



Frontiers

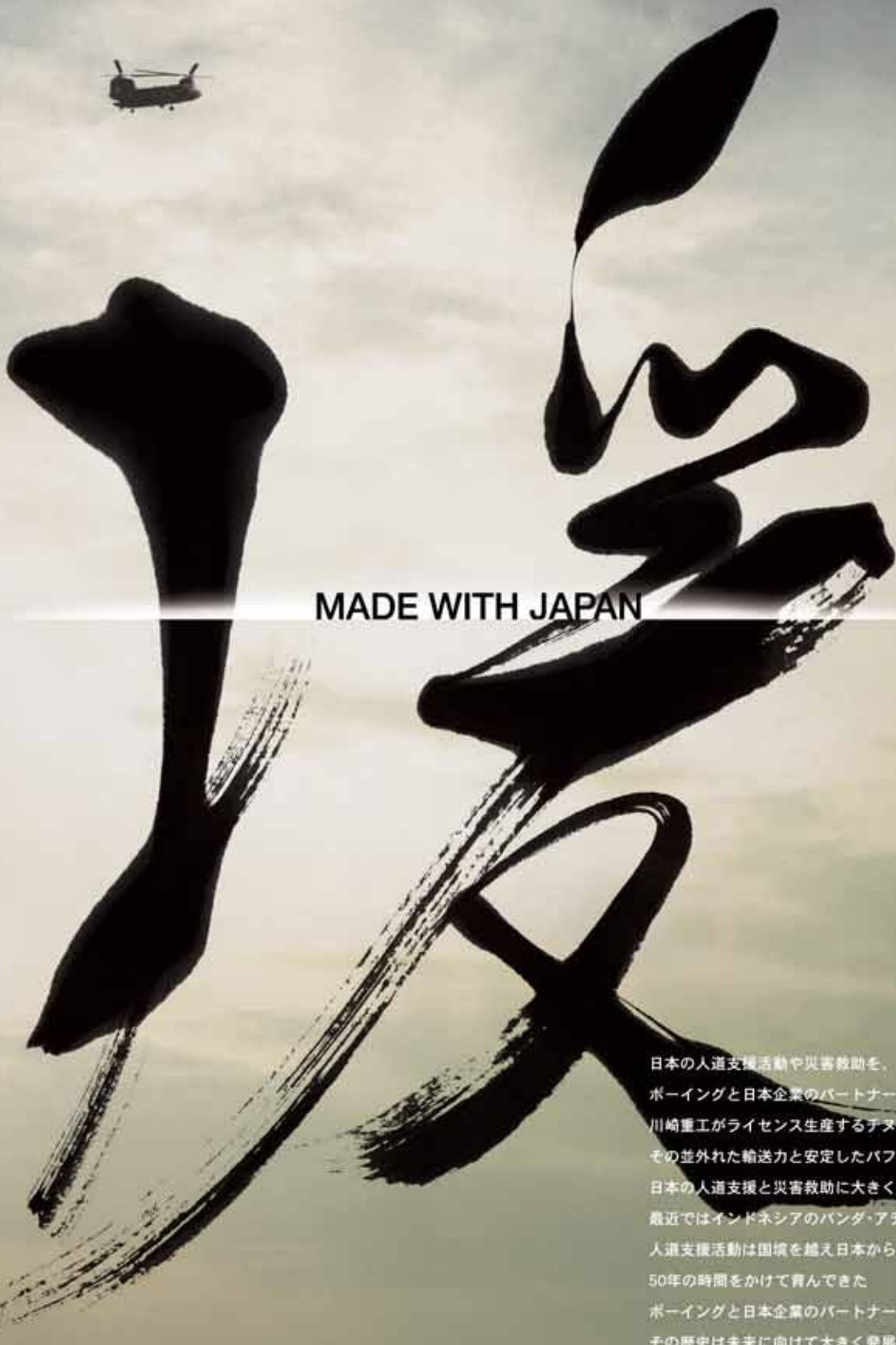
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DECEMBER 2010–JANUARY 2011 / Volume IX, Issue VIII

An aerial, top-down view of a Boeing 737 aircraft in a large factory assembly line. The aircraft is painted in a teal and white livery. The factory floor is filled with various tools, equipment, and other aircraft in different stages of assembly. The perspective is from directly above, looking down the length of the assembly line.

AcceleRATE!****

Skillful planning is essential in raising production rates. So is Boeing's teamwork.



MADE WITH JAPAN

日本の人道支援活動や災害救助を、
ボーイングと日本企業のパートナーシップが支えています。
川崎重工がライセンス生産するアマークCH-47。
その並外れた輸送力と安定したパフォーマンスは
日本の人道支援と災害救助に大きく貢献し、
最近ではインドネシアのバンダ・アチェン津波災害救助など、
人道支援活動は国境を越え日本からアジアへと拡大しています。
50年の時間をかけて育んできた
ボーイングと日本企業のパートナーシップ。
その歴史は未来に向けて大きく発展しようとしています。
さあ、一緒にすごいこと。

 **BOEING**

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Setting the pace

To meet growing demand, Boeing is raising production rates of its 777 and Next-Generation 737 jetliners, but the process is one that requires careful and extensive planning. It involves every part of the jet-making process, from the supply line to the production line. Boeing teams are heavily involved, too, and are helping to make jetliner assembly at the company's plants in Renton and Everett, Wash., more efficient than ever before.

COVER IMAGE: ONE OF THE TWO 737 COMMERCIAL JETLINER PRODUCTION LINES AT THE RENTON, WASH., PLANT. BOEING IS BOOSTING PRODUCTION RATES OF THE POPULAR SINGLE-AISLE JET. BOB FERGUSON/BOEING

PHOTO: AT THE 737 FACTORY IN RENTON, WASH., BOEING IS PRODUCING A RECORD 31.5 AIRPLANES A MONTH. THAT IS SCHEDULED TO INCREASE TO 35 A MONTH IN 2012 AND TO 38 IN 2013. BOB FERGUSON/BOEING



Ad watch

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

Inside cover:



This ad is part of a series designed to reinforce Boeing's partnership with Japan, a relationship that began more than 50 years ago. The campaign features the art of calligraphy, a Japanese tradition that communicates not only

words but a deeper meaning. This ad highlights Boeing's collaboration with Kawasaki Heavy Industries in producing CH-47J Chinooks that are called upon to provide disaster relief.

Page 6:



This Boeing Defense, Space & Security print ad is designed to establish Boeing as a key player in the cybersecurity field, uniquely qualified to provide comprehensive solutions to a growing threat. The ad is running in targeted trade publications.

Back cover:



Global corporate citizenship refers to the work Boeing does — both as a company and through its employees — to improve the world. These efforts can yield sustainable improvement in the communities

where Boeing employees live and work. This ad reflects Boeing's commitment to organizations that enrich and enlighten the lives of youths.



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 Fetters-Walp: 425-266-5871

ONLINE PRODUCTION

Web manager:
Wendy Manning: 312-544-2936

Web designer:
Michael Craddock: 312-544-2931

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

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

HOW TO CONTACT US:

E-mail:
boeingfrontiers@boeing.com

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

Phone:
312-544-2954

Fax:
312-544-2078

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

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

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Historical Perspective

The Douglas DC-3 made its first flight 75 years ago this month from an airfield in Santa Monica, Calif. As a commercial passenger plane, the DC-3 helped make flying popular and airlines profitable. As a military transport, it helped win a war. Many of these legendary airplanes are still flying today.

PHOTO: BOEING ARCHIVES



Harnessing electricity

The electrical systems of modern commercial jetliners service everything from sophisticated GPS navigation systems to the reading light over your seat. For a Boeing team in Everett, Wash., putting together the incredibly complex wire bundles necessary to make it all work is a little like creating a work of art—and no small challenge.

PHOTO: BOB FERGUSON/BOEING

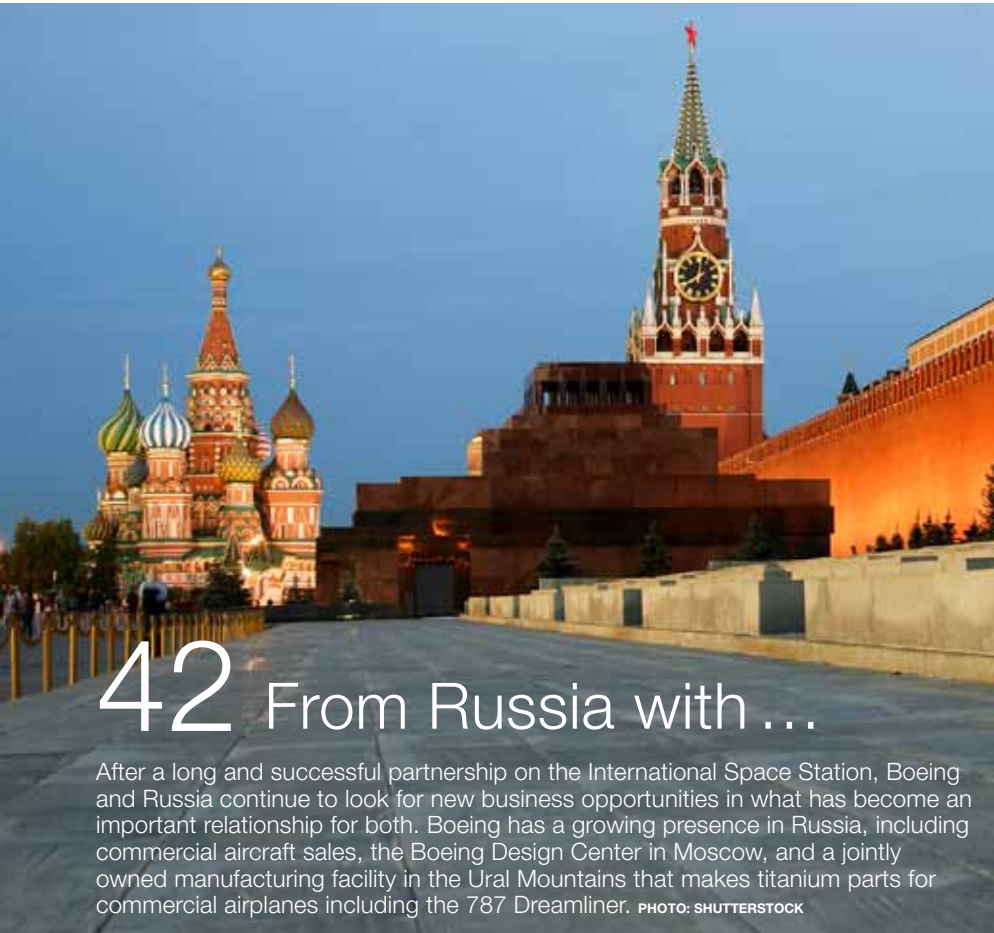


'You name it, we've tested it'

Boeing's Test & Evaluation organization is responsible for much more than just the ongoing testing work being conducted for the new 787 and 747-8 commercial jetliners. It performs critical tests at more than 70 sites across the United States. The testing might involve Boeing's largest wind tunnel at the Philadelphia site, or an antenna range in St. Charles, Mo.

PHOTO: PETER GEORGE/BOEING

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After a long and successful partnership on the International Space Station, Boeing and Russia continue to look for new business opportunities in what has become an important relationship for both. Boeing has a growing presence in Russia, including commercial aircraft sales, the Boeing Design Center in Moscow, and a jointly owned manufacturing facility in the Ural Mountains that makes titanium parts for commercial airplanes including the 787 Dreamliner. PHOTO: SHUTTERSTOCK



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Close support

The Royal Australian Air Force is retiring its F-111s (shown) with the arrival of Boeing's F/A-18E/F Super Hornets. For more than a decade, Boeing Defence Australia has successfully supported the F-111s and performed extensive upgrades on the aircraft—critical work that helped establish the organization's business—and reputation.

PHOTO: BOEING

INSIDE

07 Leadership Message

Boeing has always been a technology leader and its record of accomplishment and innovation continues today with new products such as the 787 Dreamliner. Behind all the achievements, and those to come, is the diversity, knowledge and experience of its people, says John Tracy, the company's chief technology officer and senior vice president of Engineering, Operations & Technology. When everyone works together as "One Boeing," great things can happen, he writes.

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CORRECTION

Page 39 of the November 2010 issue of *Frontiers* misstated the name of an organization involved in the development of the Boeing Crew Space Transportation-100 capsule, or CST-100. The name of the organization is Boeing Satellite Operations and Ground Systems.



CYBERSECURITY THAT'S FULLY INTEGRATED.

Every day, government and commercial cyber networks are at risk of being compromised. Protecting them requires comprehensive cybersecurity solutions. Leveraging advanced security technologies and experience garnered from its vast internal network, Boeing's expertise includes cyber capabilities across a wide array of commercial, defense, space and security systems. The result is customized, integrated solutions that ensure cybersecurity at every level.



Leading the way

Boeing's ability to operate as one global company is helping ensure competitiveness—and future growth

John Tracy

*Boeing chief technology officer and senior vice president
Engineering, Operations & Technology*

PHOTO: BOB FERGUSON/BOEING

The world sees Boeing as a global leader in technology innovation, thanks to such iconic engineering achievements as the 707, the 747, the F-4 Phantom II, the F-86 Sabre Jet, the Mercury spacecraft and the space shuttle, to name but a few. And Boeing's ongoing technology achievements are driving important new products such as the 787 Dreamliner.

Behind all these great achievements are what I think really makes Boeing a technology leader: our employees. When we have focused the diversity of their knowledge, experience and perspectives on a common goal, we have achieved bigger and better things for our customers, our company and the world. And it is this objective and this approach that underlies today's "One Boeing" strategy.

Some examples of how we are implementing this strategy can be found in this edition of *Frontiers*. You'll find a story, for instance, about one of our Boeing Test & Evaluation managers who is helping integrate the company's flight-test teams so that they can better tackle the unprecedented amount of flight testing Boeing is conducting—almost 6,500 flight tests so far in 2010 alone. We're doing this by integrating all the company's flight-test resources, cross-training our pilots, and standardizing our test processes and procedures, all of which are also designed to help improve quality, reduce costs and provide more development opportunities to our test team members. Another Test & Evaluation-related story describes how we're trying to achieve similar integration and outcomes in Boeing's lab test operations.

The advantages of this one-Boeing approach have been well demonstrated by the consolidation of the company's information technology resources some years ago. It's managed to reduce annual IT costs by more than 20 percent while also increasing the reliability, security and ease of use of one of the largest and most sophisticated IT networks in the world.

This mission of enhancing Boeing's growth, productivity and ability to operate as one company is supported by our other Engineering, Operations & Technology organizations as well. For example, the recent consolidation of all the company's resources for manufacturing research and technology, materials and processes, and product standards into Boeing Research



& Technology is paying dividends by allowing us to work more smoothly and efficiently among Boeing sites, and better engage technical experts regardless of location. And our new integrated technology planning process is not only ensuring technologies are ready when needed but also providing significant savings through more focused investments, the elimination of technology gaps and overlaps, and broader sharing of results. And the one-Boeing approach to environment, health and safety, and intellectual property management has sharpened our focus and improved our results in these areas as well.

So as in decades past, we continue to achieve bigger and better things at Boeing—and do it more efficiently and effectively—by channeling the diversity of our employees' knowledge, experience and perspectives toward common goals that help strengthen our competitiveness and ensure future growth. We have a great team of enterprising, dedicated employees at Boeing, and by working together as one company we will remain the global leader in aerospace technology and enjoy a prosperous future. ■

Snapshot

HEAVY LIFTING

A Delta IV rocket carrying a classified satellite for the U.S. National Reconnaissance Office lifts off from Cape Canaveral Air Force Station in Florida Nov. 21. The Delta IV Heavy, which was developed by Boeing and launched by the United Launch Alliance, is the most powerful liquid-fuel rocket available today. It can generate more than 2 million pounds (9,000 kilonewtons) of thrust and launch payloads of up to 24 tons (22 metric tons) into low Earth orbit, or 11 tons into a geosynchronous orbit. Standing 235 feet (72 meters) tall, the Delta IV Heavy consists of three Common Booster Core rockets. PHOTO: U.S. AIR FORCE



Quotables

“This program is very quickly becoming the Department of Defense and industry standard for how to do acquisition right.”

– U.S. Navy Rear Adm. Steve Eastburg, talking about the P-8A Poseidon at the opening of a new facility near Boeing Field in Seattle, where mission systems will be installed on the modified 737s.

“I believe the 787 will be every bit as important, and maybe even more important, to the future of this company than the 707 was to Boeing at the dawn of the jet age.”

– Jim McNerney, Boeing chairman, president and CEO, speaking Nov. 11 at the Wings Club in New York City.

Navigating change

Bringing together Boeing test teams offers challenges—and many benefits

By Sandy Angers



As the Integration leader for Boeing Test & Evaluation, Al Pedroza heads the effort to bring together test and evaluation employees, facilities and equipment into a single, companywide operation. The integration began in 2009, and when it is completed this month, about 7,000 employees working at more than 70 sites across the United States will be one team. PHOTO: JIM ANDERSON/BOEING

As a longtime test and evaluation engineer, I'm used to the challenges associated with testing and verifying the design of Boeing products. But bringing together test operations across the company into an enterprisewide test organization has been the biggest challenge of my 21-year Boeing career.

My Integration team has been working with representatives from Commercial Airplanes, Defense, Space & Security, and Engineering, Operations & Technology to ensure the right people, assets, work scope, accounting practices and facilities are brought together effectively into Boeing Test & Evaluation.

It's more than creating transition schedules; we're assessing the best way to transition Test and Evaluation entities into the organization, looking at factors such as where programs are in their life cycle, the actual scope of test work being conducted, and the potential positive and negative effects of integration.

I'm often asked, Why integrate test operations? The answer is simple: As a company, we need to improve efficiency. Boeing has more than 250 test environments spread out over 3 million square feet (278,700 square meters) throughout the U.S. Yet

even during a time when we are conducting more than 30 test programs across the company, we still have excess capacity.

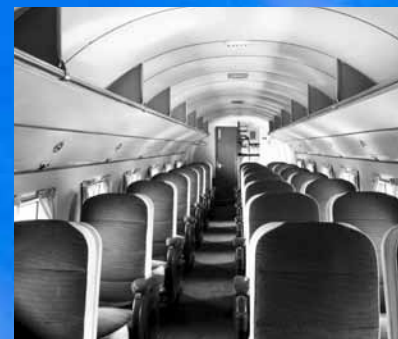
There are many advantages to having an integrated organization. In addition to reducing costs, it's easier to implement standardized processes. And an integrated organization can better provide opportunities to employees.

The biggest challenge is helping people manage the change. Some see potential opportunity; others are naturally anxious. Part of my job is to help people understand the impact and provide resources to help them navigate the change. That includes our business partners in programs, because as testers, we're an integral part of a program's organization, operations and deliverables.

The most rewarding part of my job has been the insight I've gained into what change management really requires. As an engineer, tester and manager, I've always focused on capabilities and schedules, but through this experience, I've learned that change really comes down to people. Understanding their needs and addressing them in the change process is hard work but worth every effort. ■

sandra.l.angers@boeing.com

Flying leg



PHOTOS: (Below) The American Airlines Flagship Rochester is shown in flight. **(Insets, from left)** The luxurious interior of an American Airlines Douglas Skysleeper Transport, which had seven upper and seven lower sleeping berths; the original DC-3 day plane interior; a C-47, the military version of the DC-3, off the coast of Malibu, Calif.; more than 10,000 C-47s rolled off the wartime production lines at a peak rate of two per hour. **BOEING ARCHIVES**



Legend

The DC-3's speed and range helped make air travel popular *By Pat McGinnis*

Not far from the glitz of Beverly Hills and Hollywood, the airplane that would become a legend had an understated debut.

Unlike today's first-flight media events, no film crew or even a photographer was on hand to record the moment when the Douglas Skysleeper Transport, soon to be known throughout the aviation world as the DC-3, took off for the first time from Clover Field in Santa Monica, Calif.

American Airlines had convinced Douglas to develop the plane, and two of the airline's executives, Bill Littlewood, vice president of engineering, and Melvin D. Miller, sales manager, were on the field to witness the first flight, along with the flight-test crew.

They could not have imagined that what happened on the Santa Monica runway that day would change aviation history. It was Dec. 17, 1935—32 years to the day that Wilbur and Orville Wright flipped a coin to see which one would make the first powered airplane flight on a wind-swept beach at Kitty Hawk, N.C.

It's been 75 years since the Douglas plane climbed for the first time into the Southern California sky a few miles from Hollywood. Many DC-3s are still flying.

As a commercial passenger plane, the DC-3 was one of the most successful ever developed. At a time when airlines needed government air mail subsidies to stay in business, the DC-3 made it possible for airlines to carry only passengers and turn a profit. It opened up air travel to a huge segment of the world's population.

Military versions were used extensively during World War II and were known by many names, including Gooney Bird, Skytrain, Skytrooper and Dakota. After the war, Gen. Dwight D. Eisenhower, who would later be elected president of the United States, credited the plane as being vital to winning the war.

More than 10,000 of the commercial and military transports were built.

That first one was known as the Douglas Sleeper Transport and was delivered to American Airlines in June 1936. It could be fitted as a sleeper for 14 overnight passengers, or 28 passengers







for shorter daytime flight. The first standard version of the DC-3, which could carry 21 passengers, was delivered to American two months later.

With the DC-3, American Airlines got the plane it wanted, one that could fly nonstop from Chicago to New York with more room for passengers but with the performance of the DC-2.

It all started with a \$335.50 long-distance phone call from Chicago to Santa Monica.

American Airlines President C.R. Smith placed the call to Donald W. Douglas Sr. in late 1934 to discuss a larger, faster, “wide body” version of the DC-2. Douglas was doing very well selling the DC-2 and was not that interested. But during that two-hour phone conversation, the American Airlines president convinced Douglas to pursue a design study. Douglas agreed that if his engineers told him it was feasible, he would do it.

Even though his airline was low on cash, Smith guaranteed that American would order up to 20 planes with options for 20 more. At \$100,000 each, it was a potential \$4 million deal.

American sent Littlewood, its engineering president, west to meet with the Douglas design team. Meanwhile, Smith went east to secure a loan with the Reconstruction Finance Corp. for \$4.5 million.

A plane Douglas initially did not want to build, with money American Airlines did not have, was born.

United Airlines, which was under the direction of Bill Boeing until 1934, was the second customer for the DC-3.

In all, 455 commercial DC-3s were built for the airlines. But more than 10,000 were produced as C-47 military transports during World War II. For many soldiers, the C-47—known as the R4D in U.S. Navy service and as the Dakota in service with the Royal Air Force and other Commonwealth air forces—was the first airplane they ever flew in. The C-47 was flown by every branch of the U.S. military and all the major allies. It delivered supplies during the 1948 Berlin Air Lift and saw action during the Korean and Vietnam wars.

In 1960, Douglas spoke of the DC-3 and its future. “More than 10,000 of these transports were built, and they represent a 25-year time span of service,” he said. “It is safe to predict that a few of these hardy veterans will be flying 25 years from today.”

The enduring and venerable DC-3 has exceeded his expectations by 25 years ... and counting. ■

patricia.m.mcginis@boeing.com

PHOTOS: (Far left) The American Airlines Flagship Bristol rolls out of the Douglas hangar in Santa Monica, Calif. **(Insets, from top)** DC-3 creators, from left, Arthur E. Raymond, John “Lee” Atwood, George Strompl, W.B. Oswald, James “Dutch” Kindelberger, Donald W. Douglas, E.F. Burton, F.R. Collbohm and J.O. Moxness; a DC-3 inside the Douglas Santa Monica hangar; the 2,000th C-47 built at the Long Beach, Calif., plant, with some of the “Rosie the Riveters” who helped build it. **BOEING ARCHIVES**



Healthy investment

Research shows Well Being programs are good for employees, as well as the business *By Susan Birkholtz*

Almost \$1 billion of the estimated \$2.4 billion that Boeing will spend in 2010 on health care is due to conditions linked to health risks employees have some control over, including physical inactivity, tobacco use and poor nutrition.

That's big bucks. And it's why the many Well Being offerings Boeing provides figure prominently into the company's strategies for driving down health care costs in order to remain competitive in this challenging business environment.

"We want all our employees to focus on improving their health, whether that means losing weight, quitting tobacco, eating more nutritious foods, managing their stress more effectively or starting an exercise program," said Rick Stephens, senior vice president, Human Resources and Administration.

"All of us, no matter how healthy and fit we may be, have something about our physical or emotional health that could be improved."

Stephens pointed out that even employees who have chronic health conditions can take steps to manage those conditions more effectively, such as participating in a condition management program, either through OptumHealth or their health plans.

"The payoff is twofold—improved quality of life for our employees, as well as reduced health care and disability costs for the business," Stephens said.

Recent research underscores his point: Encouraging employees to maintain or improve their health and effectively manage chronic health conditions can be effective in keeping down health care costs. This is true not only for the company but also for employees in terms of coinsurance and other out-of-pocket expenses, which many Boeing employees are going to pay for the first time in 2011.

A study by Highmark, a 12,000-employee health insurer based in Pittsburgh, speaks to the savings potential of corporate wellness and related programs. Highmark measured the return on investment of its various employee wellness, preventive and condition management programs over four years, from 2001 through 2005. Medical claims for 1,900 Highmark employees who participated in its wellness programs were compared with the claims of employees with similar health risks who did not participate.

The findings, published in the February 2008 *Journal of Occupational and Environmental Medicine*, showed that the company saved \$1.3 million over those four years, mainly because its annual health care expenses for participating employees were \$176 lower per employee. Highmark's total expenses for its wellness programs were \$808,958 over the same time period, yielding a return of \$1.65 for every dollar spent on wellness initiatives. Although the study did not measure it, participating employees likely saved on out-of-pocket costs as well.

Such results may help explain why more than 60 percent of U.S. companies with 10,000 or more employees have a wellness program, up from 47 percent in 2005, according to a 2008 MetLife survey.

Boeing has a tradition of supporting employee health and well-being that reaches back at least 25 years. Today, the company provides employees with access to an ever-growing number of Well Being programs, tools and resources—online, via telephone and in person. Based on the dozens of Boeing employees who have come forward to tell their stories over the years, these programs have transformed—and in some cases, even saved—lives. And since just 2006, these programs are estimated to have saved the company and its employees more than \$145 million—several times what Boeing invested in Well Being during this time.

"By improving the health of the work force and reducing what we spend on health care, Boeing will be able to use that money to invest in our people, products and services and, most important, remain competitive," said Stephens. "It's a win-win for everyone." ■

susan.l.birkholtz@boeing.com

For more information on Well Being programs, tools and resources that support employees' efforts to mitigate or eliminate preventable health risks and effectively manage existing chronic health conditions, visit <http://wellbeing.web.boeing.com> on the Boeing intranet.



PHOTO: Mary Wolf, director, Boeing Defense, Space & Security Manufacturing Quality, El Segundo, Calif., completed her first marathon and triathlon in her 40s. "My body is in the best shape ever," she said.
DANA REIMER/BOEING

Space:



GRAPHIC: The Space Based Space Surveillance System satellite, shown in this artist's rendering, has a telescopic camera that will give the U.S. Air Force its only space-based sensor capable of detecting and monitoring debris, satellites and other space objects without the disruptions from weather, atmosphere or time of day that limit ground-based observations. **BOEING**

The cluttered frontier

Boeing-led team developed satellite that tracks orbiting spacecraft and ‘junk’

By Diana Eastman

It's crowded up there.

Fifty years ago, when Russia and the United States began sending satellites into orbit, it was a pretty empty place. Not today.

About 1,000 active spacecraft are circling the earth, and at least 20 times as many pieces of “space junk” are flying around. Satellite builders and operators are increasingly worried about collisions that could disable or destroy their satellites and disrupt the vital services they provide, from battlefield communications to banking transactions.

In September, a government and industry team led by Boeing Space and Intelligence Systems helped the U.S. Air Force take a significant step in its ability to watch, predict and react to what's going on in space. The launch of the first Space Based Space Surveillance (SBSS) System satellite will give the military a sky-high perch from which it can see and assess orbiting objects.

What was once tracked only from the earth can now be tracked from space.

“This satellite is going to revolutionize the way we track objects in space by not being constrained by the weather, the atmosphere or the time of day,” said Col. J.R. Jordan, vice commander, Space Superiority Systems Wing, U.S. Air Force Space and Missile Systems Center, who retired in November.

Data collected around the clock by the new satellite will be correlated against information from ground- and ship-based sites to maintain a more up-to-date and accurate catalog of space information.



“SBSS will enable the Air Force to maintain a dynamic, daily map that will revolutionize space situational awareness.”

– Todd Citron, director of Boeing Advanced Space and Intelligence Systems

PHOTO: PAUL PINNER/BOEING

The new system is expected to triple the capability of detecting threats to U.S. military spacecraft from unfriendly nations and tracking debris in deep space and near the earth.

“More than 60 countries are currently operating satellites, but we aren't always told what they're for,” said Todd Citron, director of Boeing Advanced Space and Intelligence Systems. “SBSS will enable the Air Force to maintain a dynamic, daily map that will revolutionize space situational awareness and protect those space assets that are so essential to our military and our economy.”

The satellite weighs just over a ton and is about one-eighth the size of a typical communications satellite. Every 90 minutes, it passes over the North and South poles, about 330 miles (540 kilometers) above the earth.

It has a sensor, or telescopic camera, with a large aperture and wide field of vision that gives it an unobstructed view of three-quarters of the sky

without having to reposition the satellite. A reprogrammable onboard computer processes the camera's images and can quickly adapt to changing mission requirements. The Satellite Operations Center in Colorado can swing the camera as required, track objects at very high speeds and deliver near-real-time data.

As prime contractor, Boeing is handling systems engineering and integration, the Satellite Operations Center and initial mission operations. Partner Ball Aerospace provided the satellite and sensor that utilize an onboard computer and software Boeing developed.

“This collaboration is about providing critical information to our customers,” said Roger Krone, president of Boeing Network & Space Systems. “SBSS will give the Air Force a lot more knowledge, make the nation's assets more secure and keep America at the forefront of space.” ■

diana.b.eastman@boeing.com



Hard-wired for success

Making complex wire bundles for Boeing airplanes is not unlike creating a work of art

By Kathrine Beck and photos by Bob Ferguson

Think of it as the circulatory system of a commercial airplane.

Miles of electrical wiring—more than 130 miles (210 kilometers) of it for a 747-8 Freighter—travel all over a Boeing Commercial airplane, tucked away behind panels in electrical shelves and racks overhead and underfoot, from the cockpit to the wheel wells and tail.

That wiring provides power and control for systems that do everything from navigating the airplane to entertaining the passengers.

Boeing Fabrication's Electrical Systems Responsibility Center team in Everett, Wash., builds the incredibly complex wire bundles that are vital to every aspect of the airplane's operation. The center provides wire harnesses, power panels



“I’ve formed many bundles in my sleep, believe me.”

– Christina Leslie, wire assembler, Boeing Fabrication

and electrical shelf assemblies to Boeing 737, 747, 767 and 777 commercial jetliners, as well as military derivatives of commercial airplanes and out-of-production models. Its employees also support the 787 program with needed changes to electrical wire bundles, and build bundles for warranty repairs, modifications and post-delivery support to meet spares and airplane-on-ground requirements for all Boeing airplanes.

Wire assembler Christina Leslie has worked all over the responsibility center in her 29-year Boeing career. She’s even dreamed about her work.

“I’ve formed many bundles in my sleep, believe me,” she said. “I really like my job. I enjoy learning new things, and there’s a lot of documentation and classes that a

person needs to take to do this. But it’s really worth it because I know I’m putting out a quality product. I take a lot of pride in the work I do.”

Because of options and cabin configuration, wiring design is specific to each individual airplane configuration, adding complexity to an already complex job.

Building a wire bundle starts in the coding area. Big spools of many different kinds of electrical wire sheathed in various colors are placed in stacked rows inside a big glass box—part of a Spectrum Technologies Ltd. laser device. Nearby, an operator programs a machine that positions the correct spool, unreels and cuts the wire, then codes it, imprinting a number, either on its sheathing or on an attached tag.

The lengths of coded wire are brought

PHOTOS: (From top left) April Holt verifies wires in the Electrical Systems Responsibility Center coding area; Rattanak “RC” Chea installs a wire bundle in a 737 shelf; Joe Richards works on the 777 forward instrument panel; Lulu Duong fabricates a wire bundle for a 737 shelf; Clyde Larson installs a wire bundle in the 777 overhead panel; Robert Harrington (left) and Jayson Santos work on a 777 family group wire assembly.



“I look at what these people do and how they can sort it all out and make it look like a work of art.”

— Steve Gilmore, senior operations support manager, Boeing Fabrication



together with kitted parts—splices and hundreds of connectors. Each wire end is stripped, crimped and placed in the correct miniscule connector hole, some so small that workers need to use magnifying glasses.

Next, the bundles are created on formboards, marked with the pathways the wires must take. The formboards vary in size depending on the bundle that’s being built.

Formboard technology has been around for a long time. Back in 1943, Boeing sent employee Ivy Lehde and a formboard to the display window of a downtown Seattle building, where she demonstrated her dexterity and skill to thousands of amazed pedestrians. More than six decades later, seeing today’s

employees assemble a mass of wires and connectors is just as amazing.

To the casual observer, all those wires look like a maze of ultra-thin spaghetti, but every wire has just one right place to go. Pegs in the boards help employees route the wire to shape the bundles. Ties, sometimes hand-knotted, hold groups of wires together. For extremely complicated bundles, pyramid-shaped formboards called tepees are used.

Once correctly configured, terminating connectors are added to the assembly, and the wire bundle is complete.

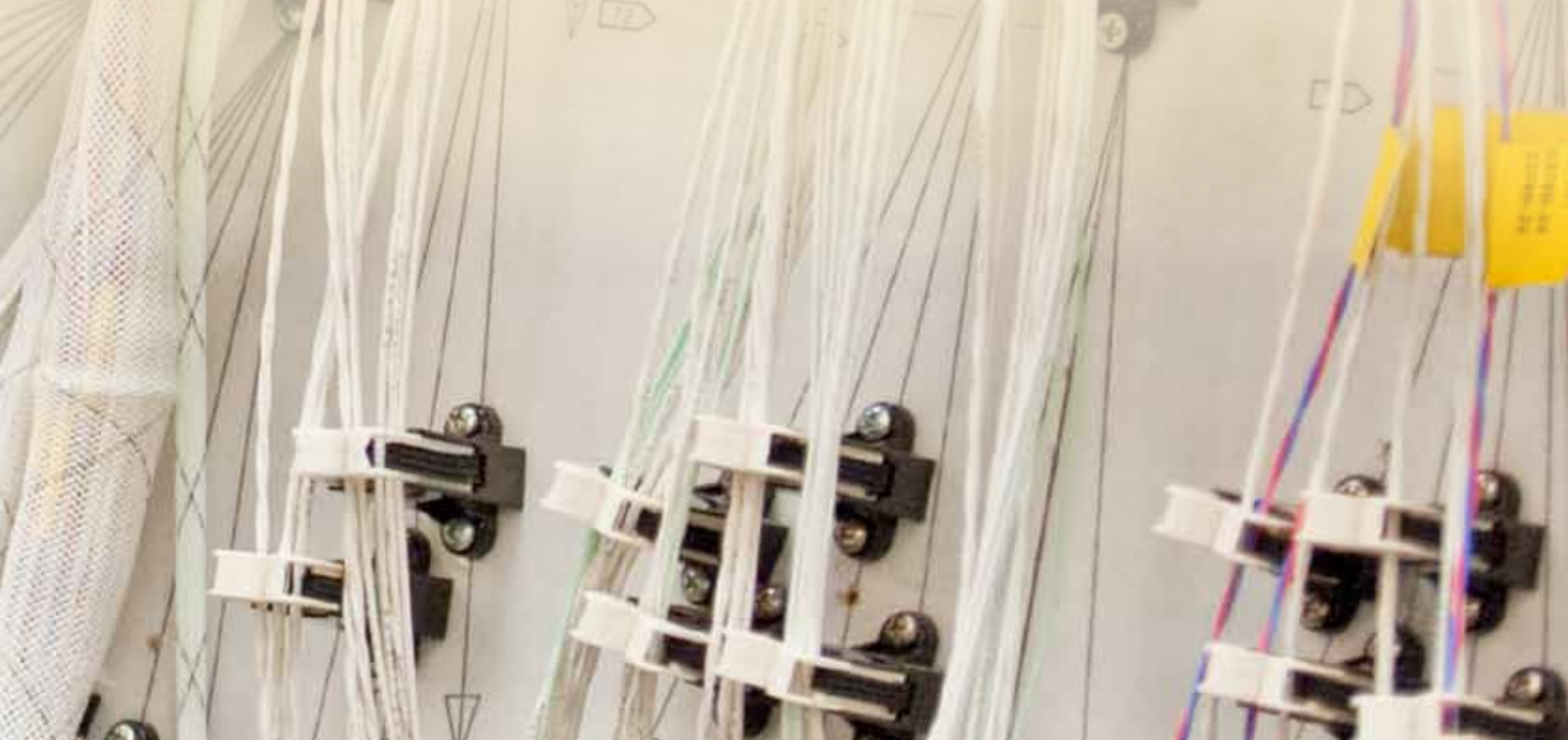
The bundles are then stuffed into the metal frameworks—shelves and panels—that will house them on the airplane. But before they are delivered, bundles are attached to an electrical testing device. A

current is run through the bundles to make sure there are no crossed wires and that no electricity is leaking out of the bundle.

Panel builder Dave Seeger installs wire bundles into panels that go to the final assembly line. He understands how complex the work of the responsibility center team might appear to observers.

“When you first see it, it looks that way,” he said. “But the engineering and the paperwork is so good it pretty much tells you where everything goes. You’ve got to follow the specs. And then we have two layers of checks before it leaves the wire shop—a test machine and inspection. We don’t want to pass on any defects to the factory.”

The responsibility center also puts together what they call “family groupings”—



long wires that might run along the length of the cabin or from the flight deck to an area much farther away. These long-haul wires don't travel alone. To make assembly easier, they are sorted into groups. Family groupings are assembled at facilities all over the United States and in countries around the world.

They come together at the responsibility center. Long, straight bundles are assembled on tables that can be 100 feet (30 meters) long. They are wound up onto round, dinner-table-sized spools that are unrolled by final assembly electricians.

"I look at what these people do and how they can sort it all out and make it look like a work of art," said Steve Gilmore, senior operations support manager at the Everett center, said of the wiring team. "It's

unbelievable. These people are so good at what they do—sometimes at very short notice—and so passionate about what they do." ■

kathrine.k.beck@boeing.com

PHOTOS: (From top left) Nghia Tran fabricates a wire bundle for a 777 shelf; Vivian Nguyen fabricates a wire bundle for a 777 panel; Frank Fischer assembles a 777 panel; Manh Pham works on a 777 formboard; Tom Bone works on a 737 formboard; Gonzalo "Junior" Dayawan assembles a 737 panel.

98 great ideas

Meet some of Boeing's top innovators *By Cindy Naucler Glickert and Marcy Woodhull*

Innovation is alive and well at Boeing. This year, the company honored 98 of its top engineers, scientists and technologists from across the company for their ingenuity at the annual Boeing Special Invention & Technical Replication Awards events.

The ideas they've brought to life, as well as their innovative replications of previous inventions, are increasing product performance, maximizing productivity and enabling new business opportunities.

"We have a strong culture of innovation and creativity," said Martha Ries, vice president of Intellectual Property Management, the organization that works to identify, protect and leverage Boeing intellectual property. Ries noted that for the fourth year in a row, Boeing has been ranked the top U.S. patentee among aerospace and defense companies by the Patent Board, a leading patent

analysis group. The rankings are based on criteria such as quantity, technical strength and how quickly a patent becomes an asset.

"This year we recognized one of our largest numbers of inventors who have taken their ideas from vision to reality to enhance our products or services."

It is also the second year the company has honored outstanding replicators. The Technical Replication Award recognizes the transition of an existing technical capability to other programs.

"This award honors our enterprising teams of engineers who work across the breadth of Boeing's products, replicating technical solutions," said Amy Buhrig, vice president of Enterprise Technology Strategy. ■

cindy.n.glickert@boeing.com

On the following pages are stories about some of Boeing's top innovators. The complete list of those who were honored in 2010 with Boeing Special Invention & Technical Replication Awards can be found online: www.boeing.com/news/frontiers/archive/2010/december/i_eot.html

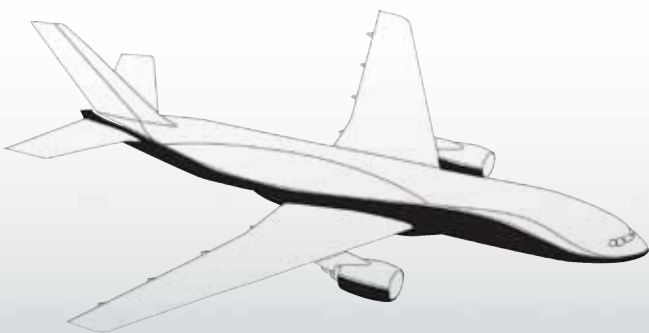
Lori Straus

Sanding an airplane to prepare it for painting requires strenuous work and creates an environmentally hazardous dust.

That's why a team of Boeing chemical engineers and material scientists worked together to develop a chemical process called the Activation Method Using Modifying Agent.

"It replaces hand sanding, which can potentially cause repetitive motion injuries, and it's cleaner for the environment," said Lori Straus, a Boeing Research & Technology materials scientist and Associate Technical Fellow in Everett, Wash.

The chemical agent is sprayed on the exterior surface of an airplane and acts as an adhesion promoter for the topcoat paint. Benefits of using the chemical agent include improved paint quality, faster production, the elimination of environmentally hazardous dust, and ergonomically safer work for painters. This new chemical material and process is currently being used on all Boeing commercial airplanes. ■ PHOTO: GAIL HANUSA/BOEING



Marty Bradley

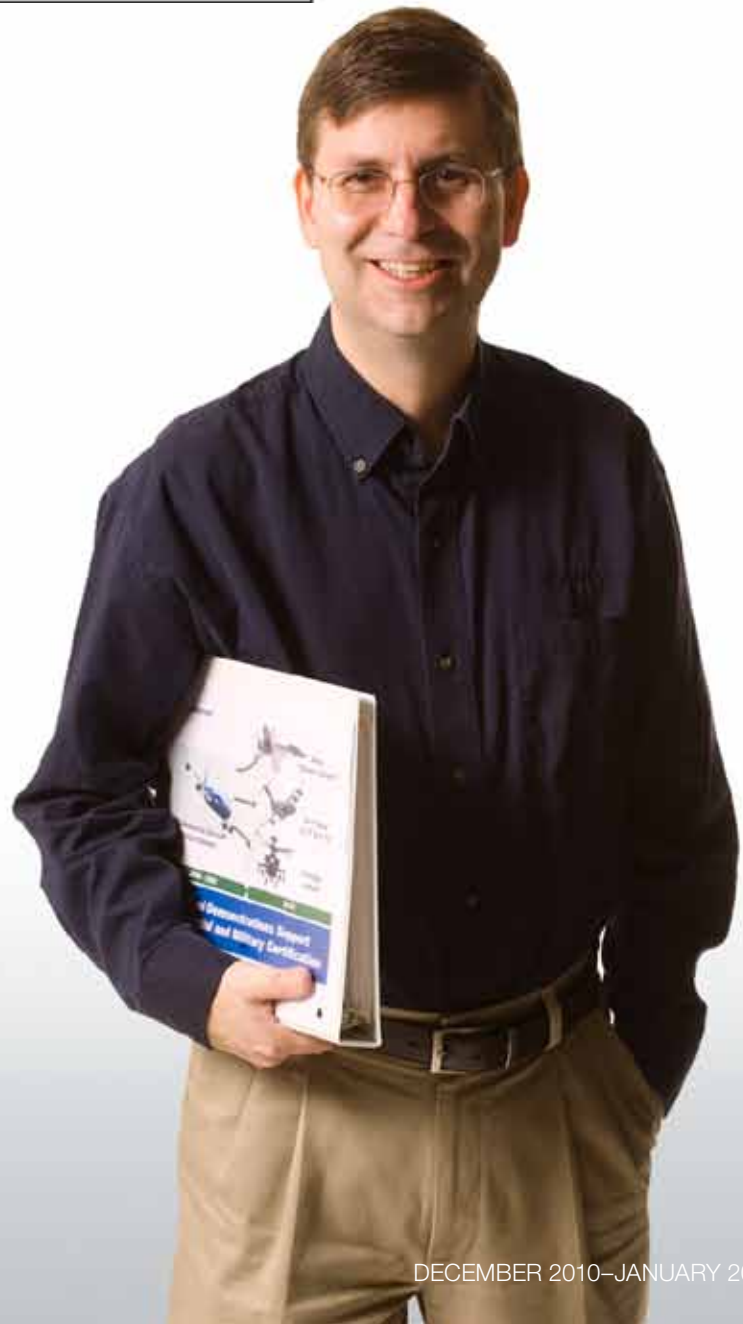
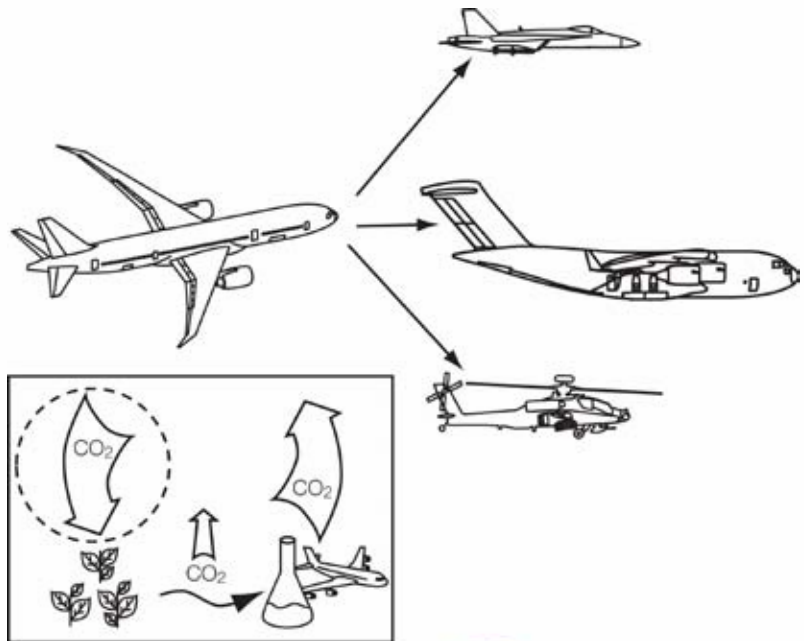
As part of its environment-related activities, Boeing is involved in developing biofuels for commercial aviation. So it made sense to replicate these efforts to support defense customers.

Marty Bradley, a Platform Performance Technology aerospace engineer with Boeing Research & Technology, was part of a team that received a Technical Replication Award for replicating its work on sustainable aviation biofuel.

“When I started working with biofuels in 2006, the U.S. Air Force was looking at making synthetic jet fuel from coal, which was not a smart environmental move,” said Bradley, based in Huntington Beach. This year, with Boeing’s assistance, the Air Force conducted biofuel flight demonstrations in its F-15 and C-17 aircraft. The U.S. Navy conducted a flight demonstration in the F/A-18 and the Royal Netherlands Air Force flew an AH-64D Apache helicopter using a biofuel blend.

In 2011, the American Society of Testing & Materials is expected to approve the use of sustainable aviation biofuel for commercial air travel. And the U.S. Defense Department is on track to certify the use of a 50 percent biofuel blend in all of its aircraft by December 2012.

“It just goes to shows how applying good work on one program to another can leverage the strengths of Boeing,” Bradley said. ■ PHOTO: PAUL PINNER/BOEING





Shuguang Song

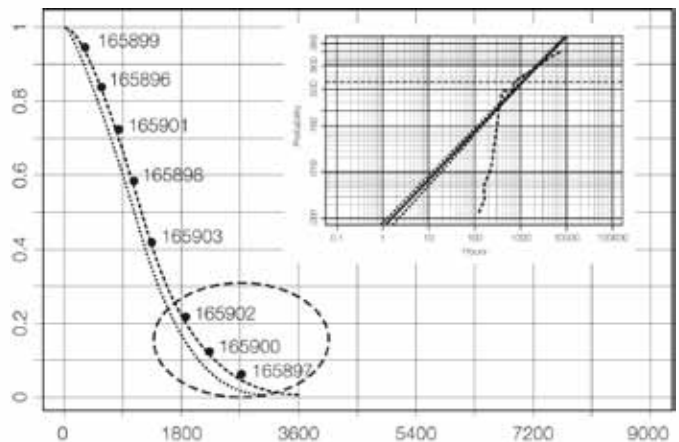
Determining the optimal schedule for when an aircraft requires maintenance work is not always obvious, and redundant repairs can cost operators time and money.

A recent Boeing-developed software system called the Maintenance Interval Determination and Optimization Tool takes the guesswork out of required maintenance by integrating an advanced statistical reliability and economic analysis module.

“It reduces the subjectivity in maintenance requirements and determines the optimal time for aircraft repair,” said Shuguang Song, a Boeing Research & Technology statistician in Seattle and member of the team that created the system.

The program was developed by a diverse team of innovators from across the company, including Boeing Research & Technology, Commercial Aviation Services, and Boeing Defense, Space & Security.

The maintenance tool has been approved by the Federal Aviation Administration for the 787 and 747-8 initial scheduled maintenance programs. It’s being replicated to support the Boeing Logistics Command and Control and the C-17 programs—which earned this invention a Technical Replication Award. ■ PHOTO: GAIL HANUSA/BOEING





Robert Reynolds

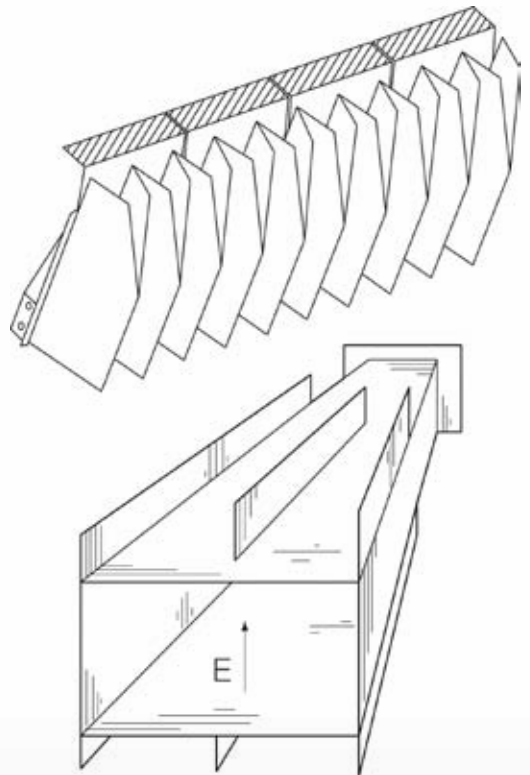
Radio frequency waves are used to send and receive information to and from satellites, but errant wave scattering can cause serious problems within the constricted space of a satellite.

“Picture a flashlight beam that’s aimed straight ahead that allows no illumination to the sides,” said Robert Reynolds, an electrical engineer and Technical Fellow with Space and Intelligence Systems in El Segundo, Calif. “In very simple terms, we needed to find a similar way to confine radio frequency illumination to avoid parasitic interference.”

Reynolds and a team of engineers did just that. They invented the Radio Frequency Absorbing Fin Blanket, a carbon-based, thermal protective blanket shaped like a series of fins that absorbs unwanted radio frequency waves.

“Without this blanket, the satellite can get inadvertent signals from different directions,” Reynolds said. “The blanket effectively blocks and absorbs stray energy from payload components and the sides and back of the satellite antennas.”

The fin blanket has enabled Boeing to bid more efficiently on satellite programs, and is being widely used on 11 different satellite programs. It also has other potential applications, such as for use in ground-based antennas. ■ PHOTO: PAUL PINNER/BOEING



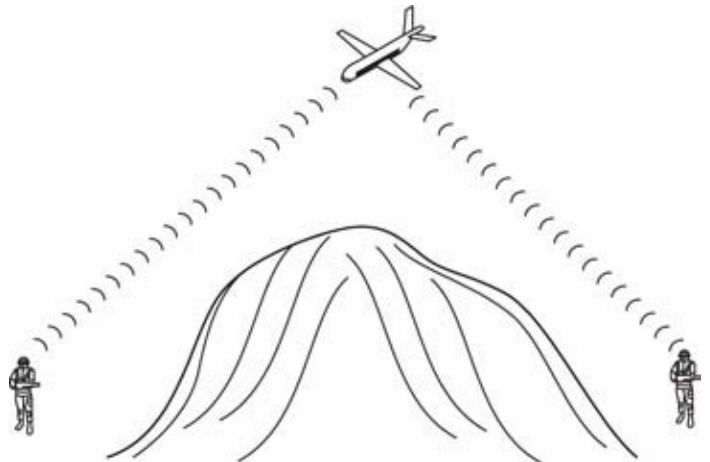
David Hilliard

Operating a ScanEagle unmanned aerial vehicle—used for surveillance in the battlefield—required intense operator control and coordination between the vehicle and its camera.

Taking automation to a new level, the inventors of the System and Method for Autonomous Tracking and Surveillance developed an electronic system that enables the aircraft's camera to automatically follow its target's destination and keep the vehicle in stealth mode and out of harm's way.

David Hilliard, a Boeing Defense, Space & Security unmanned systems engineer and ScanEagle operator, said he trained with U.S. Marines and worked with Boeing field service representatives to “identify the problem and understand the situation from the soldiers’ perspective.”

Working closely with the Marines, Hilliard and a team of Boeing engineers identified the problems, wrote software, and conducted simulations and flight testing. Undertaking these tasks also involved spending 18 months in Iraq as part of the Boeing ScanEagle operator team, Hilliard said. ■ PHOTO: ASSOCIATED PRESS



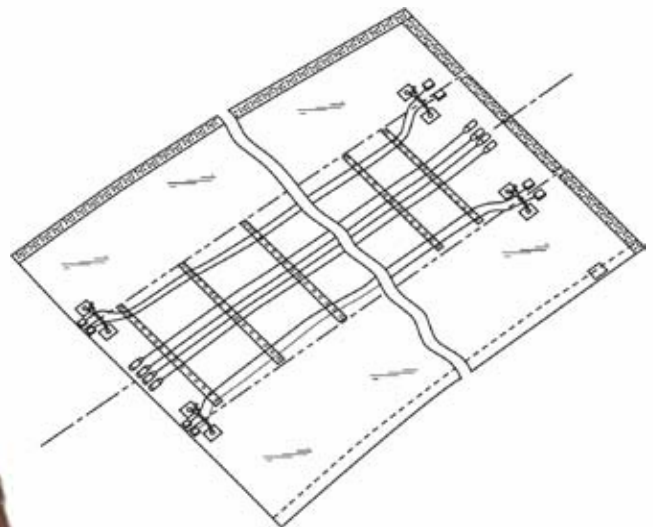
Dan Jockisch

Anyone who has flown on a commercial jetliner has probably turned on an overhead light or enjoyed the in-flight entertainment options. These and other amenities are available thanks to an airplane's electrical wiring systems, made up of wire bundles with components such as connectors and terminals. But installing these bundles can be tricky.

Faced with challenging wiring issues on the 777 Freighter Program, Dan Jockisch, a Commercial Airplanes design engineer, designed the Wire Bundle Pull Tool. The invention is a sliding piece of flat material, with Velcro around the edges that encases the wire harness assembly and can be easily threaded through complex structural assemblies. The pull tool, which can handle wire bundles that reach more than 50 feet (15 meters) long, reduces installation time, improves quality and enhances workplace safety.

Jockisch said his wife—"a great supporter of all my visions and projects"—sewed the first prototype. He brought it to his core group and they began brainstorming. From there he took it to an Accelerated Improvement Workshop.

"There are no dumb ideas, just different ways of looking at things," Jockisch said. "Never be afraid to express an idea; that's what our future is all about." ■ PHOTO: GAIL HANUSA/BOEING



In context



Boeing is developing a common control system for its growing fleet of unmanned aerial systems

By Marguerite Norgren

PHOTO: A launcher catapults a ScanEagle unmanned aerial vehicle at a test facility in eastern Oregon. INSITU

Control

Against a backdrop of sandy, scrub desert punctuated here and there by jagged mountaintops, a small, birdlike object is launched into billowing clouds above Fort Huachuca, Ariz.

Minutes later and miles away, an operator aboard a NATO Airborne Warning & Control System (AWACS) aircraft assumes full control of the “object,” a ScanEagle unmanned aerial system, and begins to receive real-time video feed from its onboard camera.

Although Boeing has been testing the control of unmanned aerial systems, or UAS, from manned aircraft since 2006, this test in the skies over Arizona this summer marked the first time an airborne command platform took control of an actual unmanned craft—without any simulation involved.

But Boeing is looking beyond even that significant milestone. Its Advanced UAS Mission Systems team is developing a universal command and control system for use with all of Boeing’s growing unmanned fleet.

The fleet includes the successful ScanEagle and its new big brother, the Integrator, both by Boeing subsidiary Insitu, as well as the A160T Hummingbird rotorcraft, UH-6 Unmanned Little Bird and S-100 Camcopter. Boeing’s Phantom Works organization is developing a number of unmanned aerial prototypes including the Phantom Ray, Phantom Eye and Solar Eagle.

Previously, every time Boeing designed a new unmanned aerial system, it would have to design a command and control system to go along with it, said Randy Rothe, the team’s senior manager. “Our new common system allows us to more easily and quickly create prototypes as well as realize efficiencies and reduce costs,” he said. “Our customers appreciate the greater flexibility it affords, not to mention the elimination of redundant systems and reduction in training requirements.”

Whether the mission is intelligence, surveillance and reconnaissance (ISR) or strike, the common command and control system enables operators on the ground or in the air to autonomously manage and task unmanned aerial systems with missions, and route them as required.

Rothe’s 30-person team is developing the new system in Irvine, Calif., Tukwila, Wash., and St. Louis.

“It’s exciting to work with an emerging technology that significantly improves the capabilities of our warfighters,” said team member and software engineer Aaron Camac.

The capability to integrate unmanned aerial systems with manned aircraft illustrates what John Hearing, senior manager, Next-Generation ISR Aircraft, calls “the value of the high ground.”

“Pairing a high-altitude, manned aircraft like AWACS that can see long distances with a UAS that’s closer to targets—without putting aircrews at risk—yields more accurate and actionable intelligence that can be used to counter threats,” Hearing said.

What’s next for Rothe and his team?

They are working to provide other Boeing-built aircraft such as the P-8 Poseidon and the Airborne Early Warning & Control aircraft—both of which are based on the 737 commercial jet—with the capability to control unmanned aerial systems. The team also has its sights on future programs such as the U.S. Navy’s Unmanned Carrier-Launched Airborne Surveillance and Strike program.

As Rothe noted, “There’s a world of possibilities out there.” ■

marguerite.o.norgren@boeing.com

Night moves

Jetliner production rates are going up, and Boeing teams are picking up the pace

By Dawsalee Griffin and photos by Bob Ferguson

In the late night and early morning hours when many Boeing Commercial Airplanes employees in Washington state are asleep, huge pieces of tooling and a future jetliner are on the move in the 777 bay at the sprawling Everett factory.

They are being “walked” across the floor by the third-shift tooling team—a vital cog in making sure that the 777 production line stays on schedule.

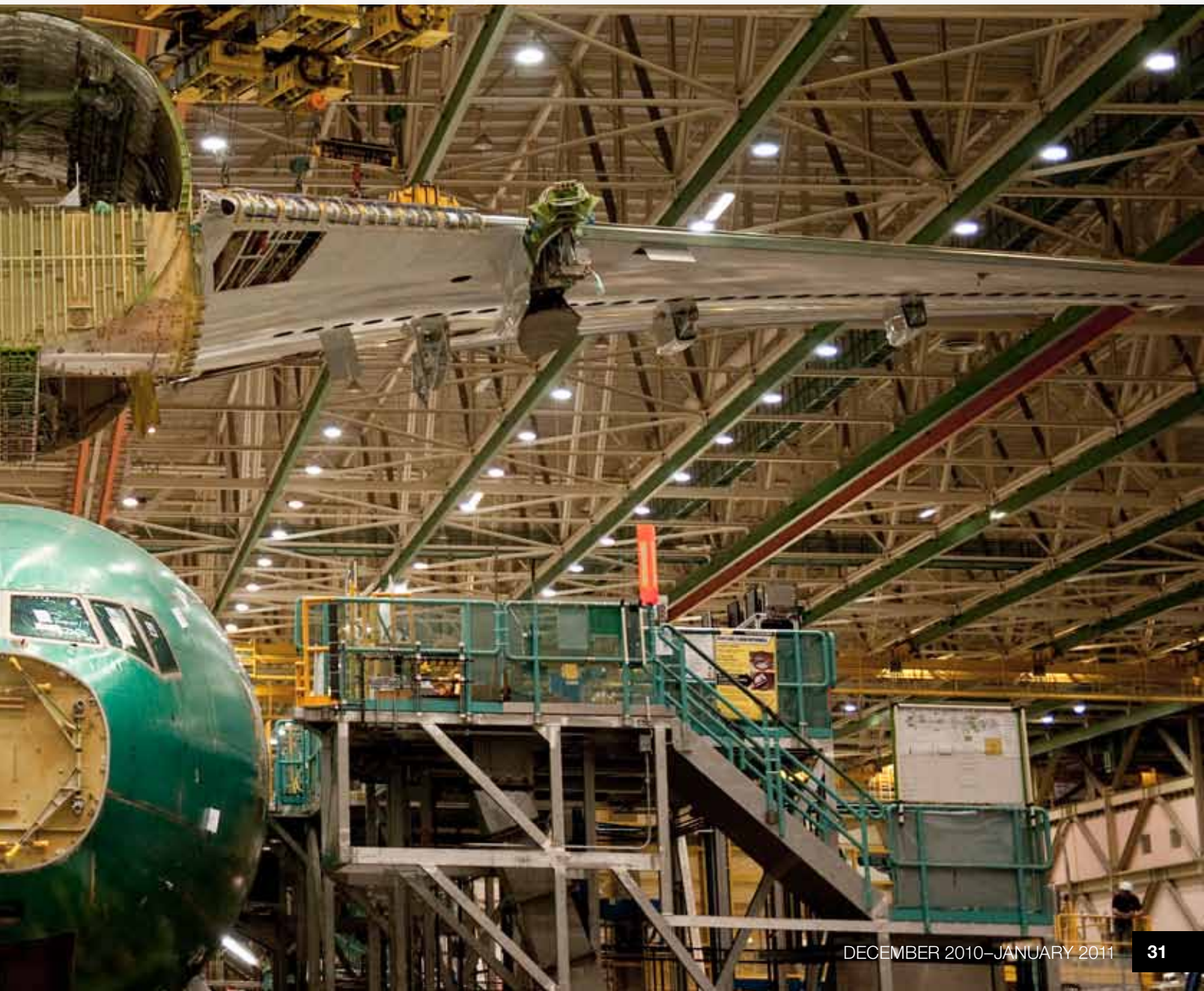
“The clock is ticking,” said Bob Bowen, third-shift 777 production manager. “We have to have everything ready for the first-shift employees to walk in and begin their work.”

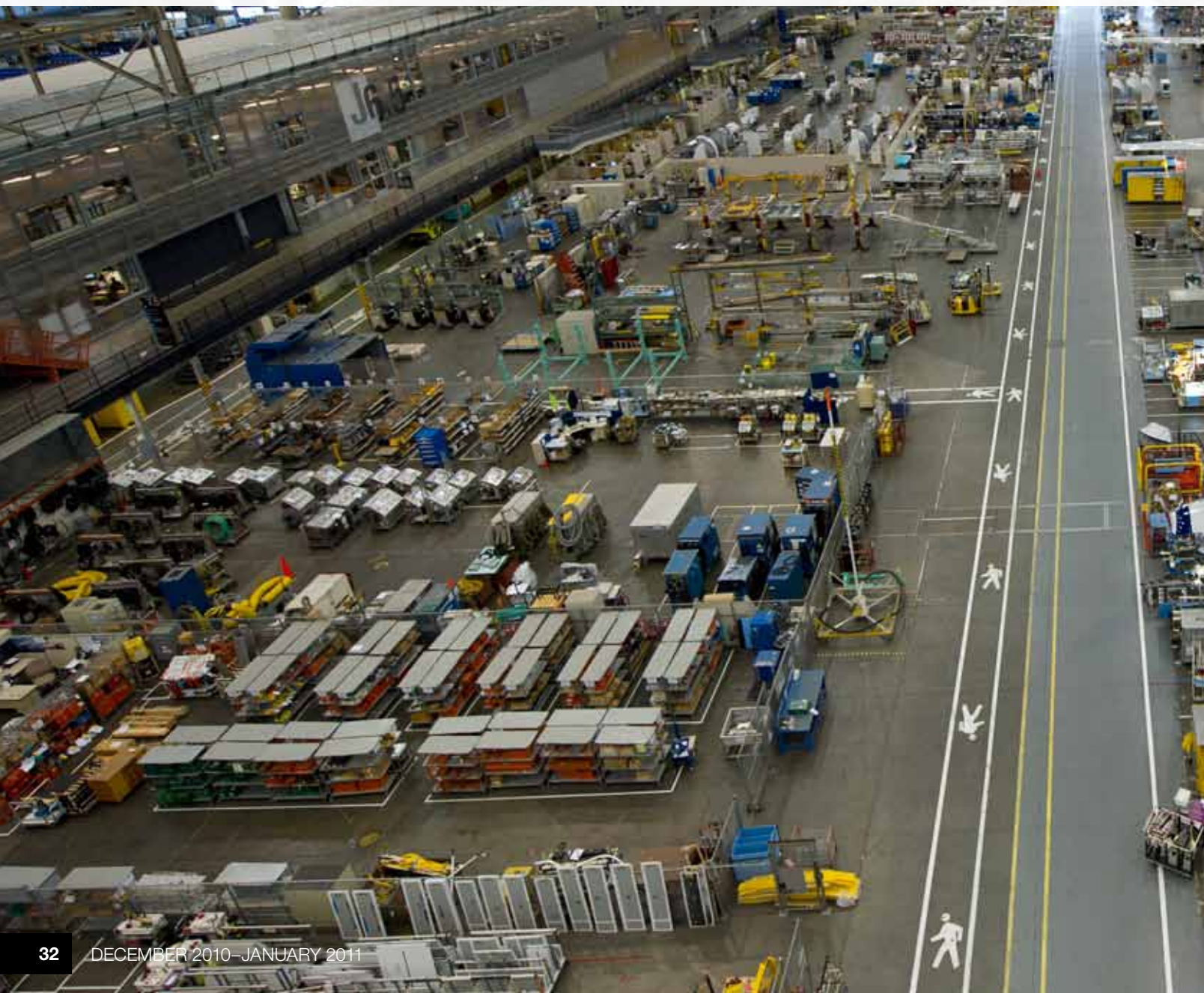
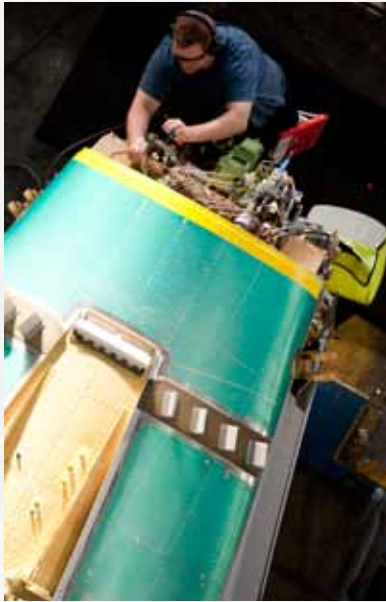
Bowen calls it a “mechanical ballet” as forklifts maneuver tooling, including large sections of scaffolding, platforms and stairs, away from 777s in preparation for moving fuselage pieces to the proper position in the final body join area where the wings are added and a familiar-looking airplane begins to take shape.

The recycle team, as the group is known, has to

PHOTOS: (Below) The giant pieces of the 777 are moved into place in the final body join area at the Everett, Wash., factory. **(Insets)** 777 mechanics Lance Lieparek (left) and Derec Sysavath (right) help guide the wing section into the final body join tool.







PHOTOS: (Below) The Renton, Wash., factory turns out a record 31.5 Next-Generation 737s a month. That rate is scheduled to increase to 35 in 2012 and 38 in 2013.

(Insets) 737 mechanics including Samoeun Van (center) work on Next-Generation 737s.

complete the intricate dance every fourth day in a little less than seven hours. And the pace is about to pick up.

Teams throughout the Boeing production system are continuously working to improve processes. But the drive to produce commercial airplanes even more efficiently has taken on a greater sense of urgency, especially for the twin-aisle 777 program at Everett and the single-aisle 737 program at the Renton plant about 40 miles (65 kilometers) south. The pace at which the jets are assembled and delivered is going up to meet growing customer demand.

Production of the 777 will increase in mid-2011 to seven airplanes a month. The 737 program, already producing a record 31.5 airplanes a month, is scheduled to push that rate to 35 a month in 2012 and then to 38 in 2013.

“We are always studying possibilities,” said Mandy Burton, Commercial Airplanes business operations. “We look at the marketplace and figure out how to balance demand versus capability.”

Knowing the current capacity of a production line—and how much of it is available for increased production—is essential in determining what needs to be done to increase rates.

Planning teams throughout Boeing identify what it will take, down to the smallest detail, to build more airplanes. The goal parallels that of the 777 team—to make sure everything is ready for the employees to do their jobs whether the increase is one plane a month or seven.

Information going back to Burton’s group addresses requirements down to the





PHOTOS: (Below) Propulsion employees prepare engines to be installed on Next-Generation 737s.

(Insets) From left, 737 mechanics Nichelle Lilly-Baylor, Jackie Thompson and Chi-Yao Hu work on 737s.

smallest detail—from people and equipment to the lead-time required for acquiring critical materials and parts. Even details such as the amount of space required for the increased production are considered.

“First-line supervisors participate in the planning,” said Rick Payment, 737 industrial engineer. “They help us understand what the mechanics do and the impact of any changes.”

Boeing has been here before. And the result wasn’t good.

“The process changed dramatically with the last 737 rate increase in the late 1990s,” explained Matt Bueser, director of 737 business operations. “We now do a more thorough study of the entire value stream, ask broader questions about capability and capacity—both inside and outside Boeing. No one wants to repeat the experience of shutting down the factories.”

Boeing performs the same production readiness assessment with suppliers. “We look at their facilities, equipment and operations in relation to capacity,” Bueser said.

Utilizing Lean+ is one way to build up capacity incrementally, according to Bueser. Boeing has made many improvements in the 737 moving line using Lean+ practices.

“We used to take 22 days in final assembly to build a Next-Generation 737. Now we take 11,” Bueser said.

It’s a similar success story at the Everett plant, where assembly processes have been



improved using Lean+ initiatives. A good example is one improvement made by the 777 third-shift tooling team.

At three positions on the production line, the tooling team has to remove equipment and then replace it for the next airplane down the line. The tooling team has to break down equipment, some of which can be 60 feet (18 meters) long and weigh up to 60,000 pounds (27,200 kilograms).

While the tooling is being moved, mechanics can't work on the planes.

The challenge: Find a way to complete the equipment moves quickly and correctly so that the mechanics can get back to work on the airplanes.

The third-shift tooling team reorganized the work area using Lean+ practices and help from second-shift provisioners who stage parts and tools so mechanics don't have to leave the airplanes to find what they need.

"Since using the new staging process," said Adam Ginsburg, 777 industrial engineer, "the tooling group has been able to complete the critical milestones two hours earlier."

That means the mechanics on third shift can get back on the airplanes earlier to complete their tasks—just one of the many critical moves that must take place in getting to rate. ■

PHOTOS: (Below) Dan Wheeler (foreground), 777 Tooling, prepares the front sections of a 777 to move into final body join. **(Insets)** The 777 line move takes the coordinated efforts of many employees. From left: a Shared Services Group forklift driver prepares to maneuver tooling; Marcus Whybark, Shared Services floor-sweeping equipment operator, cleans any foreign object debris from the floor during the line move; Rachel Bovey, 777 Tooling, directs traffic during the line move.

dawsalee.griffin@boeing.com







Testing the future

Test and evaluation teams
do much more than aircraft
flight testing

By Jennifer Hawton

In St. Charles, Mo., what looks to be a full-sized fighter aircraft is mounted on a 30-foot (9-meter) pedestal. But it's not a statue.

To make testing of complex antenna systems on aircraft more efficient and economical, a Boeing team at the antenna range designed and built this ground-based tool—to which they mount a fully functioning aircraft. It allows the team to reposition the aircraft quickly and easily to verify its many antenna systems all work regardless of the aircraft's configuration and alignment. The testing approach eliminates the need for expensive, time-consuming flight tests.

"It takes a lot of effort and knowledge to make sure we test every antenna combination from every angle," said John Vortmeier, the field lead for the antenna range. "But this team knows every trick in the book. Maybe we wrote the book."

Vortmeier's team is part of Boeing Test & Evaluation, the centrally managed test and evaluation organization. Probably best known for the flight-test work it's conducting on the 787 Dreamliner and 747-8, it also performs critical test and evaluation work at more than 70 sites across the United States, including St. Charles.



The efforts of the test teams play a large role in ensuring that Boeing ultimately delivers on the promises made to its customers.

One of those sites is in Philadelphia, where a test and evaluation team works with Boeing's largest wind tunnel, the largest privately owned one in the United States. At 20 feet (6 meters) high and 20 feet wide, it can create winds in excess of 250 mph (400 kph).

Built in 1968, the wind tunnel has been used for more than 80,000 hours of component and model testing.

"You name it, we've tested it," said Bill Grauer, wind tunnel manager. "We've tested every airplane in the 7-series from the 727 to the 787. We've tested fighters, helicopters, ships and ground vehicles."

Data obtained from these tests are often used to provide customers technical information about a Boeing product before it goes into production. Testing at the tunnel also supports in-service products by testing changes, such as the effects of adding antennas.

Boeing also owns wind tunnels in the transonic and supersonic

"This team knows every trick in the book. Maybe we wrote the book."

– John Vortmeier, Boeing Test & Evaluation engineer and field lead for the St. Louis antenna range

PHOTOS: (Left) An employee stands inside Boeing's wind tunnel in Philadelphia, the largest privately owned wind tunnel in the United States. **BOB FERGUSON/BOEING (Above)** Boeing Test & Evaluation engineers Jerry Bathon, left, and John Vortmeier at Boeing's outdoor antenna range at Smartt Field in St. Louis. **PETER GEORGE/BOEING**



“This kind of work helps ensure the future stability of the Structures laboratory and Boeing.”

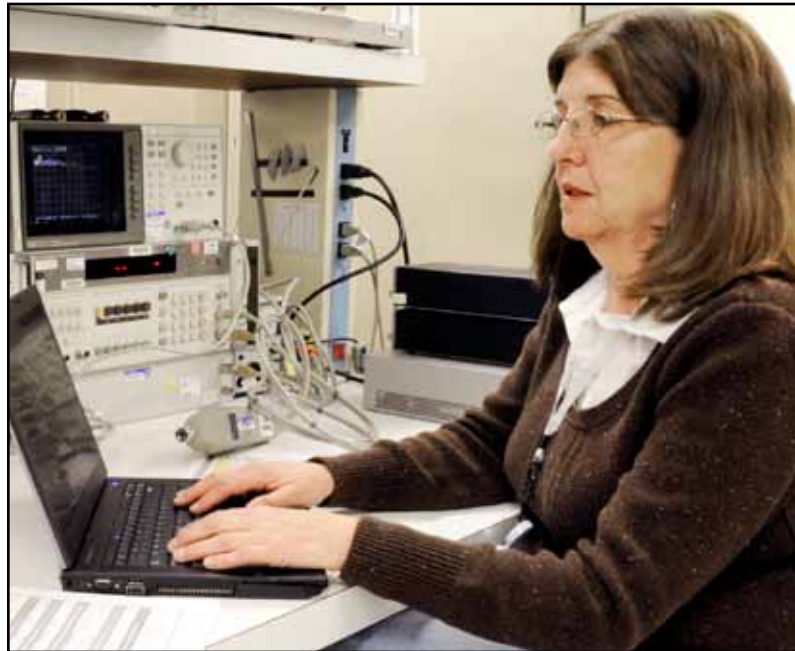
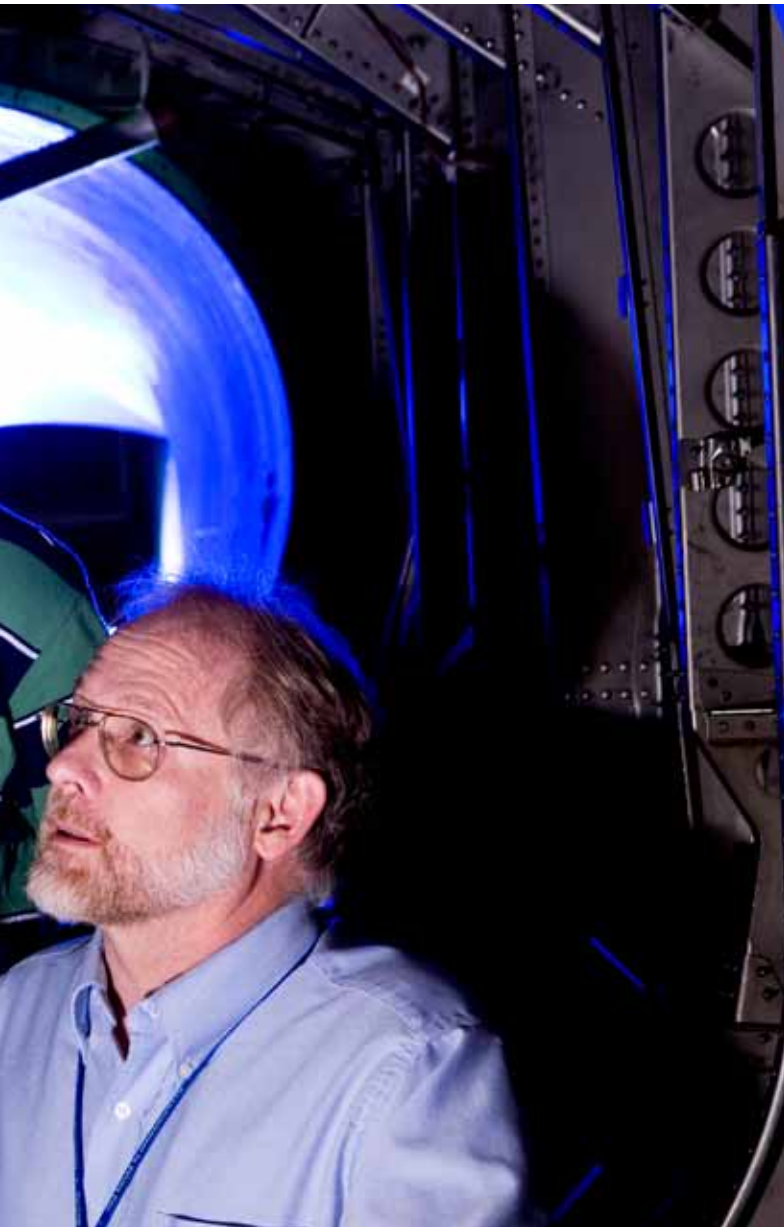
– *Mark Hopper, manager of the Structures and Material laboratory, Boeing Test & Evaluation*

ranges, which gives the company a unique strategic advantage. Grauer noted that since the Philadelphia wind tunnel became part of Boeing Test & Evaluation, it's become better connected with the resources across the company.

“The enterprise organization provides the infrastructure and connections needed to make things go faster and more efficiently,” Grauer said. “It couldn't have come at a better time, since next year will be one of our busiest years.”

Meanwhile, another team is working to keep U.S. Air Force F-15Cs in service longer. Many of these jet fighters are approaching their original design life certification. The goal of the full-scale fatigue testing is to certify the airframe is capable of continued operations to 2025.

Before fatigue testing can begin, the test aircraft must be fitted with thousands of data-collection sensors. So far the Structures lab team has completed putting 270 sensors inside the wings. Rather than buying a new data system, the Structures lab is using a data-collection system created for 787 wingbox structure testing.



Equipped for the future

To conduct their expansive range of tests, Boeing Test & Evaluation teams require specialized test and lab equipment, from oscilloscopes to multimeters. One of the organization's teams is in charge of these tools.

The Boeing Test Equipment Management Center, with locations across the company and a "storefront" on the Boeing intranet, can help find the right tool to test nearly anything.

"The current Web-based system allows us to quickly see test assets anywhere in the company," said Jim Smith, equipment focal for the southern region. Visibility of all available test equipment helps Boeing standardize across the company and control costs by reducing duplication or the need to purchase equipment the company already has.

And "because we have a bird's-eye view of overall testing requirements, we can purchase equipment that can be used by the majority of teams," said Mike Wallace, northwest equipment focal. "There is a lot of demand right now with so much flight testing on both the commercial and defense sides. I'm very pleased we can meet these needs because of our ability to share across business units. A few years ago we wouldn't have been able to meet these increased demands."

— Jennifer Hawton

The Air Force has also awarded Boeing fatigue testing of the F-15E. The company's performance on the F-15C and its ability to quickly respond to the customer's needs on the F-15E "has brought another full-scale fatigue test into our lab," said Mark Hopper, manager of the Structures and Material laboratory.

"This kind of work," Hopper said, "helps ensure the future stability of the Structures laboratory and Boeing." ■

jennifer.l.hawton@boeing.com

PHOTOS: (Above) Structures lab engineers Phil Webb, left, and Jerry Bast inspect sensors used to collect fatigue test data on an F-15C test article. **PETER GEORGE/BOEING (Right)** Denise Robinson helps ensure that the tools at the Test Equipment Management Center in Huntsville, Ala., are in proper working order.

MIKE MCCORMICK/BOEING

Down-to-Earth SUCCESS

After a long, successful partnership on the space station, Boeing and Russia expand collaboration on Earth

Stories by Bill Seil

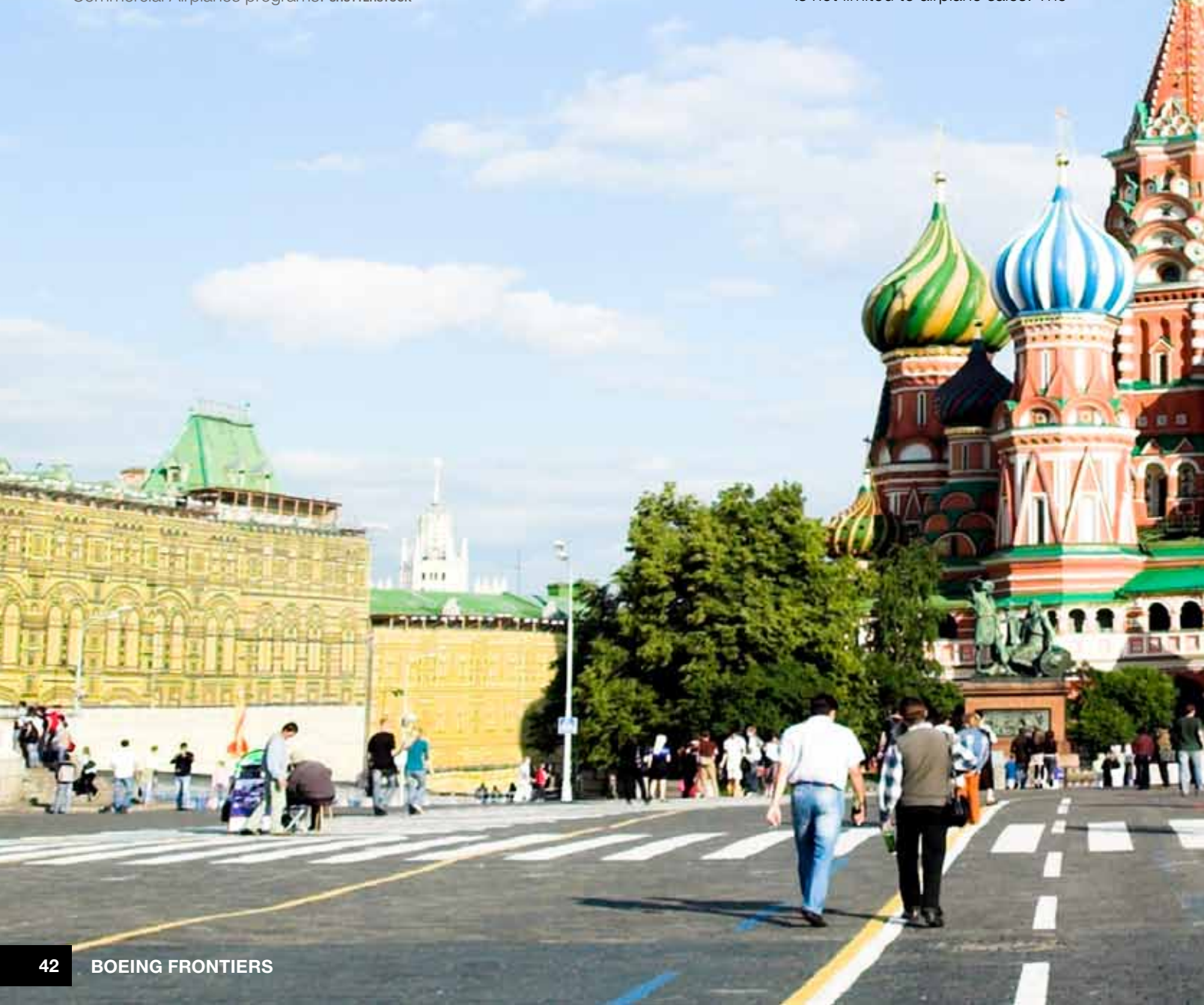
PHOTO: Where Russia's past intersects with its future—St. Basil's Cathedral in Red Square, Moscow. The nearby Boeing Moscow office and Boeing Design Center are leveraging the country's engineering talent and natural resources to advance critical Commercial Airplanes programs. SHUTTERSTOCK

As recently as the early 1980s, it would have been difficult to imagine the Soviet national airline, Aeroflot, flying Boeing airplanes.

Today, the Russian airline has Boeing jetliners in its fleet and is a customer for the 787 Dreamliner. Other Russian carriers, created since the days of the Cold War, also fly Boeing airplanes.

In late 2010, a diverse, government-owned company, Russian Technologies, placed an order for 50 Next-Generation 737 airplanes, which will be used by several state-run airlines. This is Boeing's largest sale to Russia in terms of the number of airplanes. Some of these planes will arrive before the 2014 Winter Olympics in Sochi, Russia. (See story on Page 48.)

Boeing's business activity in Russia is not limited to airplane sales. The



company has a Moscow office, employing 220 people, that oversees operations in Russia and the Commonwealth of Independent States. The same building is also home to the Boeing Design Center, which has about 1,150 contract engineers working in concert with Boeing engineers in the Seattle area. They play an important role in around-the-clock design support for Boeing commercial airplane programs.

"Russia has an excellent talent base of highly educated people," said Shep Hill, president, Boeing International. "We've been able to leverage that talent very effectively to support some critical Commercial Airplanes development programs."

The company's oldest Russian facility, the Boeing Technical Research Center, was created in 1992. It taps the talent of Russian scientists and information technol-

ogy specialists to work on Boeing contracts in commercial aviation, information technology and space. Boeing subsidiary Jeppesen employs approximately 100 people at its St. Petersburg, Russia, office.

In addition to talent, Boeing has developed a number of business alliances within the country, including one to use Russian titanium on the 787 and other Boeing commercial jetliners.

"Russia represents a very good global model for Boeing," Hill said. "We have established partnerships there that have enhanced our productivity and given us access to valuable resources. Our presence and involvement in Russia have also had a positive effect on our relationship with Russian airlines."

The company's operations in Russia are led by Sergey Kravchenko, president

of Boeing Russia and the Commonwealth of Independent States. Kravchenko joined Boeing in 1992, when he helped establish Boeing's overall presence in the region. Today, Boeing employs some 2,500 full-time and contract employees throughout Russia.

Kravchenko said business opportunities in Russia have grown dramatically since the days of the Soviet Union. The country has been open to new outside business alliances and is seeking full membership in the World Trade Organization.

One early sign of this liberalization was the opening of Russian airspace in 1999 to allow point-to-point service via polar routes. Kravchenko, representing Boeing, worked with the Russian government to negotiate this change, which gave a boost to the sale of Boeing long-haul jetliners such as the 777.

"This was a critical element to our

Russia at a glance

Location: Northern Asia, bordering the Arctic Ocean, between Europe and the North Pacific Ocean. The largest country in the world by territory with 11 time zones, it covers 6.5 million square miles (17 million square kilometers)—about 1.8 times the size of the United States.

Population: 139 million

Capital: Moscow

Other major cities: St. Petersburg, Ekaterinburg, Novosibirsk, Vladivostok, Nizhni Novgorod

National language: Russian

Government: Russia has existed as an independent republic since 1991. Current leaders include President Dmitry Medvedev and Premier Vladimir Putin.

Gross domestic product (2009 est.): \$2.11 trillion

Trade partners: (Exports) Netherlands, Italy, Germany, China, Turkey, Ukraine; (imports) Germany, China, Ukraine, Italy, United States

Sources: U.S. and Russian governments



international sales and it would not have happened if Russia had not looked on Boeing as a reliable long-term business partner,” Kravchenko said.

He sees “huge opportunities” for commercial airplane sales as Russian airlines replace their aging Soviet-built fleets. He also sees bright prospects for Boeing Commercial Aviation Services. As Russian airlines adopt Western operational models and advancements in technology, they will need support in areas such as training, management consulting, engineering, information technology and efficient operations. (See story on Page 48.)

Kravchenko believes Russian expertise in engineering, design and information technology can strengthen both Boeing and its customers.

“Our Moscow office is focused on

increasing revenue in both airplane sales and services,” Kravchenko said. “But we also want to leverage every opportunity to reduce costs and develop new technologies to improve the company’s productivity and make our airplanes more competitive worldwide.”

Kravchenko notes that the titanium partnership involving Ural Boeing Manufacturing is particularly significant to Boeing. (See story on Page 50.) The metal has long been valued by the aerospace industry, due to its strength, relatively light weight, and resistance to expansion, contraction and corrosion.

“Russian titanium has become one of the great success stories in our global supply chain,” he said.

Boeing’s longest period of collaboration with Russia has been in space exploration.

In July 1975, a Boeing-built U.S. Apollo spacecraft docked with a Russian Soyuz spacecraft. In the 1990s, joint missions were held that involved the Boeing-built U.S. space shuttle docking with the Russian Mir space station. This working relationship became more formal and challenging later in the decade as the orbital assembly of the International Space Station began, with Boeing as NASA’s prime contractor.

Kravchenko describes the space station as the best symbol of U.S.-Russian partnership since World War II. (See story on Page 46.)

“Apollo-Soyuz was a small crack in the Cold War mentality,” Kravchenko said. “It showed everyone what both nations could accomplish by working together.” ■

william.j.seil@boeing.com

“Our Moscow office is focused on increasing revenue in both airplane sales and services.”

– *Sergey Kravchenko, president of Boeing Russia and the Commonwealth of Independent States*

PHOTO: MIKHAIL MELNIKOV



Helping children across Russia

Russia

Boeing's corporate citizenship activities in Russia extend from Moscow and St. Petersburg to a remote community in the Ural Mountains.

The company has supported more than 50 charitable projects focusing on health and human services, education, and arts and culture. Philanthropy efforts include cash grants, in-kind donations and employee volunteerism. Employees are particularly active in services for children, including health and education.

Among the programs receiving Boeing support are the Downside Up Center,

which helps families raising children with Down syndrome; Children of Russia, which provides services to children with cancer and blood diseases; and Kidsave International, which helps orphaned children. Educational programs include the Moscow School for Continuous Math Education and Junior Achievement–Russia.

"I'm very proud of our employees, who generously donate their time to community activities," said Sergey Kravchenko, president of Boeing Russia and the Commonwealth of Independent States. "We don't have to send e-mails asking them to volunteer; they do it on their own."

The company's presence is especially felt in Verkhnyaya Salda, a manufacturing town in the Ural region. A joint venture called Ural Boeing Manufacturing, which is involved in the production of titanium

parts for commercial airplanes, has had an active community involvement program since it opened in July 2009.

Boeing has supplied the children's hospital in Verkhnyaya Salda with equipment that has significantly improved the facility's diagnostics capabilities and reduced the time needed to conduct laboratory tests, according to Maria Osnovina, business operations manager for Ural Boeing Manufacturing. This has modernized eye examinations, heart diagnostics, and ear, nose and throat exams. Urine analysis equipment has greatly decreased the time it takes to complete tests.

"The technicians who conduct the analysis are happy that they're better able to help the children," Osnovina said. "It's a big change from the old days, when doctors might have to wait days to get the results." ■



PHOTOS: (Above right) Boeing Moscow Communications Director Dmitry Krol and his son, Alex, help restore an airplane at the Monino Aviation Museum, Moscow. **(Inset, top)** Boeing Moscow lead engineer Alexey Musienko helps out at the city's Downside Up Center.

(Above) Boeing Moscow travel desk receptionist Ilya Poliveev distributes presents at the Downside Up Center. MIKHAIL MELNIKOV

Living space

The space station is a high-flying symbol of global cooperation—and technical achievement

The International Space Station represents nearly two decades of continuous, successful collaboration between the United States and Russia, and the dawn of the international space age.

The partnership began in the early 1990s when the U.S. space station program, facing budget cuts, opened the program to international participation. The Russians, with decades of experience in space, joined the ambitious venture. Boeing is NASA's prime contractor for the station. In addition to NASA and Russia, Japan, Canada and 11 member nations of the European Space Agency are partners in the station today.

"The thing that most impresses me about this program is that, working

together, we've accomplished everything we set out to do in the early 1990s," said Mark Mulqueen, Boeing's vehicle director for the space station. He has been working on the program since 1987.

"And this has happened despite all the setbacks and political challenges we've faced over the years," he added.

Once competitors in a race to the moon, the two countries first cooperated in the 1975 Apollo-Soyuz mission. A special module was developed to allow the Russian Soyuz and Boeing-built Apollo spacecraft to dock in space. From 1994 through 1998, there were nine missions where the U.S. space shuttle joined with Russia's Mir space station.

And the cooperation continues.



In late 2009, Boeing and Russian aerospace company RSC-Energia signed a memorandum of understanding to jointly develop a common docking system that will serve as an international standard for advanced space exploration vehicles from all nations.

Development of such standards is a vital step in the international exploration of space, according to Mulqueen. In addition to standard docking systems, commonality in propulsion systems, power systems and environmental systems will also be needed.

Mulqueen said he enjoys working with the Russian engineers, some of whom have experience from the early days of the Mir station. In planning sessions, he is often one

of the youngest people in the room.

"I was born on July 16, and I remember watching the launch of Apollo 11 during my 10th birthday party," he said. "It was on our old, black-and-white TV."

Boeing's Joe Sherrill, director of avionics projects for the space station, joined the program 15 years ago because he wanted a chance to work with Russian engineers. He had long had an interest in the country and its people. Indeed, while in college he studied the Russian language with hopes of having the opportunity to use it one day.

Seven years ago, while working at the Boeing Moscow office, he married a Russian woman. Today they have a 17-month-old daughter.

"I very much enjoy the Russian people," Sherrill said. "Politics aside, they're just like us. They want the same things. They have the same problems. They want their children to grow up and have a good future." ■

PHOTO: (Below left) A Russian Soyuz spacecraft approaches the International Space Station (foreground) for docking on Dec. 22, 2009. It carried a Russian cosmonaut and two astronauts from Japan and the United States. Another Russian spacecraft, already docked at the space station, is shown at top left. **NASA**

Engineering in any language

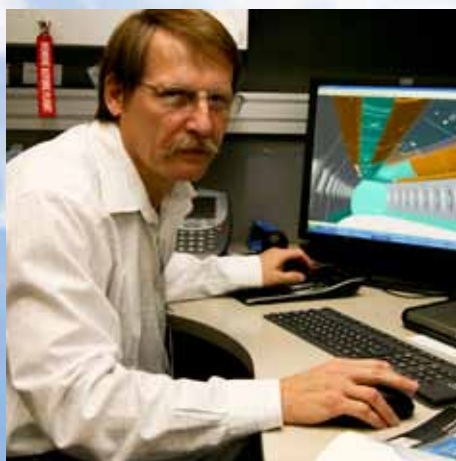


PHOTO: MIKHAIL MELNIKOV

This highly experienced Boeing engineer just happens to live in Moscow

Alexei Shuvaev was born in 1957, the same year the Soviet Union launched the first Earth-orbiting satellite, Sputnik 1.

This was the dawn of the space age, and Shuvaev as a child became a space enthusiast. He closely followed both the Soviet and U.S. efforts to reach the moon.

Today, Shuvaev is senior lead engineer at the Boeing Design Center, Moscow, which works with Boeing engineers in the United States to provide around-the-clock design support for Boeing commercial airplane programs.

Shuvaev—called Alex by his American colleagues—provides technical leadership to contract engineers on a variety of projects. Most relate to airplane interiors, payloads and environmental control systems.

His wife, Tatina, also is an aerospace engineer but left work to raise their children. They have an 18-year-old son, now an engineering student, and a 10-year-old daughter. Shuvaev's own parents were both field geologists.

Early in his career, after graduating from the Moscow Aviation Institute in 1980, Shuvaev spent 10 years working on the Russian space plane, a concept similar to the U.S. space shuttle. That program was canceled following the collapse of the Soviet Union in 1991. He joined the Boeing Design Center in 1999 as a contract employee. After a few years, he was offered a job as a full-time employee.

He travels to Boeing's Everett, Wash., plant about once a year to confer with his U.S. colleagues. He has developed friendships with American co-workers and, in his free time, has joined them on expeditions to scenic locations in the Seattle area.

"I enjoy hiking in areas like Mount Rainier, which is especially beautiful in August," he said. "I've also gone canoeing in mountain lakes, taken scenic drives and been to the Pacific Ocean."

During those trips to Everett, Shuvaev enjoys visiting a favorite used bookstore, where he tracks down science fiction stories by some of his favorite authors, including Clifford Simak, Arthur C. Clarke and Robert Heinlein.

"When I was young, people were crazy about space and science fiction stories about space travel," Shuvaev said. "Everyone followed the space flights, the cosmonauts and the race to the moon. It was a very exciting time." ■

Flying into the future

Russia's airlines are expanding and updating their fleets, and Boeing is well-positioned to help

The Russian airline industry is in transition, modernizing fleets and adopting Western operating practices.

As trade barriers come down, the growing strength of the Russian economy is expected to accelerate the replacement of aging Soviet-built aircraft. Boeing estimates that airlines in Russia and the Commonwealth of Independent States will need about 1,000 jetliners over the next 20 years—an estimated \$90 billion in sales.

While today's Russian aerospace industry produces a limited number of commercial airplanes—with plans to develop new models—Boeing sees strong potential for near-term as well as long-term sales.

Early evidence of this is a 2007 order by Aeroflot for 22 787 Dreamliners, and a

late 2010 order by Russian Technologies for 50 Next-Generation 737 airplanes. The Next-Generation 737s purchased by Russian Technologies, a diverse state-run company, will be used by several government-owned airlines. Boeing has also logged orders for 737s from Russian carriers S7 and Atlant-Soyuz, and 747-8 Freighters from Volga-Dnepr—an order book that represents the breadth of the Russian airline landscape.

Competition from Airbus has been strong, but Boeing is optimistic that it can maintain its approximately 60 percent market share of Western-built aircraft.

“With all the liberalization that's taking place, we're also seeing growing traffic to and from Europe, and that's happening at a significant pace,” said Marlin Dailey,

Major Russian airlines

Aeroflot

Headquarters: Moscow

Fleet: 96 airplanes, including 11 767s, three MD-11 Freighters, 66 A320s and 10 A330s

Notable: Aeroflot is the flag carrier and largest airline in Russia. It has firm orders for 22 787 Dreamliners. The airline will soon merge with six airlines belonging to Russian Technologies, which has firm orders for 50 Next-Generation 737s.

Transaero

Headquarters: Moscow

Fleet: 57 airplanes, including 20 737 Classics, two Next-Generation 737s, 13 747s, 12 767s and seven 777s

Notable: Transaero is the only operator of 777s and 747s in Eastern and Central Europe and the largest charter operator in Russia.

S7 Group: S7 Airlines and Globus Airlines

Headquarters: Moscow

S7 Airlines fleet: 19 A319s, nine A320s and two 767-300ERs (Extended Range)

Globus Airlines fleet: Four 737-800s and four 737-400s

Notable: S7 Airlines has leading positions in the domestic market and firm orders for 10 Next-Generation 737s.

Volga-Dnepr Group

Headquarters: Ulyanovsk

Fleet: 10 747 Freighters and AN-124 Freighters

Notable: The group has a firm order for five 747-8 Freighters.

Moskva Airlines (Atlant-Soyuz)

Headquarters: Moscow

Fleet: Three 737 Classics and six Next-Generation 737s

Notable: Moscow Airlines has firm orders for four Next-Generation 737s.

UT Air

Headquarters: Khanty Mansiysk, Siberia

Fleet: 20 737 Classics, two 757s, and Russian airplanes and helicopters

Notable: UT Air operates the largest helicopter fleet in Russia in support of oil and gas development and United Nations international transportation.

“It’s a changing market with new opportunities emerging.”

– *Sergei Leschinski, sales director, Commercial Airplanes, Russia*

vice president, Sales & Marketing, Boeing Commercial Airplanes. “Russian airlines are in the process of strengthening and growing their long-haul operations.”

The core Boeing Commercial Airplanes sales team for Russia is spread between Moscow and Seattle. Sergei Leschinski, a sales director based in Moscow, and

his Moscow- and Seattle-based team recently completed the 50-airplane sale to Russian Technologies.

More than 20 Russian airlines use Boeing airplanes, with many purchased or leased from the secondary market. About half the Boeing planes used by Russian airlines are older 737 “classic” models. As trade barriers ease, it is expected that the demand for new planes will grow rapidly.

“Our sales team is focused on the top 10 Russian airlines, but all of the airlines are on our radar,” Leschinski said. “It’s a changing market with new opportunities emerging.”

Boeing Capital Corporation is advising the nation’s aircraft financial community, according to Mher Papyan, Boeing Capital’s senior director for Russia and the Commonwealth of Independent States.

“We’re working closely with Russian banks and leasing companies to educate them on Boeing’s products, and aircraft financing in general,” Papyan said. “They’re just starting to finance airplanes, and we’re trying to ensure that ours will be on the banks’ preferred products lists.”

As Russia reinvents its airline industry, Boeing Commercial Aviation Services wants to double its business in Russia over the next couple of years, said Kamil Gaynutdinov, Moscow-based sales director for Commercial Aviation Services.

“Russia’s aviation industry is advancing quickly and is successfully competing in both domestic and international markets,” Gaynutdinov said. “The Boeing Company and the Boeing brand are well-positioned to help support our Russian customers.” ■



PHOTO: An artist’s rendering of a Boeing 787 Dreamliner in the Aeroflot Russian Airlines livery. Aeroflot is studying expansion of its domestic and international business with the help of 22 Dreamliners. **BOEING**

Ti

that binds

Partnership provides titanium for 787 while leveraging Russian manufacturing and resource strengths

Russian titanium travels long distances through various sites, from the time the ore is mined to the day it becomes part of a completed Boeing jetliner.

One of the most important stops is a recently completed facility called Ural Boeing Manufacturing, in a remote area of the Ural Mountains near the Russian town of Verkhnyaya Salda.

This is a joint venture with Russian titanium producer VSMPO-Avisma, which operates a titanium mill on the same site. The mill produces the forgings that are machined at the Boeing manufacturing facility.

The location of Ural Boeing Manufacturing is critical because it allows workers to quickly transport highly expensive titanium chips back to VSMPO's mill.

About 85 percent of the chips can be remelted at VSMPO to make new forgings. The remaining chips, which are contaminated or unusable, are sold for reprocessing.

John Byrne, director, Supplier Management—Common Commodities, Boeing Commercial Airplanes, first proposed the idea of the manufacturing facility and handled the initial negotiations for the project. The strategy allowed Boeing and VSMPO to keep the chips within Russia, thus avoiding difficult trade issues involved in returning the chips from outside the country.

"We originally set out to solve some operational challenges," Byrne said. "But the creation of Ural Boeing Manufacturing ended up being of much greater



benefit to The Boeing Company than we had imagined.”

Byrne said the joint venture gives Boeing greater oversight of the supply of titanium it receives from Russia and provides VSMPO an ownership incentive to ensure the success of the operation.

The forgings machined at Ural Boeing Manufacturing are made from a new titanium alloy that was jointly developed for the 787 Dreamliner program by Boeing and VSMPO, said Gary Koessler, a Boeing employee, who serves as chief executive and general director of Ural Boeing Manufacturing. Titanium, with its strength, stability and resistance to corrosion, makes it a natural fit with the composite materials used in the 787. The 787 requires more titanium

than any previous Boeing jetliner.

“In order to keep this new alloy affordable, we agreed to build the Ural Boeing Manufacturing plant in Verkhnyaya Salda,” Koessler said. “This creates a closed loop titanium production flow that allows us to make full use of our titanium supplies.”

The Ural Boeing Manufacturing facility was built under the direction of its first CEO, Gary Baker, who recently moved from that position to a new assignment in China.

Baker moved to Verkhnyaya Salda in late 2007, along with his wife and daughter. As the only Boeing employee on site, he worked with Russian crews to build Ural Boeing Manufacturing from the shell of an old building. By 2009 they had modern manufacturing facilities with

sophisticated machinery and comfortable amenities for the Russian workers.

“It was very exciting to move to a remote community and bring this enterprise to life,” Baker said. “But it would not have been possible without the full support of the partners, Boeing and VSMPO.” ■

PHOTOS: (Below left) A 787 side of body chord forging being rough-machined at Ural Boeing Manufacturing. MARIA OSNOVINA/BOEING

(Insets, from top) An exterior view of the Ural Boeing Manufacturing joint venture's building in Salda, Russia. MARIA OSNOVINA/BOEING
A titanium forging machined at Ural Boeing Manufacturing. MARIA OSNOVINA/BOEING



Capital id



Since January 2010, Mike Cave has led Boeing Capital Corporation, which provides financing support to Boeing customers and operates a \$5 billion portfolio of leasing aircraft and related assets. Cave talked with *Frontiers* about his, and BCC's, journey during the past year.

How would you describe your first 12 months at BCC?

Exciting, because we're working on things that are important—such as ensuring timely financing for Boeing Commercial Airplanes' deliveries and helping sales campaigns be competitive. We're working on shaping global regulations, especially for export credit. We've helped resolve issues by better integrating what Commercial Airplanes does with what we do. We've had successes and challenges in placing our portfolio aircraft coming off lease. It was much more exciting and dynamic than I expected. It was also rewarding because we've actually made progress in all those areas. It confirmed to me that BCC's team is world-class in every aspect—talent, integrity, dedication, drive, results.

What did you learn about the organization that you didn't know?

How integral we can be to Boeing Defense, Space & Security and its two important pushes. One of them is expanding international sales and the other is developing adjacent businesses. We find ourselves in the middle of global campaigns to keep BDS programs sold and healthy and as a front-end adviser on how to set up new businesses for financial success.

How does BCC help BDS?

When defense customers have financing needs and turn to Boeing, we're able to understand their budgetary constraints and respond with financing options. Generally those don't include using Boeing's money. We have long-standing relationships within the global capital markets, where the most economically attractive solutions can be constructed, so we rarely fund defense transactions.

eas

Mike Cave reflects on his first year leading Boeing Capital Corporation By John Kvasnosky



Airplane financing in 2010 turned out to be less of a worry than anticipated. What happened?

When I first took this job, we were just beginning to convince the marketplace that we were correct in our belief that there wouldn't be an aircraft financing gap affecting 2009 deliveries, and that was the case. We then had the credibility to assure investors that 2010 funding would be sufficient and, as it turns out, it was.

Financing for aircraft exports was in the news this year. Why?

There are negotiations under way for a new global agreement for aircraft export credit. Export financing is very important for us. It enables sales to countries with lending risks that commercial markets wouldn't take on. In that case, Ex-Im Bank or Europe's agencies that support Airbus step in and provide guarantees that remove the country risk and allow the sale. In a typical year, it makes up about 20 percent

of deliveries. In years like recent ones, when commercial markets seized up, it reached about 30 percent. In good times and bad, it's an important industry financing sourcing.

So why is export credit being challenged by customers and others?

Many people labor under the erroneous belief that export credit is a subsidy. That's just not true. The Ex-Im Bank makes a profit for taxpayers while enabling export sales that support millions of jobs. The debate is over how to fund export credit, in good times and bad, without having abuses by those who could otherwise use commercial financing, and ensure that credit agencies like Ex-Im can undertake ongoing

PHOTO: Boeing Capital Corporation President Mike Cave and his team are working to remarket B-717s that were to have gone to a bankrupt Mexican airline. **MARIAN LOCKHART/BOEING**

and profitable financing to balance their portfolio and maintain their skills. Our goal is to balance all of that to ensure level playing field conditions for all the involved stakeholders.

This year, your 717 customer, Mexicana, went bankrupt. How has that impacted BCC?

The 717s are terrific airplanes. We thought deploying 25 of them at Mexicana Click would be a good fit and profitable as well. Recently Mexico has seen a “perfect storm” impact its economy and tourism, and that imperiled Mexicana’s fortunes and led to its bankruptcy. We terminated our leases and are working aggressively to redeploy the 717s elsewhere. While we’re confident we’ll find those planes another good home, redeployment will require some time and expense, which is why we recognized an \$81 million earnings charge in the third quarter.

BCC’s portfolio has declined, from about \$12 billion to \$5 billion today. If that continues,

will you go out of business?

Not at all. When we were around \$12 billion, about a quarter was legacy, non-aerospace assets. The plan was to shed them and focus on core capabilities. Going to today’s \$5 billion portfolio was a concerted effort. In bad times we need to be there for our customers and provide financing. In good times we want to shrink the portfolio to build capacity to be ready to increase if needed. We’re not going out of business when that happens. We’re actually enabling future business. Portfolio is just one metric on how we measure ourselves. Success in supporting Commercial Airplanes and BDS is our primary objective, and we manage our portfolio to accomplish that. ■

john.kvasnosky@boeing.com

PHOTO: An MD-11 converted freighter, owned by Boeing Capital Corporation, was placed in June at Italy-based global freight carrier Cargoitalia. **CARGOITALIA**

“Success in supporting Commercial Airplanes and Boeing Defense, Space & Security is our primary objective, and we manage our portfolio to accomplish that.”





Smooth as silk

Boeing has a long and growing relationship with one of Asia's best-known airlines *By Patrick Summers*

Thai Airways International, a valued Boeing customer, is celebrating a half-century of service as the flagship airline of Thailand.

Once a small regional carrier, the airline has grown its domestic routes and expanded its global services to 72 airports in 34 countries on five continents. THAI, as it is known, recently raised half a billion U.S. dollars in a public stock offering.

And the airline isn't stopping there.

It has a new president and a bold plan for marketplace growth.

The company said recently that proceeds from the public offering not only will strengthen its financial status but also will support its expansion, new products and service improvements "that will elevate Thai to consistently rank among the top three airlines in Asia and the top five in the world."

This vision presents Boeing with an opportunity to build on a long-time partnership with one of Asia's most successful airlines.

"THAI and Boeing have enjoyed a long and fruitful partnership over five decades that has seen THAI become an iconic international symbol, epitomizing a melding of modern and traditional Thai values," said Skip Boyce, Boeing Southeast Asia president and former U.S. ambassador to Thailand. "We look forward to continuing our close collaboration with THAI for the next 50 years."

Of its fleet of 84 aircraft, 45 are Boeing. THAI's relationship with Boeing began with the delivery of one of the first 747-400s

in 1990. In addition to 18 747s, THAI flies almost every 777 model and the 737-400.

The airline recently signed a lease agreement to acquire eight 777-300ER (Extended Range) passenger jets that will replace aging aircraft in its fleet beginning in 2012 and fly long-haul routes to Europe.

Modernizing the THAI fleet is a priority for the airline's president, Piyasvasti Amranand, who was appointed a year ago by the Thai government and is making his mark on the carrier's market position and corporate culture.

"Our partnership with Boeing has been a critical component of THAI's success," Piyasvasti noted. "I look forward to an ongoing and strengthening friendship as we face the market challenges ahead."

As part of the second phase of its fleet renewal, THAI management will make a final aircraft selection early next year. The carrier is considering a package of Boeing airplanes, including the 787, passenger and freighter models of the 777 and 747-8, and the Next-Generation 737.

One of Piyasvasti's initiatives is to reduce the average age of the THAI fleet to best meet customer expectations and be highly competitive, yet flexible. The new president also intends to lessen the government's role in the carrier's management and strengthen its independence.

What also sets THAI apart in the marketplace is its pride in Thai culture.

"The memorable service begins the moment you check in and enter the departure lounge," said Chris Flint, Boeing sales director for Asia-Pacific. "Every passenger on board feels the Thai experience." ■

patrick.a.summers@boeing.com

"Our partnership with Boeing has been a critical component of THAI's success."

— Piyasvasti Amranand, president of Thai Airways International

PHOTO: THAI AIRWAYS INTERNATIONAL

PHOTO ILLUSTRATION: A 777-300ER (Extended Range) in the Thai Airways International livery. BOEING



Passing the torch

Arrival of Boeing's Super Hornets allows Australia to retire its iconic F-111s

By **Karinne Cilento**

For nearly 40 years, the F-111 was Australia's front-line strike aircraft, later working alongside the country's fleet of Boeing F/A-18 A/B Hornets to protect Australia.

But this month, following the last flight on Dec. 3, Australia's F-111s fly into the history books.

"Boeing, in close partnership with the Commonwealth of Australia, transformed one of the oldest strike aircraft still operating in the world into a powerful front-line warfighter that competed on an equal footing with the latest military hardware," John Duddy, vice president and managing director of Boeing Defence Australia, said of the F-111. "We are justifiably proud of the positive impact we had on this iconic Australian aircraft."

For the Boeing Defence Australia team, the retirement of the F-111s was a bittersweet event even though the aircraft is not Boeing-built. Since 2001, the team maintained the F-111's airframe and performed extensive upgrades that improved the fleet's reliability, availability and capability for the Royal Australian Air Force. With the aircraft's retirement, that ends.

"This work has been the backbone of Boeing Defence Australia for more than a decade and established it as one of the Australian Defence Force's most important engineering organizations," said Murray Brabrook, director of the Global Services & Support—Australia Integrated Logistics division.

"We were able to demonstrate to the Commonwealth that we were capable of supporting and enhancing their mission-critical aircraft, Boeing-built or not," he added.

But there's a sweet side for Boeing Defence Australia—the engineering, supply chain management and maintenance it is now providing for 24 F/A-18F Super Hornets that are being delivered this year and next. Arrival of the more capable Boeing fighters allowed Australia to retire its F-111s. The first five Super Hornets were delivered ahead of schedule to Australia in March 2010 and another

PHOTOS: (Above) The F-111 performs a "dump and burn," during which fuel is dumped and intentionally ignited using the aircraft's afterburner.

ROYAL AUSTRALIAN AIR FORCE

(Insets, from left) Boeing Defence Australia employees service an F-111 at RAAF Base Amberley; Rob Connell performs maintenance on one of the strike aircraft; Boeing Defence Australia was responsible for the F-111 wing refurbishment program. **BOEING**



“We are justifiably proud of the positive impact we had on this iconic Australian aircraft.”

– John Duddy, vice president and managing director of Boeing Defence Australia



“We were able to demonstrate to the Commonwealth that we were capable of supporting and enhancing their mission-critical aircraft.”

– Murray Brabrook, director of the Global Services & Support–Australia Integrated Logistics division

PHOTO: The F-111 is one of the only aircraft in the world that can perform the “dump and burn.” For years, this spectacular maneuver was a highlight at major Australian sporting events, air shows and fireworks events. ROYAL AUSTRALIAN AIR FORCE

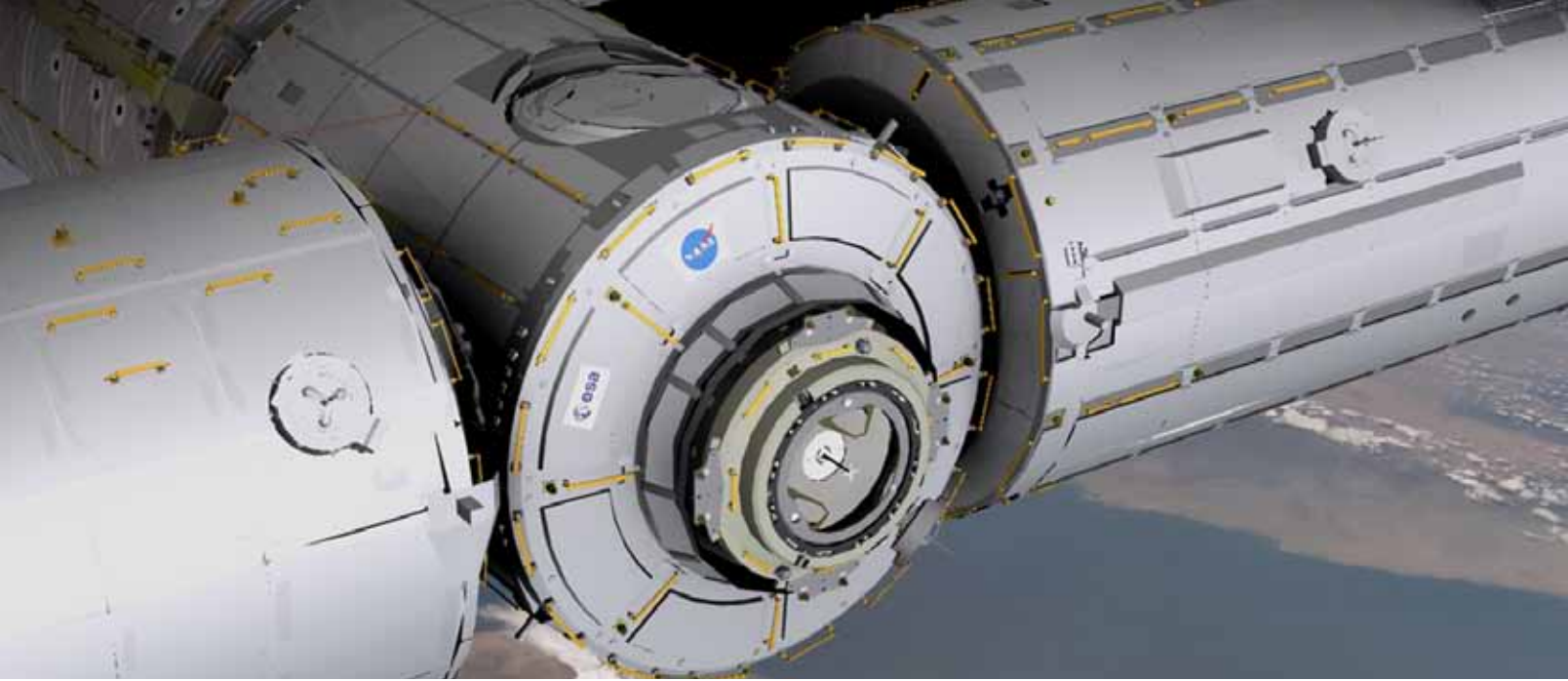
six were delivered in July. More deliveries are scheduled over the next year, with the final delivery in October 2011.

It was Boeing Defence Australia’s successful support work on the F-111 that was a key factor in obtaining Super Hornet support work, according to Glen Ferguson, Super Hornet program manager for Boeing Defence Australia.

“The Air Force wanted a proven solution that could be applied immediately with low risk,” Ferguson explained. “We had the people, skills and processes already in place—as well as a success record—enabling a seamless and rapid transition. We’ve been able to redeploy our best and brightest engineers and tradespeople from the F-111 program to the Super Hornet program, among others.” ■

karinne.n.cilento@boeing.com





Cosmic connection

Boeing and NASA are developing a common docking system to enable international and commercial spacecraft visits to the space station

By Ed Memi



GRAPHIC: The Common Docking Adapter is shown on the Node 2 Tranquility module of the International Space Station in this artist's rendering. JAMES POMIER/BOEING

PHOTO: Boeing senior technician Pete Becak, left, and Stan Daniels, a Boeing operations engineer, demonstrate a spacecraft and space station docking sequence using a mock-up of a common docking system being designed by Boeing and NASA. ELIZABETH MORRELL/BOEING

In the not too distant future, commercial spacecraft could be paying regular visits to the International Space Station—especially if space tourism evolves into more than an entrepreneurial dream.

But those spacecraft would need a common docking system that attaches to the space station, allowing transfer of crew and payloads.

For Boeing and NASA, such a docking system is no dream. They are already designing an international docking system that will enable a variety of spacecraft to bring crews to the station. It will replace the Orbiter Docking System when the space shuttle is retired in 2011.

"It is a very dynamic project, still being defined, but there has been a lot of good conceptual design," said Craig Tyer, Boeing mechanical design lead for the Common Docking Adapter. He has been working on structurally integrating the new docking adapter with the space station and led the effort to build a docking mock-up.

NASA is designing the active side of the docking system that will attach to the front of a spacecraft. Boeing is designing the Common Docking Adapter (the passive side) that attaches to the Node 2 module on the space station.

"We were provided some funding to help understand a docking system that would ultimately be a hybrid between the Russian system and an active smart system," Tyer explained. "That helped us better understand how these two different approaches to docking systems could come together as one."

As the spacecraft approaches the space station, magnets energize to help align the docking system during its initial contact with the ISS. The control system then gradually pulls the spacecraft in as magnetic forces are reduced. Emerging hooks grab the spacecraft and tighten until an airtight seal is achieved and the connection is then pressurized. The docking port can accommodate one astronaut at a time as a crew transfers between the spacecraft and the station.

NASA funded the Boeing project with financial support from the American Recovery and Reinvestment Act. Boeing recently received additional funding to continue design process toward a Preliminary Design Review. Following this review and assuming NASA funds the next stages, there will be a Critical Design Review in October 2011, followed by qualification testing before manufacturing of flight hardware begins. ■

edmund.g.memi@boeing.com

OUT-OF-THIS-WORLD VIEW

The aurora borealis casts a greenish glow over Earth's northern latitudes in this remarkable photo by astronaut Douglas Wheelock, taken from the International Space Station. A section of the station's solar panels is seen at the top. Wheelock, who moved into the station in June, had been posting his photos to his Twitter followers as Astro_Wheels. With his stay in the station coming to an end last month, Wheelock wrote about this photo: "Aurora Borealis as I will forever paint it in my dreams ... Leonardo da Vinci was right. 'For once you have tasted flight, you will forever walk the earth with your eyes turned skyward, for there you have been ... and there you will long to return.'" Boeing is NASA's prime contractor for the International Space Station. In addition to designing and building the major U.S. elements, Boeing also is responsible for ensuring the successful integration of new hardware and software—including components from international partners—as well as for providing sustaining engineering work.

PHOTO: DOUGLAS WHEELOCK





LIFE IS AMAZING IF YOU KNOW WHERE TO LOOK.

To a child, it's not just a sky. It's a dream. We proudly support those who strive to introduce children to the many wonders of the world. And help us all see through young eyes.

 **BOEING**