searches using night vision goggles with the searchlight’s infrared light, Haughey said, adding:

“The Nightsun is, and has always been, a game-changer.” ■

diana.b.eastman@boeing.com

PHOTOS: (Above, from left) Technician Jose Saavedra, one of 45 Spectrolab employees on the searchlights team, works on a Nightsun’s support structure; Antonia Garibay, searchlight and solar simulator manufacturing technician, inspects searchlight circuit boards. **(Far right)** Federal Aviation Administration–certified repair technician Bruno Aguniaga focuses and tests a searchlight to get it ready to return to flight status. **BOB FERGUSON/BOEING**

Lighting the way—from the Panama Canal to Hollywood

Spectrolab’s searchlights have found many uses, including:

- Nighttime photography and even deterring birds from airport runways
- Illuminating the Panama Canal to help maintain clearance between ships and the canal’s lock walls
- Combat search-and-rescue missions, such as one in Afghanistan featured in a recent History Channel program, “Helicopter Missions: The Taliban Gambit”
- Hollywood movies, including *Mission Impossible II*, *Transformers*, *Training Day* and *The Long Kiss Goodbye*

Solar cell leader

Spectrolab first developed searchlights as an offshoot of its primary business—spacecraft solar cells—when it needed to test its products with simulators that would reproduce the intensity of light that solar cells get exposed to in the vacuum of space.

Since its founding in 1956, Spectrolab has manufactured just over 3 million solar cells for 500 satellites and interplanetary missions and is the world’s leading solar cell manufacturer. It supplies high-efficiency solar cells and panels to Boeing Space & Intelligence Systems and to all major satellite prime contractors.

Spectrolab’s products, which power the International Space Station and NASA’s Mars rovers, are the highest-performing in the industry, converting almost 30 percent of space sunlight to electricity.

A decade ago, Spectrolab brought its space expertise down to earth and began making miniature solar chips aimed at the alternative-energy market—a growth business for Boeing. Its terrestrial solar cells convert up to 40 percent of the sun’s light into electricity, using the company’s space-cell technology that captures energy from more colors of the spectrum than ordinary silicon cells, which convert only about 15 percent of sunlight to energy.



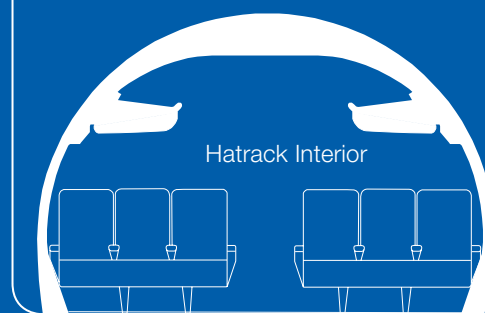
Time travel

By looking at its past, Boeing is developing the aircraft interiors of tomorrow

By **Bret Jensen**



PHOTO: An original mock-up of the 707 cabin known as the Hatrack Interior. The hatrack can be seen at the top of the photo. **BOEING ARCHIVES**



Hindsight may be 20/20. But members of the Commercial Airplanes Payloads Concept Center are hoping that looking back provides a clear path forward for Boeing passenger cabin interiors.

"We're analyzing our interiors, starting with the 707, and the design influences through time that shaped them, so we may better understand the future," said Rich Simms, senior industrial designer at the Payloads Concept Center. He noted that Boeing designers over the years have developed both revolutionary and evolutionary cabin interiors that have lasted for decades.

Simms' team also includes principal industrial designer Charles Lau and research specialist Cerise Fraker, both representing design partner Teague.

The team has gathered historical data by accessing Boeing and Teague archives and interviewing retired and current employees involved in the interior design and payloads engineering process. The information has provided further insight into cabin interior evolution.

To visualize the past, Simms and his team have created large,

poster-sized timelines of Boeing products and interiors over the years. The photos of airplanes and cabins overlay major events in aviation and product design influences through the same period of time. The posters give a visual representation of 60 years of Boeing cabin interior development.

One example of the evolution of interiors design is the stowage bin because it represents a commodity that changed due to external influences. The stow bin's evolution also significantly altered the appearance of Boeing interiors.

The first 707 interiors were very transit-inspired and simply had an open shelf on which passengers could set a coat and hat (referred to as the Hatrack Interior). In the 727, Boeing developed the New Interior Program, or the Super Jet interior, that introduced enclosed, overhead stow bins for the first time. They were integrated into an angular and sculpted overhead architecture. Passenger Service Units, containing reading lights, air vents and call buttons, were integrated beneath the bins for the first time.

By the time the 737 entered service in the late 1960s,

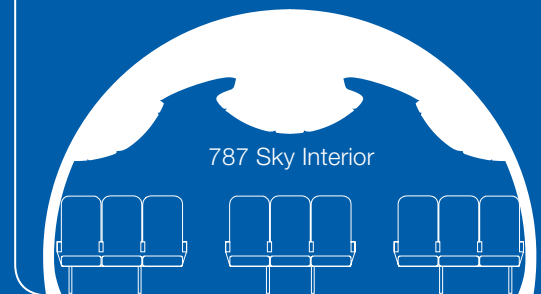
“We’re analyzing our interiors, starting with the 707, and the design influences through time that shaped them, so we may better understand the future.”

– Rich Simms, Boeing senior industrial designer

PHOTO: GAIL HANUSA/BOEING



PHOTO: A look at the premium economy seating available on the 787 Dreamliner. **BOEING**



airplane passengers were carrying on more and larger luggage. This marked a turning point in bin design and Boeing began offering larger, shelf-type stow bins.

The 747 presented new challenges as the first large, twin-aisle airplane. Boeing designers wanted to create a human-scaled interior to offset the fact that the airplane was sized like an auditorium. They subdivided the length of the airplane into “passenger zones” to give it a better feel. Centerline stow bins were incorporated into the ceiling above the middle seats to increase stowage volume.

When the 757 and 767 airplanes were developed in the 1980s and '90s, Boeing had to create two different interior schemes simultaneously. New safety and flammability standards added to the challenge.

With the 777, Boeing introduced the Signature Interior in 1995. The outboard bins in the Signature Interior were the largest pivot bins that Boeing had ever offered. This “signature look” was subsequently incorporated into the 767-400ER (Extended Range) and the 747-400ER NLI (or new look interior).

Boeing designers entered the 21st century looking to further revolutionize airplane interiors. Boeing was developing the Sonic Cruiser and designers began seeking passenger input, asking them what they would like to see in the Sonic Cruiser’s interior.

While the Sonic Cruiser program was abandoned in response to market demands, the results of the research became the genesis for the new Boeing Sky Interior, developed for the 787 but applied on the 747-8 Intercontinental and introduced on the 737. The Sky Interior features stow bins that pivot up and out of the way to give more room to passengers when standing in the aisles and the appearance of a more spacious passenger cabin.

“Boeing interiors have been a part of the long and successful history of our airplanes,” said Alan Anderson, Commercial Airplanes director of Payloads Systems Engineering and founder of the Payloads Concepts Center. “As we’ve developed new and industry-leading products, it’s important for us to remember all that has preceded us—because it can make us better.” ■

bret.r.jensen@boeing.com

Delta force

It was the largest rocket ever launched from the West Coast of the United States.

Standing 235 feet (72 meters) tall, and generating nearly 2 million pounds (8.9 million newtons) of thrust, a Delta IV Heavy blasted off from Vandenberg Air Force Base in California on Jan. 20, carrying a classified payload for the National Reconnaissance Office.

United Launch Alliance, a 50-50 joint venture between Boeing and Lockheed Martin, is the prime contractor for the Delta IV. Boeing was responsible for the rocket's initial development in the 1990s as part of the U.S. Air Force Evolved Expendable Launch Vehicle program, the aim of which was to reduce launch costs with a new family of rockets.

For this unique National Reconnaissance Office mission, Boeing provided engineering services, flight data acquisition system installation and checkout.

The liquid-fueled Delta IV consists of a central core booster and two strap-on boosters. Final assembly of the common booster core section and other components takes place in the United Launch Alliance factory in Decatur, Ala.

This was the fifth launch of a Delta IV but the first from the West Coast. The other four launches were from Cape Canaveral, Fla.

Preparing the Vandenberg complex for the Delta IV launch took three years and required about \$100 million in infrastructure upgrades, according to United Launch Alliance. But the launch represented a milestone as it restored heavy-lift capability to the West Coast rocket range.

Vandenberg is located about 130 miles (200 kilometers) northwest of Los Angeles. ■



PHOTOS: (Right) The Delta IV Heavy soars skyward from its launch pad near the Pacific Ocean. The flames near the top of the booster on the left are from liquid hydrogen vapors being burned off and are not unusual. **ASSOCIATED PRESS (Inset)** The massive Delta IV before launch. **UNITED LAUNCH ALLIANCE**





PHOTO ILLUSTRATION: The 747-8 Intercontinental, shown in this artist's concept, is significantly changed from the 747-400 and features a new wing, engine and interior. AIRPLANE GRAPHIC: BOEING; SKY PHOTO: SHUTTERSTOCK **(Insets)** 747-8I team members, from left, Donnie Gilbertson, functional test mechanic; Jaylene Pederson, sealer; Hoang-Bao Mang, systems installations mechanic; and Jarmaal Quinn, mechanic.



Labor of love

After years of hard work, excited employees take great pride in new 747-8 Intercontinental

By Deborah Feldman and photos by Bob Ferguson

It was a moment permeated with pride, excitement and, for some, even relief. When the 747-8 Intercontinental was finally unveiled last month before thousands of the Boeing employees who labored to create it, most of those in the crowded bay of the Everett, Wash., plant probably felt a personal connection to the massive, awe-inspiring flying machine.

Boeing's newest passenger jetliner is the culmination of more than five years of long hours, immeasurable enthusiasm and no shortage of angst. It is also testament to the skill and determination of countless men and women.

Wing line mechanic Mike Herman could have been speaking for many when he made clear what he has put into the Intercontinental program: "All of me," he said. "I dream about it. I take it home with me," he explained. "I think about what I'm going to do the next day."

Herman knows well how great an impression a 747 can make. A 23-year Boeing veteran, with fine laugh lines around his eyes and a gray-flecked goatee, he still has a faded Polaroid photo that was snapped back in 1977. It shows him as a 10-year-old boy standing inside Chicago's O'Hare airport with his mother and brother. They are dwarfed by the nose of a 747 looming at the window behind them.



PHOTOS: (Top) Wing and fuselage sections of a 747-8 Intercontinental are shown in the early stages of final assembly at Boeing's Everett, Wash., plant. **(Insets)** 747-8I team members, from left, Tony Krause, systems installations mechanic; mechanics at work; Andrew Behar, aircraft maintenance technician; and Solomon Mekuria (left) and Timothy Smart, both aircraft maintenance technicians.



And he still vividly remembers how he felt boarding that airplane.

"I was just so in awe over the 'bigness' of the plane," he recalled. "It was kind of intimidating looking down this big tube and it was just so long. It seemed like it went forever."

Herman's fellow mechanic, Shawn Halpin, has been with Boeing just three years. But it's long enough for him to feel ownership in the Intercontinental, too.

"When it's standing at the end of the runway and you know that you crawled around on the inside of that wing for a couple of weeks, or the inboard engines are hanging off the structure that you put in ... you have a lot of pride in that!" Halpin said.

Years of engineering occurred before the 747-8 Intercontinental moved into Herman and Halpin's capable hands.

That was Brian Thorpe's realm. The 747-8 airframe leader said his experience on the Intercontinental was unlike any airplane program he's worked in more than 32 years at Boeing.

And he's worked them all.

"The work statement we were looking at five years ago versus what we have today is significantly different," Thorpe said, comparing recent life on the program to a marathon. A brown bowl at his side in the second-floor office of the Everett factory seems to offer testament: A giant bottle of Tums and packets of Tylenol are surrounded by individually wrapped Life Saver candies.

"We started out pretty fast," he explained. "We had a huge challenge with respect to schedule, and we kept running into hills along the way. Whether it's work statement, whether it's staffing, it has just been really hard."

With the unveiling of the new jet behind him, both relief and reward are in sight.

"Now we see the finish line, and it's out in the factory," Thorpe said. "It's coming together. It's a beautiful airplane."

Employees involved in creating the Intercontinental rose to meet the challenges time and again, Thorpe said. Team members were filled with determination, and they learned from experience on the 747-8 Freighter, which required additional



resources and engineering work that delayed both models.

Even so, the engineers didn't slow their pace.

A sheet of paper tacked to Thorpe's cubicle wall trumpets the unprecedented accomplishment of Intercontinental engineers. They achieved 100 percent on-time release performance from June 2008 onward. More than 11,000 assignments were completed on time.

"I've never seen anything like this before," Thorpe said. "Not one was late."

One team, headed by engineering manager Mark Clayton, was at risk of being the first in 30 weeks to miss a deadline. Clayton had gone home, his engineers confident they would make their deadline. The project was practically complete.

When he returned the next morning, three teammates were already there.

"It started to dawn on me that they were in the same clothes they'd been in the night before," Clayton said. "They were just so determined to keep the record alive!"

Engineer Paul Radebaugh downplayed the all-nighter he pulled.

"We weren't planning on spending the night," he said. "We just kept getting closer and closer and then it was morning. ... I didn't want my team to be the one to miss the date."

From her cubicle on the third floor of the factory, Elizabeth Lund, deputy manager for the 747-8, sits almost nose to nose with 747s that are under construction. Lund explained that her experience with the 747-8 program isn't what she expected when she joined the group last August.

"When I came in, I was really expecting a team that was down and discouraged," she admitted.

That's not at all what she discovered.

"I found ... a team that was incredibly technically strong," Lund said. "They were addressing the challenges and the issues. They had good plans, they were optimistic and they are so talented."

She also pointed out that the 747-8 team carried an incredibly heavy workload as they set about designing the Intercontinental



PHOTOS: (Top) Boeing's largest-ever passenger airplane, the 747-8 Intercontinental is 250 feet (76 meters) long, or about 18 feet (5.6 meters) longer than the 747-400. **(Insets)** 747-8I team members, from left, Henderson Chan, systems installations mechanic; Warren Hatfield, systems installations mechanic; Sal Cully, mechanic; and Corey Stalcup, systems installations mechanic.



PHOTOS: (Top) The first 747-8 Intercontinental, with colorful new “sunrise” livery, is unveiled in February at the Everett, Wash., factory. **(Insets)** Among the crowd of 10,000 celebrating the 747-8 Intercontinental unveiling were Boeing employees, their families, friends and retirees—including Joe Sutter, third from left, who led the team known as The Incredibles that developed the first 747 in the 1960s.



“Now we see the finish line, and it’s out in the factory. It’s coming together. It’s a beautiful airplane.”

– Brian Thorpe, 747-8 Intercontinental airframe lead

while simultaneously finishing and certifying the freighter.

“It’s hard to focus on a brand-new product when you’ve still got another one you’re trying to certify,” she said. “The team’s done a great job with that as well. You know, I tell everyone that 2011 will be the year of the 747-8, and I truly think it is.”

Herman, the mechanic, would agree.

“It’s just going to fly like a dream,” he said. “I can’t wait. I hope I get to fly on one!”

Until then, he’ll keep building 747-8s that will inspire a new generation of airplane enthusiasts.

“Yeah,” he said, ruminating about other children experiencing the 747 as he once did. “Isn’t that something?” ■

deborah.s.feldman@boeing.com

(See related story on Page 12.)




 Flightglobal

PHOTO: Boeing engineer Andy Noble is shown with the cutaway drawing of the Boeing A160T Hummingbird he helped coordinate.

PAUL PINNER/BOEING
ILLUSTRATION BY TIM HALL

Cut away

In the world of cutaway illustrations, caution is the word of the day

By Sean Griffin

Beneath the stark fluorescent glare of a new but as-yet unoccupied building at a Boeing site in Irvine, Calif., technical illustrator Tim Hall is working across a brown veneer-surfaced table from A160T Hummingbird engineer Andy Noble. Except for the occasional restroom break or lunch, they have been at it for about 32 hours.

The information Noble is making available to Hall is technical data, and—per federal International Trade in Arms Regulations (ITAR)—that constitutes an export. Why? Both Hall and his client publication, *Flight International*, are based in the United Kingdom. America's national security is the foundation for ITAR. The aim is to prevent advanced technologies and information from falling into an adversary's hands.

Noble can only provide information he has been authorized to provide.

That authorization was granted by the U.S. Department of State in a technical assistance agreement three years earlier, detailing everything from the types of Boeing products that could be illustrated, to the kinds of components and systems that could be shared, and even the specific *Flight International* artists it could be shared with.

"We had to be careful during the whole process to ensure we did not have any issues with export control," Boeing's Noble would later explain.

Welcome to the work of producing technical cutaway drawings—a process that can take years to bring about and yields highly detailed and annotated illustrations of Boeing products and those of other manufacturers in *Flight International* magazine, and on its Flightglobal website.

The manufacturer contracts for the work, and once the drawings are complete, the manufacturer is authorized to reproduce them for a period of time on coffee cups or PowerPoint presentations. They may become framed posters or wall murals or handouts—especially at air shows such as those in Paris, Farnborough, Dubai or Singapore—and at myriad trade shows throughout the industry.

Who picks them up? Existing customers, potential customers, news media, trade media, analysts, employees. Aviation and space buffs. The drawings also can be downloaded at www.flightglobal.com/cutaways; more than a million cutaways have

been downloaded. Boeing's 787 Dreamliner cutaway from 2008 has been the most popular, with more than 50,000 downloads.

For the Hummingbird cutaway, Boeing's Global Trade Controls and Security mapped out the specific areas on site that Hall was restricted to. Hence the unoccupied building, where there was no chance of seeing a drawing or piece of hardware that was not authorized for disclosure.

Then, on Hall's fifth and final day, every A160T Hummingbird drawing, document and photograph had to be carefully reviewed by Boeing Export to ensure compliance with the State Department agreement. Forms had to be filled out. Labels with precise wording attached. Logs of all information maintained.

Only then could Hall begin work on the drawing, which was submitted for a review by the program, by Export and by the customer. Any changes were incorporated, and at long last the illustration could be submitted to the publisher.

Hall then had one more task—destroy all the data Boeing provided to him.

His Hummingbird cutaway was subsequently featured in a special issue of *Flight* for the 2010 Farnborough International Airshow. Hundreds of copies were given away at the show itself.

"The return on the investment is far in excess of what we pay for the cutaways," said Paul Lewis, director of International Communications for Boeing Defense, Space & Security and a former *Flight* bureau chief.

Compared with magazine ads, which have a shelf life of a week or so, "a cutaway has a shelf life of years," Lewis said. "You go into the Pentagon, you often see them on the wall. You go into an airline, you often see them on the wall. You go into a manufacturer, you'll see them on the wall. They're prolific in where they show up."

Over the years, 84 Boeing, Douglas, McDonnell Douglas and North American products have been illustrated, as well as most of their competitors' products. While new products and derivatives ripe for cutaway illustrations are in development all the time, the ranks of independent cutaway illustrators in aerospace have dwindled to just Hall and fellow *Flight* artist Joe Picarilla.

So there's no lack of business to keep them busy—especially since each cutaway takes from 800 to 1,000 hours to create. ■

elaine.m.brabant@boeing.com

Extreme measures

The 787 Dreamliner has been tested to the extreme—and performed as expected in every situation

By Lori Gunter

The story of 787 flight test is largely a matter of perspective. Yes, the program has experienced many challenges. But it's also a story of perseverance and accomplishment. "The challenges are real," said Scott Fancher, vice president and general manager the 787 program. "But so are the accomplishments. And at the end of the day, that's what the 787 program is all about.

"If we were intimidated by the challenges, we'd have thrown our hands up and walked away before we ever got to flight test," he said. "But that's not what we do. We work through the challenges with a focus on making this a great airplane. That ensures we do the right thing and that we keep moving forward."

Fancher acknowledged the 787 teamwork across the organization. "The program, Boeing Test & Evaluation and our partners are working hard to make sure we do the testing right and get good data," he said.

Since an onboard fire that halted flight testing in November, the team has developed hardware and software improvements that make the 787's power control system more robust. Interim fixes have been deployed on the flight-test airplanes, and one by one, they have re-entered flight test.

Within the same time span, a seventh airplane made its first flight and joined the flight-test fleet on a temporary basis.

By the end of January, the fleet had logged more than 2,600 hours of flying, nearly 900 flights and approximately 1 million miles (1.6 million kilometers). The team has pushed the 787 to prove that it is ready for the most extreme flight conditions it will ever experience in revenue service and many that it likely will never experience outside of testing.

The 787 has conducted testing in Iceland, Puerto Rico and Bolivia—demonstrating performance in high winds, and takeoff and landing performance at high- and low-field elevations. The team has been in the heat of the desert, the extreme cold of the McKinley Climatic Chamber at Eglin Air Force Base in Florida, and even conducted polar navigation tests at the North Pole.

"We operate in the same environments that our customers do," said Mike Bryan, 787 project pilot, Boeing Test & Evaluation. "It takes us all over the world and while it may sound like fun, it's



“The challenges are real. But so are the accomplishments. And at the end of the day, that’s what the 787 program is all about.”

– Scott Fancher, vice president and general manager of the 787 program



PHOTO: The 787 test-airplane fleet has made more than 200 flights since it returned to flight status in late 2010. **BOEING**



also a lot of work. The sheer logistics of getting the airplane and team to a new location, setting up our offices and coordinating our test flights with the local air traffic authorities is a huge job.”

Perhaps the most difficult deployment concluded in February when the team on ZA005 returned from high-altitude testing in La Paz, Bolivia. The airport’s 13,300-foot (4,050-meter) altitude meant the ground crew was operating with only 60 percent of the oxygen found at sea level.

“We started in Victorville, Calif., doing fuel consumption testing,” Bryan said of the 24-day deployment for the high-altitude tests. “From there we went to Albuquerque, N.M., and performed takeoff tests at a mile-high airfield. The next stop was Puerto Rico for warm-weather takeoffs, and then on to La Paz.”

In all cases, according to Mike Sinnett, 787 vice president and chief project engineer, the 787 has performed as expected.

Sinnett described one particularly challenging test that demonstrates the overall robustness of the 787 design and its capability to maintain safe conditions in the presence of multiple failures.

“We intentionally failed one of the three air-data systems that

“We operate in the same environments that our customers do. It takes us all over the world and while it may sound like fun, it’s also a lot of work.”

– Mike Bryan, 787 project pilot, Boeing Test & Evaluation



provide key information on speed and altitude,” Sinnett explained. “After that, we caused the remaining two systems to disagree.”

When the two remaining systems disagree, it means there is no known valid source of speed and altitude data. That’s when the backup systems kick in.

“Pilots see an annotation that they are getting this information from backup systems, but they never lose data on the primary flight display,” Sinnett continued.

Altitude is provided from the GPS system. Known conditions from a variety of systems and inputs, including aircraft gross weight, angle of attack, high-lift configuration and other parameters, allow the airplane to back-calculate airspeed from the lift equation and display it on the flight deck.

“This represents a significant advancement in safety and crew awareness in the presence of multiple failures,” he said.

Compared with previous new-airplane programs, the 787 flight-test program has experienced fewer software problems. While flight test is not yet complete, the improvement is measurable; it is attributed to an increase in integration tools,

laboratory capacity and ground-based testing.

The airplane’s aerodynamic performance has been stable as well. Only two minor changes to the external aerodynamics have been made since the start of the flight-test program: Vortex generators have been added to the vertical fin to improve rudder effectiveness at high rudder deflection angles, and the in-board slat position has been tuned to address behavior in stall entry.

“Every program learns from what has happened before and makes its own advancements,” Sinnett said. “It’s part of what sets Boeing apart as an industry leader.”

Because of the significant amount of new technology on the airplane, the 787 team decided to increase the laboratory testing that preceded flight testing. The team conducted about three times as much systems testing in integration labs than with the 777. Structural testing was even more robust.

The results have been noticeable.

Not only are there fewer flight-test problem reports, but fewer changes have been needed to the interface that controls the timing and flow of information between systems on the airplane. Such changes are both costly and time-consuming.

Sinnett said the program has seen a 90 percent reduction in those changes since the start of flight test, compared with Boeing’s previous all-new airplane.

“That’s significant and it’s a tribute to the team that integrated the functions and tested the architecture so diligently before we ever got into flight test,” he said.

Through last month, Boeing has completed more than 75 percent of the flight testing required to certify the first version of the 787 and retired the majority of the risk associated with flight testing.

Most of the remaining tests are to either demonstrate for the Federal Aviation Administration conditions that the 787 test planes have already flown, or to show how the 787 will behave in normal operating conditions, Sinnett said. Also remaining are extended operations tests known as ETOPS to certify the 787 to fly long transoceanic and transpolar routes.

The nature of flight testing, Sinnett pointed out, is to find issues—and solutions when possible.

“From very early on we’ve told people that testing is a dynamic environment, and while the risk is lower, we’re realistic about the possibility of new discoveries,” Sinnett said.

Fancher, the program’s leader, noted that no one started working on the 787 “under the illusion that it would be easy.

“We have created an airplane that brings exceptional value to the market,” he said. “And at the end of the day, everyone understands that safety is our first priority.” ■

loretta.m.gunter@boeing.com

PHOTOS: (Top) The first of the 787 test airplanes conducts extreme takeoff testing as part of the certification process. **BOEING**

(Left) La Paz, Bolivia, provided a unique environment to demonstrate the 787’s takeoff and landing performance at high field elevations. **RUBEN DARIO CUELLAR LORINI**





Model partnership

Australia is home to Boeing's largest international operation *By Bill Seil*

PHOTO: Boeing F/A-18 Super Hornets fly by Australia's Gold Coast in southeast Queensland. AUSTRALIAN DEFENCE FORCE

Boeing and its heritage companies have a history in Australia dating back to the pioneering days of aviation. Today, Australia is a center of advanced aviation technology and home to Boeing's largest operation outside the United States.

Headquartered in Sydney, Boeing Australia has 2,800 employees based at 28 locations throughout the country.

"We have a historic legacy in Australia that has helped us build a strong foundation," said Shep Hill, president, Boeing International. "We also have some wonderful customers who have bought our products over many years and stayed with us through difficult times."

Australia is a model for the company's international operations and sales, Hill said. It represents a good mix of the



Australia at a glance

Official name:

Commonwealth of Australia

Location: A continent in the Oceania region between the Indian and South Pacific oceans. It is the sixth-largest country by area in the world, slightly smaller than the contiguous 48 states of the United States.

Population: 22,545,168 (June 2010 estimate)

Capital: Canberra

Other major cities: Sydney, Melbourne, Brisbane, Perth, Adelaide, Darwin, Hobart

National language: English

Government: Australia has a federal parliamentary democracy led by a prime minister and a bicameral Federal Parliament, consisting of a Senate and a House of Representatives.

Economy: Exports include coal, iron ore, gold, meat, wool, alumina, wheat, machinery and transport equipment. Imports include machinery and transport equipment, computers and office machines, telecommunications equipment and parts, and crude oil and petroleum products.

Source: U.S. and Australian governments

company's diverse business activities and is, in many respects, a microcosm of Boeing's worldwide operations.

"We have a presence there, we have partnerships there and we have products there," Hill said. "We also have an outstanding, creative group of employees. They're loyal and supportive of the company and are contributing to the bottom line."

The company's history in Australia began in 1927, when the de Havilland Aircraft Co. created de Havilland Australia. In 1961, that company became Hawker de Havilland Australia and in 2000 it was acquired by Boeing. The name was changed two years ago to Boeing Aerostructures Australia.

Douglas Aircraft Co. sold its first DC-2

to Australia in 1936. During World War II, the Australian military purchased a number of aircraft from Boeing heritage companies, including the DC-3 transport, the B-25 Mitchell bomber and an Australian-produced P-51 Mustang fighter.

Australia's Commonwealth Aircraft Corp., which later became part of Boeing, was contracted during the war to build a modified version of North American Aviation's general purpose NA-16 aircraft to meet the special needs of the Royal Australian Air Force. A total of 755 of these "Wirraways" were produced from 1939 to 1946.

Qantas, the Australian flag carrier, in 1959 became the first international customer for the Boeing 707 jetliner. Qantas used the 707 for long-haul flights across

the Pacific and on the "Kangaroo route" from Sydney to London.

This history, along with the long-standing friendship and cultural ties between the United States and Australia, has contributed to the growth of Boeing's business operations Down Under, said Ian Thomas, president, Boeing Australia and South Pacific.

Today, Boeing Aerostructures Australia is the nation's major manufacturer of high-end aerostructure components, including rudders for the 777 and the 787's movable trailing edge, which is based on patented composite technology. Boeing is a major supplier of commercial airplanes to Qantas Airways and the Virgin Blue Group of Airlines.

Boeing Defence Australia, a subsidiary

of Boeing Defense, Space & Security, is a major supplier to the Australian military and other customers. Recently, the Royal Australian Air Force retired its fleet of F-111 aircraft and is in the process of adding 24 Boeing F/A-18F Super Hornets to its fleet.

Boeing Research & Technology–Australia, established in 2008, is the focus of the company’s research and development collaboration with Australian industry, government and academia. The organization has 35 full-time researchers based throughout Australia and partnerships with researchers around the world. It has four areas of focus: high-value composites, autonomy and robotics, life-cycle analysis, and wide-area communications using non-satellite-based systems.

“We are tapping into the tools, talent and technology of Australia to make Boeing more competitive within this country and more agile in global markets,” Thomas said.

He emphasized the strength and duration of the company’s partnerships in Australia—especially those with long-standing customers. Qantas, in addition to being the first international customer for the Boeing 707, is among the largest airline customers for the 787 Dreamliner, with a 50-aircraft firm order. Boeing maintains a strong relationship with both Qantas and its low-cost carrier, Jetstar.

Another important airline partner is Virgin Blue, along with its new, long-haul carrier, V Australia. Virgin Blue has been a major customer for the Boeing 737 since the carrier was launched more than a decade ago. V Australia, which took delivery of its first 777-300 ER (Extended Range) in 2009, is growing rapidly with plans to expand its fleet.

“Boeing Commercial Airplanes has a very substantial, enduring and strategic partnership with the airlines,” Thomas said. “Our customers know that we’re part of the fabric of the industry and part of the fabric of Australia.”

Australia is also a key customer for Boeing’s military aircraft and other products.

Boeing enjoys a strong partnership with the Australian Defence Force, one that has endured some difficult times, Thomas noted. There were lengthy delays, for example, delivering the first Wedgetail 737 Airborne Early Warning and Control (AEW&C) aircraft to the Royal Australian Air

“We are tapping into the tools, talent and technology of Australia to make Boeing more competitive within this country and more agile in global markets.”

– Ian Thomas, president, Boeing Australia and South Pacific

PHOTO: ASSOCIATED PRESS



Force. But today, four of the six airplanes have been delivered, with the remainder to be handed over later this year. The fleet is scheduled to attain full operational capability by the end of 2012.

Thomas said the relationship has stayed strong because Boeing took the measures necessary to correct problems, maintaining the Australian military’s confidence in the company’s integrity and determination to meet commitments.

Boeing’s recent ahead-of-schedule deliveries of F/A-18 Super Hornets helped justify that trust, he said. The Royal Australian Air Force also operates a fleet of 71 upgraded F/A-18A/B Hornets and has introduced four Boeing C-17 cargo planes to its fleet. The Australian military also operates Boeing CH-47 Chinook

helicopters and is studying acquiring Boeing 737-based P-8 aircraft for maritime patrols. Australian troops are supported by Boeing Australia’s reconnaissance and surveillance services using the ScanEagle unmanned aircraft system.

With these programs come opportunities for Boeing to ensure the operational readiness of the aircraft and their crews, Thomas said.

Boeing Defence Australia is providing engineering, supply chain management and maintenance support for the 24 Super Hornets being delivered to the Royal Australian Air Force through October 2011. And Boeing Defence Australia worked closely with Training Systems & Services to deliver the Super Hornet and C-17 training infrastructure. Boeing Australia is heavily involved in the



training of Australian Defence Force crews through instruction of Scan Eagle operators, C-17 aircrew, AEW&C aircrew and maintainers, and army helicopter aircrew and maintainers, including initial training on Kiowa, Black Hawk and CH-47D Chinook helicopters. Boeing also provides field service and logistics support to the Royal Australian Air Force's C-17 fleet.

Two key Australian Boeing Network & Space Systems products—Vigilare, a battle management system, and the High Frequency Modernization Program, a communications system—are now in operation with the Australian Defence Force, after overcoming development challenges. Both have received positive evaluations from the Australian military.

Meanwhile, Boeing is contributing to

the Australian economy in many ways, including the use of local suppliers. Boeing, through the Office of Australian Industry Capability, helps develop local small and medium-sized enterprises and identifies opportunities for them to take part in the company's global supply chain, helping local industry secure more than \$190 million (U.S.) in contracts over the past three years.

Thomas said Boeing Australia serves as a hub for showcasing and marketing Boeing products throughout the region.

"Our goal here is to delight our customers," Thomas said. "And to the degree our customers are excited about our products and quality of service, we have some highly respected advocates for the Boeing brand." ■

william.j.seil@boeing.com

PHOTOS (Top right): Qantas was the first international customer for the Boeing 707, flies more than 20 747s (shown) and has ordered 50 Boeing 787 Dreamliners. **TIM STAKE/BOEING**
(Above) The Royal Australian Air Force has added four Wedgetail 737 Airborne Early Warning and Control aircraft to its fleet, with another two scheduled for delivery this year. **AUSTRALIAN DEFENCE FORCE**

G'day, mate!

At more than two dozen Boeing sites around the vast Commonwealth of Australia, some 2,800 employees are supporting the company in many ways, from building parts for Boeing commercial jetliners to supervising installation of the Vigilare battle management system for the Royal Australian Air Force to helping develop Australia's aviation biofuels industry.

"I'm working with people who love what they build," said Julie Robson, a human resources officer at Boeing Aerostructures Australia in Bankstown, New South Wales.

The nearly 400 Bankstown employees, part of Boeing Fabrication, build airplane components that include 777 rudders, elevators and cove lip doors, the 747-8 wing leading edge, 737 ailerons and C-130 flaps.

Robson's duties cover employee career development—and organizing activities such as Family Day for family members.

While Boeing Aerostructures Australia has a major role in manufacturing structures for Boeing jetliners, Boeing Defence Australia is a key supplier to the Australian

military and other customers.

"Our team operates under incredibly demanding conditions," said Boeing Defence Australia employee Charlie Stone. "We are fortunate to have on staff the most highly skilled leaders in their field."

Stone is the deputy chief pilot at the Boeing Army Aviation Training & Training Support facility in Oakey, Queensland. There, personnel from both the Australian Army and Navy are trained as pilots on Bell Kiowa and Sikorsky Black Hawk helicopters by instructors who are Boeing employees. One instructor is embedded with an army regiment training CH-47 Chinook pilots. The facility also provides crew training, refresher courses and instructor training.

"It's nice to watch a trainee who couldn't fly four months ago and have



them tell you how they feel,” Stone said. “Seeing them grow in skill and confidence is very rewarding work.”

At another Boeing site in Brisbane, Peter Birt is working closely with Boeing Aerostructures Australia and the company’s other Australian subsidiaries to develop new technologies that will benefit the Australian operations.

Birt is a program integration manager with Brisbane-based Boeing Research & Technology–Australia (BR&T-A), which is an integral part of Boeing’s global research network.

“Our team actively engages with our Boeing Australian subsidiaries to understand what technologies they require and whether we’ll need to develop that technology in-house or

in partnership with other research agencies in Australia,” he said.

The BR&T-A team is working with the Australian Research Centre for Aerospace Automation on Project Smart Skies to explore technologies that will manage airspace to accommodate unmanned air vehicles.

Other projects include developing a new resin to be used in advanced composite components.

– Kathrine Beck

PHOTOS: (Clockwise, from left)

Julie Robson at work in Bankstown, New South Wales. **ASSOCIATED PRESS**
Charlie Stone in Oakey, Queensland. **IAN CLARK/BOEING**
Brisbane-based Peter Birt. **HEIDI SNOWDON/BOEING**

Boeing in Australia

Australia represents Boeing’s biggest global footprint outside the United States. The company’s Australian business operations and subsidiaries include:

Boeing Australia Holdings

(headquartered in Sydney) – Central office for all Boeing business operations within Australia

Boeing Aerostructures Australia

(headquartered in Melbourne) – Australia’s major manufacturer of high-end aerospace composite components

Boeing Defence Australia

(headquartered in Brisbane) – A subsidiary of Boeing Defense, Space & Security that is a leading Australian defense aerospace company

Boeing Research & Technology–Australia

(headquartered in Brisbane) – Established in 2008 to serve as a central point for Boeing’s research and development collaboration with Australian industry, government and academia

Aviall Australia

(headquartered in Melbourne) – A leading supply-chain management provider to the aerospace, defense and marine industries

Boeing Training & Flight Services–Australia

(headquartered in Brisbane) – A provider of commercial flight and technical training to airlines in Australia and around the world

Insitu Pacific

(headquartered in Brisbane) – A company that designs, develops and manufactures unmanned airborne systems for commercial and military organizations

Jeppesen Australia

(headquartered in Brisbane) – A provider of advanced flight information solutions and computerized flight planning software, as well as high-end scheduling for air and rail customers

Jeppesen Marine

(headquartered in Sydney) – A provider of digital maritime cartography, data services and other navigational information to the Royal Australian Navy and commercial customers



Flood of help

Boeing's corporate citizenship program in Australia is there to help—especially when natural disasters hit

The recent floods in the state of Queensland affected an area the size of Germany and France.

Boeing employees in Australia—and throughout the company—were ready to help.

While working to fight flooding at their own homes and work areas, employees in Australia pitched in to help their neighbors. Boeing-supported Black Hawk helicopters, flown by the Australian Defence Force, played a critical role in relief operations throughout the entire state.

“The massive scale of this disaster touched all Australians,” said Ian Thomas, president, Boeing Australia and South Pacific. “We’re very proud of our employees, whose individual acts of volunteerism and generosity made an important contribution to those affected by the floods.”

Employees both within and outside Australia provided financial support to the flood relief effort, coordinated by the Queensland Premier's Disaster Relief Appeal. The company also contributed through matching funds. By Feb. 18, employee and corporate contributions totaled \$216,775 (U.S.).

Boeing and its employees in 2009 demonstrated similar support for relief efforts involving bushfires in Victoria, Australia, which burned thousands of acres and destroyed the homes of hundreds of people.

Over the past five years, Boeing Australia has provided more than \$3 million to support local charities, community organizations and universities. The company's corporate citizenship



program in Australia has a special focus on civic organizations, early childhood education and environmental programs. These priorities were determined based on areas where communities have the greatest need.

In July 2010, Boeing had its first Global Day of Service in which employees on three continents volunteered for community projects. In Australia, employees joined with members of the Brisbane, Queensland, community to help improve the grounds for Balmoral State High School.

Boeing Australia and South Pacific in 2010 changed its corporate citizenship strategy to focus contributions to a few select community agencies rather than providing smaller grants to many organizations.

Virginia Wheway, Environment, Health and Safety director for Boeing Australia, said this approach allows the company to form solid partnerships with several charitable organizations.

“We believe there will be more impact in working closely with a few well-selected agencies,” Wheway said. “You develop a deeper level of engagement, support and partnership.”

One of these partners, the Smith Family Foundation, is a national, independent children's charity that supports disadvantaged Australian children. It unlocks opportunities through education and learning. Its Launchpad to Learning program focuses on the importance of reading by young children. Pilot programs are in Brimbank, Victoria; Ipswich, Queensland; and



“We’re very proud of our employees, whose ... volunteerism and generosity made an important contribution to those affected by the floods.”

– Ian Thomas, president, Boeing Australia and South Pacific

Fairfield, New South Wales.

Another partner, the Australian War Memorial, serves as both a memorial and a museum of Australia’s involvement in international military conflicts and peacekeeping missions. The museum houses a number of Boeing heritage aircraft, including the Australian-built Wirraway. It is located in Canberra, the Australian capital.

Boeing also partners with Greening Australia, which has been working with communities for more than 30 years to bring about environmental education and regeneration of green spaces. One of its programs, Generation Green, engages local communities in Western Sydney to advance a range of environmental efforts.

In neighboring New Zealand, the

company partners with the Foundation for Youth Development. Its youth development programs inspire children, from 5 to 17 years old, to reach their full potential. The goal is to help them become confident, healthy adults who contribute to society. The foundation also has activities with an environmental focus.

“Our goal for 2011 is to strengthen our relationships with these organizations in ways that go beyond funding,” Wheway said. “For example, we want to provide more opportunities for employees to become involved, including skills-based volunteerism.”

– Bill Seil

PHOTOS: (Above and right) Boeing employees supported Australian Army Black Hawk helicopters flying flood response and recovery operations.

AUSTRALIAN DEFENCE FORCE



“It’s a privilege to fly it, knowing how long it’s been in service, how many other aviators have flown it and how well it’s served.”

– U.S. Air Force Maj. Steve Walden, B-52 commander with Detachment 1 of the 53rd Wing at Barksdale Air Force Base, La.

PHOTOS: (Below) A B-52H assigned with the U.S. Air Force 2nd Bomb Wing taxis into position for takeoff at Barksdale Air Force Base, La., while a B-52H (pictured at top) from Minot Air Force Base, N.D., comes in to land. **U.S. AIR FORCE (Inset)** The crew of a B-52 based at Barksdale maneuvers it into position for aerial refueling from a KC-135 Stratotanker. **U.S. AIR FORCE**



Bomber for the ages

Boeing's workhorse B-52 bomber has been on active duty for more than five decades — with no plans to retire soon

By Eric Fetters-Walp

When the last B-52 Stratofortress rolled off Boeing's production line in Wichita, Kan., in 1962, the aircraft already was the centerpiece of the U.S. strategic bomber fleet during the Cold War.

The world has changed dramatically since then, yet the B-52 remains a workhorse for the U.S. Air Force, and that isn't likely to change anytime soon. Already operational for more than half the era of powered flight, the B-52 is slated to stay in service until 2040.

"It's been an amazingly resilient airplane as it has aged. It has turned out to be very robust when it comes to accepting changes and upgrades," said Dale Clevenger, B-52 capability team manager, Flight Mechanical Systems in Wichita.

Since the B-52 first took to the skies, Boeing has helped to maintain and update the aircraft, assisting the Air Force with both regular maintenance and major overhaul phases—integrating the latest technology. Through it all, the fleet has performed well, said Scot Oathout, Boeing's director of B-52 programs.

"The flexibility and pure elegant design of the aircraft allowed that to happen," Oathout said. "We have capitalized on keeping the platform flexible."

The relationship between Boeing and the Air Force was reaffirmed last fall with a contract to modernize the B-52 weapon system and related components over an eight-year period. That contract alone could be worth nearly \$12 billion.

Meanwhile, Boeing also is providing engineering services and upgrades, as well as advanced communications technology, for the B-52 fleet. In 2010, the first B-52 outfitted with Combat Network Communications Technology, or CONECT, flew and tested the system, which allows for more networked and instant communication. Boeing also has a contract to design future capability allowing B-52s to communicate via secure broadband satellites.

Mandy Trainer, contracts administrator for the B-52, explained that Boeing's partnership with the U.S. Air Force is a close one, with Air Force personnel installing most of the upgrades.

"We have the expertise to assist the government if they need it during modification work," she said. "However, we are usually tasked to do the design and development and/or sustainment engineering."

Boeing also commonly performs first-of-type modifications for complex installations. Additionally, Boeing performs aircraft tracking, aircraft-on-ground technical support, emergency repairs





and in-flight emergency support for the fleet of 76 B-52H aircraft. In all, about 350 employees in Wichita support the B-52 program, with a handful on location at Tinker Air Force Base in Oklahoma and Barksdale Air Force Base in Louisiana.

Dennis Roemer, a systems engineer on the B-52 CONECT program in Wichita, said it's a unique challenge to keep the 20th-century bombers up to date for the 21st-century Air Force.

"In order to meet new mission requirements for the Air Force, the work we do here is to keep pace with new and emerging technologies and bring the best of those to the warfighter," said Roemer, who's worked on B-52 development and sustainment programs for 23 years. "We work closely with the Air Force requirements community, aircrew and maintenance personnel to continually improve the B-52 and its mission and to ensure that the systems installed are reliable and meet the life-cycle requirements established by the Air Force."

With swept wings, eight jet engines paired two by two, and a long, thin fuselage, the B-52 looks like nothing else in the skies. It also has a two-story flight deck, with navigators sitting

under the pilots in a windowless level. "It's an aircraft that needs no introduction," said Maj. Ken Theis, a radar navigator with the 49th Test and Evaluation Squadron at Barksdale Air Force Base. "We've taken it to air shows all over the world, and you don't need to tell people what aircraft this is."

Maj. Steve Walden, B-52 commander with Detachment 1 of the 53rd Wing at Barksdale, said the aircraft has less automation and fewer creature comforts compared with newer fighters and bombers. But he's proud to be part of its legacy.

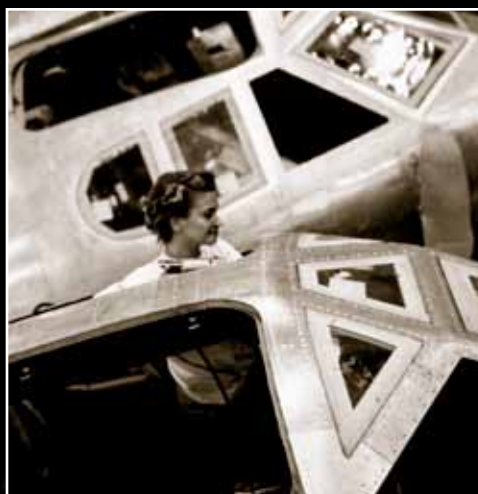
"It's a privilege to fly it, knowing how long it's been in service, how many other aviators have flown it and how well it's served in combat over the years," Walden said.

Ted Bates got to know the B-52 as an airman in 1965, when he performed nuclear weapons maintenance on the aircraft. A decade later, after joining Boeing, he helped with the engineering details for what was then called a "midlife" modernization of the fleet. Now a Technical Fellow and systems engineer with Boeing Defense, Space & Security's Maintenance, Modifications and Upgrades unit in Wichita, Bates helps to figure out how to successfully integrate



“The bones of the aircraft are remarkably unchanged, thanks to years of careful maintenance.”

– Ted Bates, Technical Fellow and systems engineer, Boeing Defense, Space & Security



PHOTOS: (Top) An early production B-52 rolls out of Seattle’s Boeing Plant 2 in December 1954. **BOEING ARCHIVES (Insets, from left)** A production employee works on the flight deck of a B-52C at the Seattle plant in October 1956. **BOEING ARCHIVES** Matthew Yost, a B-52 engineer, left, and engineering intern Jennifer Hoffman discuss a prototype curtain they hold in front of a B-52 cockpit window at Tinker Air Force Base, Okla. The curtains are designed to block the blinding light resulting from a nuclear explosion. **U.S. AIR FORCE**



“It has turned out to be very robust when it comes to accepting changes and upgrades.”

– Dale Clevenger, B-52 capability team manager, Flight Mechanical Systems in Wichita, Kan.



the latest technology into nuclear-capable B-52s.

“You really have 70 years of technology on this plane simultaneously,” Bates said, noting it ranges from pre-transistor vacuum tubes to digital equipment. “But the bones of the aircraft are remarkably unchanged, thanks to years of careful maintenance.”

Lessons learned from other Boeing programs have helped the B-52 fleet stay operational, according to Bates. For example, aging polymers on the aircraft, including coatings inside the fuel tanks, presented a special challenge. But expertise developed in Boeing’s maintenance programs for the C-130 proved applicable to the B-52.

With the new contract to keep upgrading the B-52 fleet, Trainer said, the plan is to move forward with installing advanced communications capabilities. These encompass new radios, monitors and computer terminals for the aircraft. Also on the horizon is the potential replacement of the B-52’s strategic radar, which was last updated in the 1980s.

Boeing also is helping update the weapons carried on the B-52.

Jeff Claybrooks, program manager for B-52 weapons programs, said activity has begun to bring the latest smart weapons into the

aircraft’s payload bay. It already can carry GPS-guided Joint Direct Attack Munitions and laser-guided bombs on its wing pylons.

To save money and time, Boeing tries to solve sustainment issues with the aircraft while adding new capabilities. For example, Boeing and the Air Force will add a needed modification to cool the aircraft interior while performing another update.

“We look for ways to be smart with the taxpayers’ dollars while enhancing the airplane and resolving basic issues,” said Jim Kroening, development programs manager for the B-52 team in Wichita.

That flexibility in the B-52 platform to incorporate modifications and updates through the years has been its ultimate strength—and the reason it’s still serving well, Clevenger noted. When it comes to aircraft availability, he added, the Boeing B-52 is still the most reliable bomber in the Air Force arsenal.

Brian Werner, Engineering manager, B-52 Sustainment program, said generations of Boeing employees can take credit for that.

“It’s an incredible achievement by Boeing design that it’s still relevant, useful and reliable,” Werner said. ■

eric.c.fetters-walp@boeing.com



PHOTOS: (Above) A B-52 from the 2nd Bomb Wing at Barksdale Air Force Base, La., deploys a Boeing Joint-Direct Attack Munition during a weapon systems evaluation held at Eglin Air Force Base, Fla. **U.S. AIR FORCE**

(Insets, from left) Staff Sgt. Ben Norton of the 2nd Aircraft Maintenance Squadron checks the engine of a B-52 at Barksdale Air Force Base, La., during an operational readiness inspection. **U.S. AIR FORCE** Staff Sgts. Dustin Hyden and Doyle Atkinson of the 36th Expeditionary Maintenance Squadron upload naval mines onto a B-52's wing-mounted ordnance rack at Andersen Air Force Base in Guam in preparation for an aerial mine-laying exercise. **U.S. AIR FORCE**

B-52 Stratofortress at a glance

Production run: 1951–1962 in Wichita, Kan., and Seattle. A total of 744 were built in all versions.

Current U.S. Air Force fleet: 76

Primary mission: Long-range heavy bomber that can carry up to 70,000 pounds (31,750 kilograms) of mixed ordnance

Engines: Eight Pratt & Whitney TF33-P-3/103 turbofan engines

Flight speed: Mach 0.84, or 625 miles per hour (1,000 kilometers per hour)

Range: 8,800 miles (7,650 nautical miles, or 14,160 kilometers)

Wingspan: 185 feet (56 meters)

Length: 159 feet (48 meters)

Maximum takeoff weight: 488,000 pounds (221,350 kilograms)

Crew: Five

Notable: The B-52 won the National Aeronautic Association's Collier Trophy for 1955. The aircraft's combat operations include all major U.S. offensives since Vietnam in the 1960s.



VOYAGE OF *DISCOVERY*

Space Shuttle *Discovery*, shown just before sunrise on Launch Pad 39A at Kennedy Space Center in Florida, is readied for its last trip into space. At the time *Frontiers* went to press, *Discovery* was set for a launch to the International Space Station in late February. *Discovery* already has logged 352 days in space over 38 missions—totaling more than 5,600 orbits around Earth. NASA plans to retire the shuttle fleet and has tentatively planned two more shuttle missions after the *Discovery* launch. Space Shuttle *Endeavour* and *Atlantis* would fly later this year. Boeing and its heritage companies developed the fleet of space shuttles. PHOTO: NASA







ONE PARTNERSHIP. ENDLESS POSSIBILITIES.

With Boeing as a trusted partner, the flight to success for India's aerospace industry promises to be a short one. We're committed to expanding the manufacturing and engineering base through key partnerships. Backing them up with industry best practices such as program management and aerospace and lean manufacturing processes. Propelling the Indian aerospace industry to the global stage, the possibilities of how high this partnership will soar are, indeed, endless.