



Frontiers

www.boeing.com/frontiers

JUNE 2010 / Volume IX, Issue II

A photograph of a Boeing technician working on the interior of an aircraft. The technician is wearing a head-mounted display (HMD) with a camera, safety glasses, and large headphones. He is holding a power drill and pointing at a circular panel on the ceiling of the aircraft. The lighting is dramatic, with a strong blue tint. The technician's face is in profile, looking upwards and to the right.

JET set

A look at the men and women who build
Boeing's commercial jetliners



12 Making jets

In two massive factories in Washington state near Seattle, thousands of employees work the production lines, bringing their skill, experience and dedication to the task of building the company's 7-series jetliners—the 737, 747, 767, 777 and the 787 Dreamliner. Thousands more people across the company support them, as well as partners and suppliers around the globe. *Frontiers* photographers visited Boeing's jet-making plants in Renton and Everett recently and captured the pride that goes into making the world's best commercial jetliners.

COVER IMAGE: BOEING MECHANIC JAMES KINNEAR INSTALLS A FAIRING ON A 777. UNTIL MARCH, KINNEAR WORKED ON 777 FINAL BODY JOIN. HE NOW WORKS ON 787 QUALITY ASSURANCE. BOB FERGUSON/BOEING

PHOTO: THE 747 TEAM'S REID TALLMADGE PERFORMS ASSEMBLY WORK ON SECTION 41 OF A 747-8 FREIGHTER. BOB FERGUSON/BOEING



THERE IS STRENGTH IN NUMBERS.

Boeing employees combine their charitable contributions to form the largest fund of its kind in the world, the Employees Community Fund of The Boeing Company. It's just another example of how Boeing people, working together, can do amazing things.



Ad watch

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

Inside cover:



Boeing employees combine their charitable contributions to form the largest fund of its kind in the world, the Employees Community Fund of The Boeing Company. It's just another example of how Boeing people, working together, can do amazing things. No ECF contributions were used to produce this material. All awareness campaign costs are paid by The Boeing Company.

Page 51:



This Boeing Defense, Space & Security ad is one of a series of ads supporting the U.S. Army's Brigade Combat Team Modernization program. The ads are designed to position Boeing and the modernization effort as offering relevant and critical capabilities that will make a difference in the protection and safety of Army warfighters. The ad will run in key military and congressional trade publications.

Back cover:



This ad demonstrates Boeing's appreciation and gratitude for the U.S. Armed Forces. Part of an integrated effort, this print ad ran in *The Washington Post* and *The Washington Times*, as well as in regional, trade and military publications. The campaign also featured complementary TV and online components.



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table of contents



24

Transformers

Electric utilities are looking for ways to make their power grids smarter, more efficient and more secure, and Boeing is focused on providing solutions for this growing services market. The company's Energy Solutions group was formed last year and is leveraging Boeing's global technical talent and expertise in areas including cybersecurity and large-scale systems integration.

PHOTO: PAUL PINNER/BOEING



28

Designing safety

Across Boeing, employees are finding creative ways to improve safety in the workplace, helping the company meet its goal of reducing the number of injury cases that result in lost work by 25 percent by 2013. This article looks at what employees at three Boeing sites—St. Louis, Renton, Wash., and Fishermans Bend, Australia—have done to deliver on safety. It includes an interview with Mary Armstrong, Boeing vice president of Environment, Health and Safety.

PHOTO: RON BOOKOUT/BOEING



38

Shaping flight together

Boeing and Lufthansa have had a close working relationship for 50 years, since the German airline entered the jet age in 1960 with the delivery of its first Boeing 707. Lufthansa has played a significant role in the design of a number of Boeing jets since, including the 737 and the 747-400. That relationship continues today: Lufthansa is the launch customer for Boeing's new 747-8 Intercontinental.

PHOTO: JOERG MUELLER

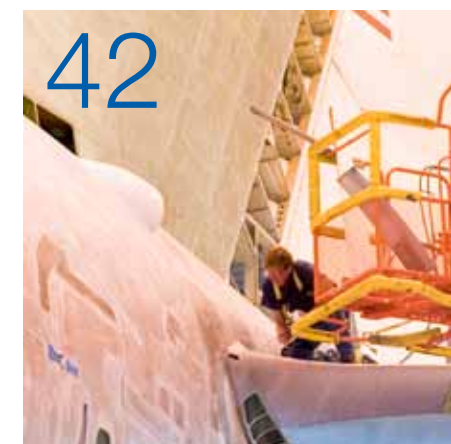


22

Global collaborators

A flight demonstration in Australia for a potential customer considering the company's 737 Airborne Early Warning & Control aircraft looked like it might not happen due to export-control challenges. That's when a "One Boeing" team went to work. The result: a global collaboration that allowed the demonstration flight to take place as planned.

PHOTO: CHAD SLATTERY



42

Command response

It's known as the E-4B—a modified 747 that has served as a flying military command post for the United States for more than 35 years. One of the most sophisticated communications aircraft in the world, it must be ready at all times to respond in case of war or national emergency.

PHOTO: BEVERLY NOWAK/BOEING

INSIDE

06 Leadership Message

Boeing has a huge stake in growing its business around the world, and the company's success in the global marketplace depends on making sure it meets all applicable export rules and regulations, both in the United States and overseas. Boeing's Global Trade Controls organization is helping ensure this happens by involving employees and taking a "One Boeing" approach to compliance strategies, according to Kathie Greaney, the group's vice president.

07 New and Notable

08 Snapshot / Quotables

09 Why We're Here

10 Historical Perspective

44 Stock Charts

45 Milestones

50 In Focus

At the controls

Boeing's expanding international business depends on strict compliance with export regulations

Kathie Greaney
Vice President, Global Trade Controls
Office of Internal Governance

International business opportunities burn bright for our company. Boeing's reputation for providing high-quality aerospace and defense products and services around the world is unparalleled, and it represents a distinct advantage for capturing future contracts. Almost 80 percent of the future commercial aviation market through 2028 is projected to be outside of North America, while the addressable non-U.S. Defense, Space & Security market is estimated at \$170 billion over the next four years.

The obligation that comes with these opportunities is for Boeing to operate within all applicable export rules and regulations, both in the United States and overseas. We want to make sure compliance issues don't get in the way of future business opportunities. And we need the support of every Boeing employee—your help—to do this flawlessly.

Part of the Office of Internal Governance, Global Trade Controls is responsible for creating, implementing and maintaining effective export and import compliance strategies, enabling the seamless execution of global business plans. This follows the company's international strategy of global presence, efficiency and compliance.

In the past, export compliance had been viewed by some as an impediment to doing business swiftly. Today, we at Global Trade Controls are committed to serving as partners who have a stake in the successful execution of the company's business plans. We are looking at these relationships through the "One Boeing" prism and—as a consequence—we are achieving better results than ever.

A core of that changed relationship has been embedding export compliance into programs, and doing so as early as possible. We have found that if compliance is recognized and included from the ground floor of a program, chances of success skyrocket. Global Trade Controls has been adding tools and upgrading its Web portal to make global trade activities simpler and more efficient. This is adding transparency and making compliance easier than it has been in the past—and increasing Boeing's competitiveness.



The interconnected global marketplace has attracted attention at the highest levels. After his State of the Union announcement, President Barack Obama unveiled details of his Export Initiative, including reviving the President's Export Council advisory board. Boeing Chairman, President and CEO Jim McNerney is taking a leadership role in this effort, serving as chair of the council. This underscores the important role exports serve on every level—to each of us as individual Boeing employees and to our company as a whole.

One of those important Boeing exports is the 737 Airborne Early Warning & Control aircraft, or Wedgetail. In this issue of *Frontiers*, on Page 22, an article explains how Global Trade Controls worked closely with the AEW&C program to overcome obstacles and secure licenses for an important flight demonstration of the Wedgetail in Australia. It's an example of how operating as One Boeing drives greater success.

Global Trade Controls is working hard in partnerships across Boeing to enable the company to become an even bigger player in the international economy. This will boost the company's bottom line and competitive strength for years to come. As such, I ask every employee of The Boeing Company to be aware of export control regulations that could affect the work they do and maintain strict compliance. Because we cannot afford to allow missteps to derail potential international business deals, and the work and jobs they can bring. We have an obligation not to miss this opportunity. ■

PHOTO: BOB FERGUSON/BOEING



Something old, something new

A Boeing 787 Dreamliner passes its ancestor, a Boeing Model 40, the only flyable Model 40 in the world and the oldest flying Boeing aircraft of any kind, in the skies south of Seattle last month. The Model 40, Boeing's first production commercial airplane, is owned by Addison Pemberton of Spokane, Wash. Taking a short break from the 787 flight-test program, Boeing Chief Test Pilot Michael Carriker maneuvered Dreamliner ZA001

next to the Model 40 at 12,000 feet (3,660 meters) altitude to allow Ryan Pemberton to take this photo from a third plane. "When I came alongside the Model 40 against those big puffy clouds it was unbelievable," Carriker said. "Here is this 1928 biplane flying with a 2010 airplane side by side—how amazing the history of The Boeing Company is."

— Mike Lombardi

Results that count

Boeing's 2010 Environment Report shows how the company's employees are making strides to protect the environment.

The report, released last month, highlights the company's conservation efforts, environmental research programs, and the development of environmentally progressive new products and services. It also details how Boeing is making steady progress toward meeting its environmental targets.

"These efforts are delivering results and helping us address the issues of pollution and climate change," said Mary Armstrong, vice president, Boeing Environment, Health and Safety. "We're doing this by tapping into the talent and skills of Boeing people to improve the environmental performance of our products and reduce the environmental footprint of our operations. This in turn enhances our competitiveness and productivity."

Here are some key numbers from the report.

- 31 percent reduction in carbon dioxide emissions at major Boeing U.S. manufacturing facilities, on a revenue-adjusted basis, since 2002
- 68 percent of solid waste recycled by Boeing in 2009, up from 51 percent in 2007
- 84 million estimated miles (135 million kilometers) Boeing employees in Everett, Wash., avoided driving in personal vehicles in 2009 by taking public transportation, van pools and alternate commuting options
- 97.7 million reduction in gallons (370 million liters) of water consumed by Boeing in 2009 compared with 2008 (a 5.5 percent cut)

The complete 2010 Environment Report can be found online at http://www.boeing.com/aboutus/environment/environment_report_10/index.html



WINDOW TO THE UNIVERSE

The Stratospheric Observatory for Infrared Astronomy, or SOFIA, a modified Boeing 747 Special Performance model with a 98-inch- (2.5-meter-) diameter infrared telescope, flies a test mission over the Mojave Desert with the sliding door to its telescope cavity open. NASA and DLR, the German Aerospace Center, are partners on the project. A NASA F/A-18 is flying chase. [NASA](#)

Intent to prevent

Designing safety into Boeing products and processes helps reduce workplace injuries—a key Boeing goal

By Kathrine Beck and photo by Paul Pinner



Missy Brost works with engineers to prevent workplace injuries through well-conceived product and process design. In this *Frontiers* series, which profiles employees talking about their jobs and the way their work fits into Boeing's overall goals, Brost explains how this approach can help the company keep its people healthy and reduce lost work time.

Quotables

“We’ve electrified it. We’ve shaken it. We’ve baked it and we’ve frozen it. ... We’ve flown it at nearly the speed of sound. It’s rock solid.”

— Pat Shanahan, vice president and general manager for Airplane Programs, Boeing Commercial Airplanes, on May 12 describing the performance of the 787 Dreamliner in certification and reliability tests to business and financial news network CNBC.

“Today we sail in a cyber sea. It’s an outlaw sea.”

— Adm. James Stavridis, Supreme Allied Commander, Europe, and commander of the U.S. European Command, speaking May 17 to the Defense Writers Group about cyberattacks on NATO. (Boeing is responding to the growing threat of cyberattacks. See “Cyber defenders” story on Page 33 of this issue of *Frontiers*).

When I was a shop floor manager, I saw the effect of physically demanding work on the crew. They had been doing tough jobs for a long time and it was a strain.

Now, as the program manager of Design for Ergonomics and Workplace Safety, a new position, my job is to figure out how to address safety as we’re designing our products and processes. This way, we can help employees avoid injuries as they assemble our products. To develop and deploy tools, capabilities and processes to create products that are easier and safer to produce and maintain—that’s the goal of ergonomic design.

One example would be an assembly that typically comes from a supplier in a single, very large piece that is heavy and awkward to move into installation position. What if the design stipulated that the assembly arrive in three pieces to make it easier to move? And what if the design ensured that mechanics could install it on the airplane without ergonomic stress, to minimize the potential for related injuries?

I work in Seal Beach, Calif., as part of Boeing Defense, Space & Security, but this is a companywide initiative. Because I’m still setting up the program and have an engineering background and not an Environment, Health and Safety background, I spend a lot of time on the phone talking to folks who have that know-how. I also work to get leaders on board with this new approach to designing safety into our processes rather than fixing problems as they come up.

I’m looking at developing an ergonomics risk checklist for engineers—to be used when parts and processes are being designed—and exploring ideas like a “reverse” safety fair that brings ergonomic issues to engineers. I’m pursuing that with Boeing/IAM Joint Programs. It was one of their ideas and would give engineers the opportunity to be hands on—something they really enjoy but don’t often get to do.

It’s rewarding to use engineering to help make people’s lives easier and safer by making a few changes upfront. The ultimate outcome—keeping our employees safe—is awesome. ■

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To learn about other employee efforts to improve safety throughout Boeing, see Page 28 in this issue of Frontiers.

A star is born

Developed to be a Cold War warrior, the B-1B is ably performing a critical mission today as a conventional, not nuclear, bomber

By Erik Simonsen

With a thundering roar, the B-1B Lancer displaying the “Star of Abilene” nose art performed a low-level, high-speed pass over Dyess Air Force Base, Texas. That flyover, on June 29, 1985, marked the arrival of the first Rockwell B-1B bomber for the 96th Bomb Wing at Dyess. It came 30 years to the day after the first subsonic Boeing B-52 Stratofortress began its career with the Strategic Air Command.

With the arrival of the B-1B, a new supersonic, intercontinental-range bomber had joined the ranks of the U.S. strategic bomber force.

The B-1B Lancer evolved out of the B-1A program, which was canceled by the Carter administration in 1977 before going into production. During the ensuing years, extensive flight testing of the four B-1A prototypes continued and Boeing predecessor company Rockwell, hoping for a reversal of the production decision, kept engineers in place to refine the B-1’s capabilities.

The program was indeed reborn, after President Ronald Reagan took office in January 1981. During a national address

later that year, Reagan talked about the Cold War and a “window of vulnerability” in U.S. defenses. To help fill that gap, the president ordered the production of 100 B-1B bombers. Rockwell was awarded a \$20.5 billion contract in January 1982 to begin production of the bomber, now designated the B-1B.

“Every B-1B Team member took President Reagan’s statement seriously, and they all felt that they were fighting in the front-line trenches of the Cold War,” Sam Iacobellis, retired executive vice president and deputy chairman of Rockwell, and the B-1B program manager at the time, said recently. Later in the program, as the learning curve improved, four and sometimes five aircraft were built per month at the Rockwell plant in Palmdale, Calif. Only six years after the production contract had been signed, the 100th B-1B was rolled out.

With the end of the Cold War in the early 1990s, the B-1B’s capabilities as a conventional bomber rose to the fore. It was decertified for nuclear missions and today carries an array of precision conventional munitions. It

is playing an important role in Afghanistan.

Maj. Scott Higginbotham, B-1B operational test director at Edwards Air Force Base, Calif., has had recent B-1B combat experience in Afghanistan. “The standard mission duration was nine to 16 hours and involved three or more air-to-air refuelings—this allowed up to seven hours over-country to provide on-call close air support for coalition ground forces,” Higginbotham said.

A typical B-1B payload is 24 2,000-pound (900-kilogram) Joint Direct Attack Munitions (JDAM); each weapon can be uploaded with individual GPS-based target coordinates. On a sortie during Operation Anaconda in Afghanistan in early March 2002, Higginbotham told a ground controller that his B-1B had 24 JDAMs aboard and the controller called off four F-16s and assigned all the targets to the B-1B.

The smaller 500-pound (225-kilogram) JDAM has been certified on the B-1B with a primary goal to limit collateral damage. And nonlethal “show of force” missions now are common to avoid injuring civilians, according to Higginbotham. These involve a “tactical surprise” low-altitude, high-speed pass by the B-1B with engines in full afterburner while dropping flares and then going supersonic only 2,000 feet (600 meters) above the designated area. “It gets their attention,” Higginbotham said.

A compact tactical laser using the latest

in solid state technology is being developed to fit in the B-1’s weapons bay. As envisioned, the aircraft’s offensive systems officer would pinpoint targets and operate a rotating laser turret mounted on the underside of the aircraft. A prototype system could be ready for testing by 2014.

By then, it will have been nearly three decades since the “Star of Abilene” roared over Dyess Air Force Base on a hot Texas day and reported for duty with the Strategic Air Command.

The world has changed greatly since then—but so has the B-1B. And it continues to evolve. As a result, the bomber affectionately known as the “Bone” (B-One) to its crews should remain a viable platform, defending freedom around the globe, for many years to come. ■

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PHOTOS: The B-1B has been in operation with the U.S. Air Force since 1986. U.S. AIR FORCE

(Insets, from left) The “Star of Abilene” B-1B nose art. U.S. AIR FORCE In Afghanistan, the B-1B has performed nonlethal low-altitude, high-speed passes over enemy forces with engines in full afterburner. ERIK SIMONSEN/BOEING At the June 29, 1985, B-1B arrival ceremony, Don Beall (left), Rockwell president and CEO, and Sam Iacobellis, B-1B program manager, greet General Bennie Davis, commander of Strategic Air Command. BOEING ARCHIVES



Boeing B-1B Lancer: Long-range strategic/tactical bomber

Crew: Four—aircraft commander, pilot, offensive systems officer, defensive systems officer
Length: 146 feet (44.5 meters)
Wingspan: 137 feet (42 meters) forward position, wings swept 15 degrees; 79 feet

(24 meters) aft position, wings swept 68 degrees
Height: 34 feet (10.4 meters)
Speed: Mach 1.2 (more than 900 mph, or 1,480 kph)

Powerplant: Four GE F-101-GE-102 turbofans, with 30,750 pounds (137 kilonewtons) thrust each with afterburner

Pride on the line

Making the best jets takes the skill and dedication of thousands of employees

Photos by Jim Anderson, Bob Ferguson, Alan Marts and Ed Turner

These are heady times at Boeing's commercial jetliner plants in the Puget Sound area of Washington state. At the sprawling Everett factory, the world's largest building by volume, two new jetliners, the 747-8 Freighter and the 787 Dreamliner, are now in production. The passenger version of the 747-8, the Intercontinental, has begun assembly. The 777 is being assembled on a moving line for the first time, to further drive production efficiencies. And if Boeing is picked to supply the U.S. Air Force with aerial refueling tankers, that 767-based platform will be assembled in the plant. Some 40 miles (60 kilometers) south, at the Renton site, the single-aisle 737 also is making news for record-breaking efficiency gains: In the past 12 years, the site has rolled out more than 3,100 Next-Generation 737s. And the new 737 Boeing Sky Interior will be in production this summer.

The 737, 747, 767, 777 and 787 represent Boeing's broad product line of commercial jetliners. But none would ever roll out of the factory doors without the efforts of thousands of highly skilled men and women who by day and night assemble the planes and their millions of parts, supported by thousands more workers across Boeing and at supplier and partner companies worldwide. Here's a look inside two of Boeing's biggest factories. ■

Have an idea for a photo essay? Send an e-mail to boeingfrontiers@boeing.com



737

PHOTOS: (Top) The 737 team's Derek Charbonneau, left, and Terry Nooney. **(Insets)** Team members (from left) Ray Jacobs; Anne Scholzen; Mike Dufour; Jack Stendahl; Tim Brooks and Simon Lee; and Gary Shamp.



PHOTOS: (Top) The 747-8 team's Shonn Kidoguchi, left, and Tim Barfield. **(Insets)** Team members (from left) My Tran; Sunnytha Keo; Teresa Craig; Eddie Melkumian; Reynaldo Bobadilla and Jeffrey Ledin; and Charles Peters and Jane McKnight.

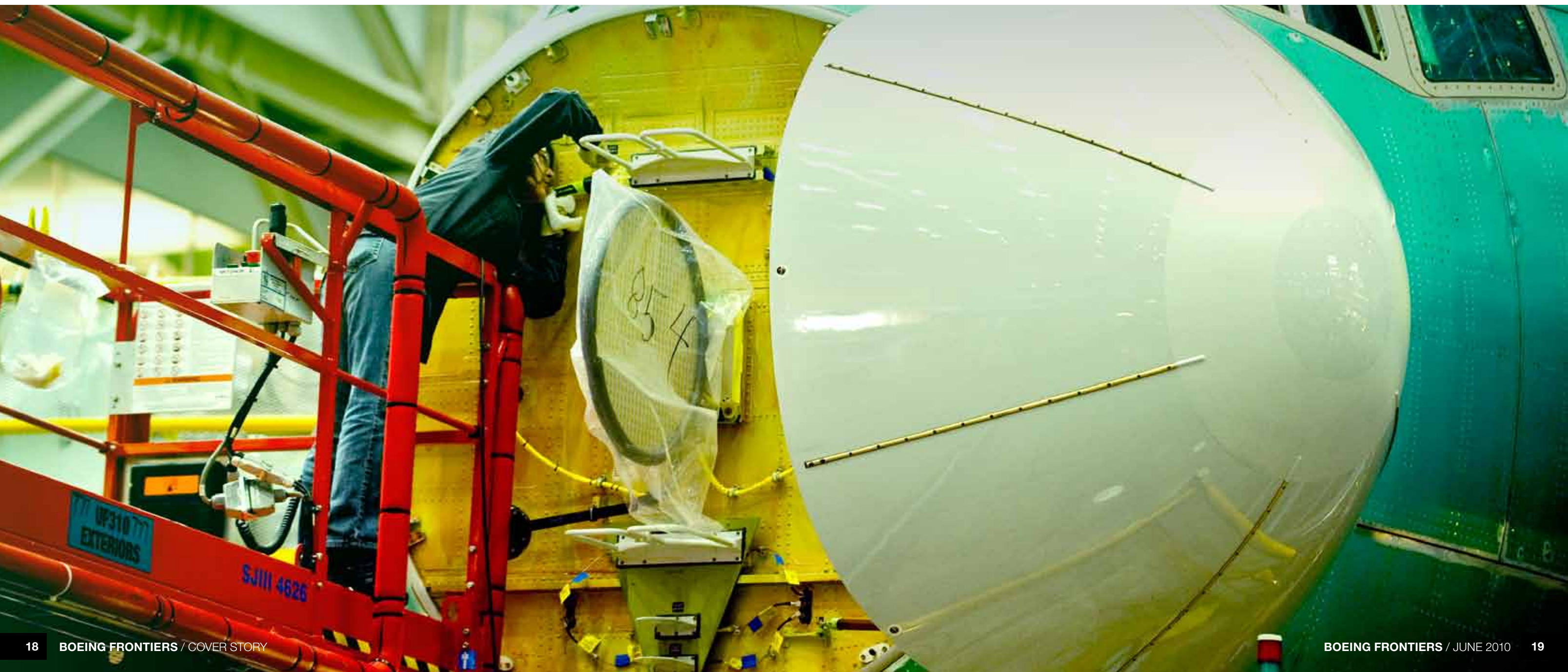
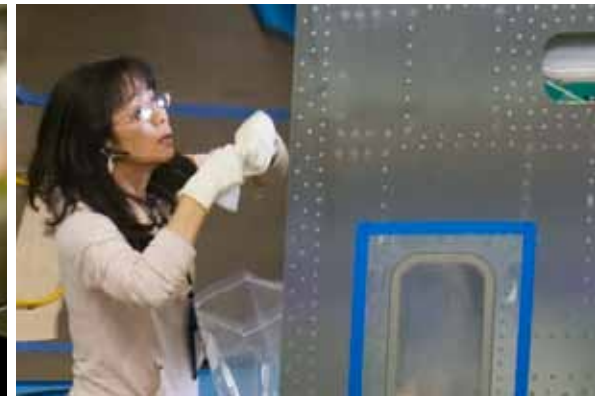
747

767

PHOTOS: (Bottom) The 767 team's Todd Stillwell, left, and Ricky Carter. **(Insets)** Team members (from left) Ryan Johnson; Robin Goetz and James Nice; Adam Garner; Michael Pitchford; Renato Augusto and Raymond Lao; and Rick Abbott.



PHOTOS: (Bottom) Installing equipment on the 777. **(Insets)** 777 team members (from left) Tony Pawavichahn, James Kinnear, Sophia Sorenson, David Kim, Bruce Wedin and Robert McMackin.



787

PHOTOS: (Bottom) The 787 team's Tran Nguyen, left, and Gary Birdsall. **(Insets)** Team members (from left) Justin Meyers, Ricardo Barreda, Miguel Elizondo, Lucila Dapiaoen, Joel Hetland and Jason Pam.



A Boeing 737 Wedgetail aircraft, registration N378BC, is shown in flight over a coastal landscape. The aircraft is white with "ROYAL AUSTRALIAN AIR FORCE" written on the side. The background features a sandy beach, green vegetation, and a blue body of water under a clear sky.

Demonstrating *Success*

When export challenges threatened a 737 Wedgetail demonstration flight, a 'One Boeing' team sprang into action *By Matt Grimison*

PHOTO: A Wedgetail flies over Newcastle, Australia. ROYAL AUSTRALIAN AIR FORCE

It was the kind of task that seemed straightforward at first. The Boeing 737 Airborne Early Warning & Control Program team was planning a demonstration flight for representatives from the United Arab Emirates—an important potential customer.

The program also was preparing its first two aircraft to be accepted into the Royal Australian Air Force fleet. Australian officials agreed to host the demonstration while a group of UAE military leaders was in Australia on an official visit. Everything seemed to be coming together.

But as the demonstration grew near, a number of export control issues cropped up that threatened to undermine the effort. In true "One Boeing" fashion, AEW&C program leaders and Boeing's Global

Trade Controls organization came together to tackle the export hurdles. The result: a "picture-perfect" demonstration in March.

"For all of the challenges we had in pulling this together, this flight represented a very big step forward," said Egan Greenstein, AEW&C business development manager. "The system worked beautifully and the crew was humming as if they'd been flying together forever."

Called the Wedgetail by the RAAF—a name derived from Australia's largest bird of prey—the 737-700-based derivative provides state-of-the-art airborne surveillance, communications and battle management. The program kicked off in 1999 when Australia chose the aircraft to meet its airborne early warning and control requirements. Since then, Korea

and Turkey have ordered the aircraft.

The program's business development team also had been in detailed talks with the UAE military, and as is customary, the potential customer wanted to see the aircraft perform in a detailed demonstration. Boeing representatives went to work putting a demonstration together.

The aircraft to be used in the demonstration was still owned by Boeing—it had not been accepted by the Royal Australian Air Force at that point. As such, Boeing secured an export authorization from the U.S. State Department to conduct the exhibition.

At this point, however, things got a bit more complicated.

U.S. Government export policy restricts a company's ability to simultaneously transfer U.S. military technology to

multiple foreign governments. Even one-time events like a flight demonstration are carefully regulated, and the license the U.S. government issued dictated specific restrictions on participation by non-U.S. persons. This meant that the Australians would be limited in what they could take part in during the demonstration.

The solution? A new license.

But timing was a limiting factor. A new license would require review by several U.S. government agencies that normally would take weeks—well past the visit to Australia by the UAE officials.

Boeing and its Australian partners sprang into action on several fronts. AEW&C program managers worked closely with Global Trade Controls to coordinate with the appropriate government agencies,

with the "heavy lifting" being performed by Boeing's Washington, D.C., office. The Australians requested an expedited license through their embassy in Washington; the U.S. embassy in Canberra also provided strong support.

This global working-together combination paid off with a license approval in a matter of days rather than weeks—and just in time for the flight demonstration March 31 at RAAF Base Williamtown on Australia's southeast coast.

Greenstein said the UAE representatives were impressed and the program gained significant credibility with a potential customer. The AEW&C program expects a decision from the UAE this year.

The first two Wedgetail aircraft were officially accepted into the Royal Australian

Air Force on May 5 during a ceremony in Williamtown. Boeing is scheduled to deliver three more aircraft to Australia by the end of this year.

Global Trade Controls Vice President Kathie Greaney said the effort to support the UAE flight demonstration shows the potential of all forms of collaboration.

"This is a perfect example of how working closely with partners—both inside and outside of The Boeing Company—can pay great dividends," Greaney said. ■

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For more about Boeing's Global Trade Controls, read the Leadership Message by Greaney in this issue of Frontiers, on Page 6.



Power play

The electric power industry is transforming itself, and that means opportunities for Boeing to pursue innovative solutions **By Derrell Carter**

Smart utilities are the future, and it's a future that Boeing aims to be part of.

As electric utilities everywhere look for ways to make their power grids smarter, more efficient and secure, Boeing is weighing in with its expertise in cybersecurity and large-scale systems integration.

"We've developed secure technology that connects command centers in Langley, Va., with troops and weapons in Afghanistan and Iraq; so why not do the same for utilities?" said Tim Noonan, vice president of Boeing Defense, Space & Security's Energy Solutions, the organization responsible for developing and capturing opportunities in the energy field.

"Boeing is known for a number of aerospace firsts including the space station's 'micro-grid' electrical system. We can make the 'smart grid' a reality as well."

Simply defined, a smart grid enables multiple applications to operate over a shared network, similar to the way the Internet works. Smart grids allow utilities to monitor where their electricity is being consumed and know ahead of time whether problems are looming, such as a possible power shortage, or blackout. Consumers also can tell how much energy they are consuming and which appliances are using the most energy, and can make adjustments to reduce usage and costs.

A critical concern, however, is the need

for protection of the smart grid against attacks by hackers, as well as its resiliency in the face of natural disasters, equipment failures and user errors. This concern over grid vulnerability is driving utilities to work closely with system integrators such as Boeing to develop a framework for smart-grid cybersecurity. The process has accelerated over the past year, spurred in large part by the U.S. Energy Department's smart-grid stimulus program.

"This is absolutely the right direction for Boeing to pursue, and a wonderful use of the company's broad technical and highly innovative talent," said Chris Smith, director of operations for Energy Solutions.

Tony Parasida, president of Global



"We can apply our broad scope of knowledge to provide valuable solutions for energy assurance and a national power grid that is both smart and secure."

— Tony Parasida, president of Global Services & Support

Services & Support, said the energy market is one Boeing should be pursuing in its expanding services business. He cited Boeing capabilities such as supply-chain management, logistics command and control, systemwide situational awareness, and real-time network management services. "We can apply our broad scope of knowledge to provide valuable solutions for energy assurance and a national power grid that is both smart and secure," he said.

Formed late last year, the Energy Solutions group is working on ways to modernize the U.S. electric grid and make it more secure and reliable. The areas of focus, which represent

a potential \$45 billion market for Boeing, include smart-grid management, technology development and energy assurance (ensuring the security of an energy infrastructure).

"Our knowledge of the energy market, from renewables to micro-grids, and our expertise in information and project integration uniquely position us," said Gautam Bahri, project manager for Energy Solutions.

Boeing's smart-grid efforts already are paying dividends. A few months after Boeing launched its Energy Solutions group, the Energy Department awarded the company federal stimulus funds worth up to \$38 million for three projects demon-

PHOTOS: Boeing's Energy Solutions is implementing three advanced smart-grid demonstrations to make power plants, power lines and substations more reliable, secure and efficient. RICHARD RAU/BOEING

(Insets, from left) Boeing's Energy Solutions is developing technologies to integrate renewable energy sources into the national grid, including building the 100-kilowatt power facility at California State University, Northridge, shown in this artist's rendering, using solar power technology. BOEING

To reduce energy consumption in cities, Boeing and Danish technology company Amplex are working on an intelligent street-light management system. PAUL PINNER/BOEING Boeing is developing technology to help power generators more securely and reliably manage electricity transmission and distribution. PAUL PINNER/BOEING



“Our knowledge of the energy market ... and our expertise in information and project integration uniquely position us.”

– Gautam Bahri, project manager for Energy Solutions

PHOTO: PAUL PINNER/BOEING

strating advanced smart-grid technology. Boeing was the only company outside the traditional power industry to win a smart-grid grant.

Boeing is partnering with two utilities, Southern California Edison and Consolidated Edison of New York, on two separate proposals to demonstrate how Boeing’s comprehensive communications and cybersecurity network can serve as the

common operating environment and the command and control network of an enhanced smart grid. Boeing and Consolidated Edison have worked together before—to develop a supervisory control and data acquisition system for the utility 25 years ago.

The third proposal, in which Boeing is the prime contractor, includes a consortium of regional transmission

operators and utilities that collectively serve all or part of 21 states and more than 90 million people. These operators are responsible for moving electricity over large interstate areas, as well as the coordination, control and monitoring of the electricity transmission grid.

“These grants give us the opportunity to show how proven technologies already being used on a host of military and cybersecurity programs can be applied to the public sector,” said Noonan. “It also allows us to help shape an exciting and challenging market, partner with new customers and suppliers, further sharpen the skills of our work force, and contribute to the company’s business growth strategy.”

Boeing also is developing business alliances to access the energy market. The company is working with Danish

technology firm Amplex to offer an intelligent streetlight management system—Amplight—that could decrease streetlight energy consumption in major cities by 25 to 35 percent, significantly reducing their carbon footprint. Amplex already manages several million streetlights in markets including Norway, Sweden, China, Indonesia and the United Arab Emirates, as well as 50 percent of all Danish streetlights. Boeing is in discussions about Amplight with the cities of Chicago; Columbus, Ohio; and Mesa, Ariz.; as well as the state of Nevada.

Practicing what it preaches, Boeing has embedded smart-grid technologies at multiple company sites to reduce energy consumption and costs.

“Our ultimate goal is to show the value of an interoperable, well-secured energy grid, and we’re willing to invest the time

and talent to satisfy customer demand and get the job done,” Noonan said. “We’re not just creating new products or services for ourselves or our customers. We’re creating energy security, which is fundamental to national security.” ■

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PHOTO: Boeing is working with Danish technology company Amplex to offer an intelligent streetlight management system known as Amplight that could decrease streetlight energy consumption in major cities by 25 to 35 percent. SHUTTERSTOCK.COM



Delivering safety

Employee ingenuity is helping reduce injury risk at sites throughout Boeing

By Christine Hill

At the Boeing site in Fishermans Bend, Australia, three employees came up with a better and safer way to work with heavy rolls of material used to make the 787 Dreamliner's composite movable trailing edges.

The improvements eliminate possible injuries from bending down, lifting and dragging. "Basically backs, knees, shoulders and arms," said Ross Garlick, a safety coordinator for Boeing Aerostructures Australia.

In St. Louis, a Boeing team on the C-17 program is using discarded packaging foam and duct tape to prevent injuries. And at Boeing's 737 jetliner plant in Renton, Wash., employees helped with ergonomics and safety challenges that came with a new assembly method for the airplane's wings.

These are just three of the many ways, throughout the company, that Boeing employees are changing processes and tools to improve ergonomics—the ease and safety with which tasks can be performed. They're proving that even simple changes can drive injuries out of the workplace.

Boeing has set an aggressive goal of reducing the number of injury cases that result in lost work by 25 percent by 2013. To that end, Boeing last year launched a companywide effort called Safety Now. Mary Armstrong, vice president of Environment, Health and Safety, explained that at the core of Safety Now are two ideas: "We're all responsible for our safety and the safety of our co-workers, and we're improving the design of our processes and our products to create safer workplaces," she said.

Here is a look at how those Boeing employees in Renton, St. Louis and Fishermans Bend took the initiative to improve safety at their workplaces.

At the Fishermans Bend site, the rolls of fabric used to make 787 movable trailing edges arrive in 90-pound (40-kilogram) boxes. Previously, one employee had to drag each box from a rack onto an electric lifter that raised it to the right height. Then two employees lifted the fabric roll out of the box and onto a cutting machine.

Because the entire roll isn't used all at once, the employees then had to reverse the process. It resulted in a lot of daily dragging and lifting with the risk for ergonomic injuries,



according to the team. So quality engineer Sam Scicluna and teammates Goran Najdovski and Won Jae Lee designed rollers for the rack, as well as a roller-equipped frame that fits onto the electric lifter. They also modified the loading frame so the lifter moves the rolls directly into position. And, in a simple process change, they now cut away part of the roll packaging as soon as a shipment arrives so they can position the bar that holds the roll on the cutting machine without manually lifting the roll from its box.

The three were not only recognized for their efforts, but now other parts of the factory are making similar improvements. "We're a small team, so we look out for one another," Scicluna said.

A St. Louis team that assembles the C-17 main landing gear pods showed similar initiative. "One idea we came up with was to have pads on all protruding tooling so people don't bang knees and shins," said Jim Daniels, aircraft assembler and team leader.

To make the pads, the team used discarded packing foam secured with duct tape. Previously, they had arranged for tool cribs to "ergo-wrap" vibrating drill motors and rivet guns,

reducing the risk to users of joint pain, carpal tunnel syndrome and shoulder pain.

Daniels said safety has always been the team's priority and a commitment, and has paid off with a 17-month perfect safety record. "If we see an employee without safety glasses, we say something," he said. "We've always worked that way."

When Boeing changed its 737 wing assembly line in Renton, the development team asked employees for help making changes that not only improved production efficiency but also ergonomics and safety. Employees set up mock production areas where they could test production line work heights as well as the weight of tools and parts. An ergonomics expert was on hand to make adjustments. As a result, mechanics use lighter, counterbalanced, automated tools that put them in a better ergonomics position to perform their tasks.

"Because employees were involved with the redesign from start to finish, they were able to 'design in' safety and ergonomics," said Les Weige, 737 Environment, Health and Safety director. "Totally rethinking the way we build products, then ensuring that improved



safety and environmental impacts are part of the new process, is huge for us. Taking on these kinds of initiatives and continuing to attack our most difficult ergonomics issues speaks volumes about our commitment to employee safety." ■

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For information, tools and resources on ways to improve workplace safety, visit the Safety Now site at <http://safetynow.web.boeing.com> on the Boeing intranet.

PHOTOS: (Left) Deandre Harris, a Next-Generation 737 mechanic in Renton, Wash., works on the 737 horizontal wings assembly line, where employee input helped improve efficiency, safety and ergonomics. **MARIAN LOCKHART/BOEING (Top)** Jim Daniels, an assembler on the C-17 team in St. Louis, uses a drill with a padded handle that reduces vibration that can contribute to ergonomic stresses and injuries. **RON BOOKOUT/BOEING (Above)** At Boeing Aerostructures Australia, Quality engineer Sam Scicluna (left) and Environment Health and Safety coordinator Ross Garlick use an in-house-designed lifter used to transport and load heavy rolls of fabric for composite lay-up. **ANDREW HENSHAW**

Workplace safety: Make it part of our DNA



In 2009, Boeing set a five-year goal to reduce its lost-workday injury rate by 25 percent. *Frontiers* spoke to Mary Armstrong, vice president of Environment, Health and Safety, to get her perspective on Boeing's progress toward this target.

How has Boeing's workplace safety performance been lately?

Overall job injuries at Boeing have dropped about 5 percent since 2008. That's a tremendous start toward our five-year goal. Still, there's a lot to do. Collectively, we're developing innovative ways to protect ourselves and our co-workers from injury. And there are some outstanding examples in this edition of *Frontiers* of what people and teams around the company are doing to prevent injuries.

Where is Boeing focusing its efforts?

Post-injury investigations often uncover ergonomics issues we can address through thoughtful process redesign. By analyzing the data, we have found the top 10 areas where injuries occur most often. The data also have shown us some of the root causes. Now, we're focusing our efforts on these high-leverage areas. As we make gains, we'll replicate these proven solutions in other areas around the company where people do similar work.

Are these the only areas we're focusing on through the Safety Now program?

Actually, the opposite is true. We're raising the bar on workplace safety in both manufacturing and office environments. For example, in our office areas during the past five years, ergonomics-related injuries that caused lost workdays dropped 45 percent. That's partly due to ergonomics focals who use Lean+ methodologies to help make workplace improvements.

What are the next steps?

By the end of 2011, major Boeing manufacturing sites will implement a common safety management system aligned to OHSAS 18001, the globally recognized standard, which we will tailor appropriately to meet our aerospace needs. By having a single safety management system, we will use similar tools

and metrics at all sites and programs across Boeing. This will enable us to consistently assess and manage safety risks—and understand how to best target our resources and how to design safety enhancements into our processes. This will give us a common way to meet safety-improvement targets, comply with safety and health regulations, and, most important, protect employees.

As a company, we build amazing machines that fly in unforgiving environments. Our success has depended on making flight safety part of Boeing's DNA. Workplace safety is equally important, and we intend to make workplace safety part of our DNA as well.

With our ongoing Safety Now effort, strong leadership at every level and the continued commitment of employees around the company, we have everything we need to achieve our aggressive goal of a 25 percent improvement in workplace safety. Keeping everyone safe at work is our responsibility and our right. It's up to all of us to get it done. ■

PHOTO: JIM COLEY/BOEING

These workplace-safety resources are available for employees:

An overall Safety Now guide, <http://ehs.web.boeing.com/sheadocs/safetynow/safety%20now%20guide.pdf>

Ergonomics Solutions Catalog, http://ehs.web.boeing.com/ergonomics/ergo_catalog.asp

Office Ergonomics Self-Help checklist, http://ehs.web.boeing.com/ergonomics/office_ergo.asp

The *Lion* king

A strong relationship with Boeing has helped make Lion Air a transport of choice in Indonesia *By Marcy Woodhull*

Navigating Indonesia can be a challenge unlike any other. But thanks to Lion Air, Indonesians have affordable and accessible transportation throughout the nation's 30 provinces and more than 17,500 islands, with routes to over 36 destinations across Indonesia and the Asia Pacific region.

Celebrating its 10th anniversary this month, Jakarta-based Lion Air operates an all-Boeing fleet and was the launch customer for the Next-Generation Boeing 737-900ER, or Extended Range, a higher-capacity variant that can carry up to 215 passengers. Lion Air has had the distinction of being the market leader in Indonesia each year since 2006.

"Lion Air is critically important to Indonesia as the largest private carrier in Indonesia," said Marlin Dailey, vice president of Sales, Boeing Commercial Airplanes. "Its presence gives the residents of Indonesia a safe and efficient way to travel." Indonesia is the world's fourth most-populous country, with about 230 million people.

Led by President Director Rusdi Kirana, Lion Air aims to carry 20 million passengers this year to destinations within Indonesia as well as to Malaysia, Singapore, Vietnam and Saudi Arabia. The carrier is based at Soekarno-Hatta International Airport in Jakarta.

"Our airline is strong and profitable in large part because of our relationship with Boeing," Kirana said. "The safety and comfort

of our passengers is paramount for us, and the Boeing airplanes we use provide extraordinary measures of both."

Lion Air operates a fleet of 47 Boeing airplanes. It took delivery of the first 737-900ER in April 2007 and expects to have its 100th in November 2013. Lion Air also operates two 747-400s, which are mainly used to carry Muslim pilgrims to Mecca.

It is the first airline in the region to utilize Boeing's Required Navigational Performance system, which uses global positioning satellites and onboard flight-management systems to guide airplanes along flight paths with pinpoint accuracy. The system's flight procedures provide operators an effective tool for safe and efficient operation in challenging terrain or weather conditions.

Underscoring the special relationship between Lion Air and Boeing, the airline is also one of the launch customers for the new 737 Boeing Sky Interior. Drawing on years of research that went into the interior design of the 787 Dreamliner, the new 737 interior features a number of cabin enhancements, such as sculpted sidewalls and larger, pivoting overhead stowage bins.

"Rusdi Kirana and Boeing have a great partnership," said Dailey, "and continue to work side by side to move the airline forward." ■

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PHOTO: Rusdi Kirana, Lion Air's president director, in front of the airline's Boeing 737-900ER (Extended Range) at Soekarno-Hatta International Airport in Jakarta, Indonesia. BUDHY ASHARY

Cyber defenders

Defending against cyberattacks is a top concern for Boeing and its military and government customers

By Lynn Farrow and photos by Paul Pinner

It's nothing short of a war, and the weapons can cause damage on a global scale. But this war is not being fought at some remote location far away. The battlefield is invisible. And the enemy could live right next door.

In what some have termed a "virtual 9/11," today's cyberattacks do not target a person or place, but a person's personal data, a corporation's intellectual property or a government's network infrastructure.

In the face of increasingly sophisticated cyberattacks, the demand for computer-security experts has become so critical that U.S. Homeland Security Secretary Janet Napolitano announced in October that her agency would hire 1,000 more to tackle what she called one of government's most urgent priorities.

The need for cybersecurity is no less important for a company the size of Boeing, where 300,000 users, including employees, customers and suppliers, collaborate and share information daily in more than 90 countries.

Boeing's Cyber and Information Solutions, part of the Intelligence and Security Systems division created two years ago to address cybercrime and other homeland security issues, is using some unconventional recruiting methods to find these cyberwarriors—including keeping an eye on university "cyber competitions."

"Partnering with universities for new technologies and talent is a key initiative within Boeing," said Barbara Fast, vice president of Cyber and Information Solutions. "These cyber competitions,

"Partnering with universities for new technologies and talent is a key initiative within Boeing."

— Barbara Fast, vice president of Cyber and Information Solutions

PHOTO: The Global Network Operations talent pool includes (clockwise, from top right) Sallil Pandit, Brian Trimmer, Sarah Tran, Ernesto Morales-Perea, Tin Tam, Jarrad Sims and Matthew Gill.



mission successfully," said Mike Snyder of United Space Alliance in Houston. The alliance is a 50-50 joint venture by Boeing and Lockheed Martin.

With the shuttle program winding down, the teams are looking to take advantage of their diverse skills to build new business. The results so far have been promising: "A couple of direct contracts with NASA not related to [the] shuttle," according to Donald Varanauski, a Boeing propulsion and power engineer.

One project taps the teams' Easy5 experience to model and analyze a proposed cryogenic rocket test stand for NASA.

"This is the first time NASA has attempted to build and test something in a computer model before building it in real life," Arrieta said. "Our success in modeling the proposed test stand will position us to capture new propulsion design and analysis work from both the government and industry."

Snell and Arrieta credit the relocation—and team members recognizing and encouraging one another's strengths—for the new work. "We have a diverse set of skills across our two teams that we hadn't fully appreciated before we were co-located," Snell said. "We wouldn't have brought in this new business without integration, or at least not as well. And we have a very happy customer." ■

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Sometimes, the person sitting across the aisle may have the answer.

That's the thinking that inspired two managers working on Boeing's space shuttle propulsion systems to co-locate their Houston-based teams for improved efficiency and interaction. Previously, the teams were in separate buildings three miles (five kilometers) apart. Now, they're within steps of each other.

And the move is paying off—for the shuttle program as well as in new business opportunities for Boeing.

One of the Boeing teams is led by Steve Arrieta and deals with propulsion system hardware. Steve Snell leads the other team, which integrates propulsion on the Space Shuttle.

Shortly after their relocation, Snell's team volunteered to learn from and assist their new suite mates on projects using a software program called Easy5, which models fluid and gas systems and allows users to virtually build components such as valves.

Both teams were soon working a modeling problem involving one of the space shuttles. *Discovery* was on the pad and being readied for an April launch when an internal valve apparently failed. But the valve was in a place that was almost impossible to reach, so it could not be easily checked.

"The teams worked together to model the problem and found that even if the valve failed, we were well within [performance and safety] tolerances. It was a tremendous effort in getting answers quickly in order to fly the

The 'next' step

For two Boeing teams, a small move to be closer has gone a long way in building new business

By Tabatha Thompson

PHOTO ILLUSTRATION: Symbolizing the synergy and modeling expertise of their recently co-located space shuttle propulsion teams, Boeing managers Steve Snell (left) and Steve Arrieta go "on-site" to inspect a virtual propulsion system.

BRANDON LUONG/BOEING; PHOTOS ELIZABETH MORRELL/BOEING

which are held nationwide, are a lot like the TV show *Jeopardy* on cybersteroids. To win one is quite a feat."

That's how Paul Ambrosini, Raffi Erganian, Matthew Gill, Jeff Henbest, Jarrad Sims and Tin Tam landed jobs at Boeing.

The Cyber Six, as they have been called, are 2009 graduates of California State Polytechnic University in Pomona, Calif., where as students last year they won the Western Regional Collegiate Cyber Defense Competition. Their efforts caught the eye of Jim Ross, Boeing senior systems security engineer. Eventually all six were hired by Cyber and Information Solutions, which is designing and integrating cybersolutions for Boeing's network as well as the

U.S. Defense Department and other government agency platforms.

"In order to design a good defense against hackers, there's nothing better than knowing exactly what tools are being used by the bad guys so you can incorporate that knowledge into your defensive capabilities—precisely what these students did to win the [collegiate] competition," said Rich Wada, chief segment engineer with Boeing's Global Network Operations, part of Cyber and Information Solutions.

The Global Network Operations team has a deeper talent pool than just the Cyber Six. There's Sarah Tran, a recent UCLA graduate, Zach Nelson from the Missouri Institute of Technology, Brian Trimmer from the University of Southern

California, Ernesto Morales-Perea from Rensselaer Polytechnic Institute, Andrew Huah from the University of Michigan, and Salil Pandit from Cal Poly. "We've been able to integrate the strengths of the Cal Poly team with the rest of our talented [Global Network Operations] staff in Anaheim, Calif., who also share a passion for the cyberdomain. And together they've come up with some pretty innovative ideas," Wada said.

The group's focus is on research and development projects that will ultimately produce solutions that protect the company and customer networks. To do this, the team examines system weaknesses and determines possible infiltration methods. The Cyber Six also built a replica of the computing

environment they used to win the Collegiate Cyber Defense Competition and have turned it into a training tool.

The Cyber Six meet through a Cal Poly club that provides a forum for students to explore computer security. But their interest in network infrastructures and how to protect them started very young.

"I didn't have a computer but I'd go to the local library and mess around in their computer lab," Tam said. "Every time I broke something I had to learn how to fix it myself, so I learned a great deal about how computers function."

Henbest's parents enrolled him in a computer class and by the time he and Tam were 8, they were skilled at computing and hooked on the technology. Ambrosini was in the sixth grade when he built his

first computer for a science project using parts he bought commercially. Sims loved computers as a kid and with encouragement from his father enrolled in the Cisco Certified Network Associate Academy his high school offered. By the fifth grade, Erganian was already interested in computer programming. Gill isn't sure when he became interested in computers, but it was early. "There has always been a computer in my house and I've just never stopped using one," Gill said.

Their passion and enthusiasm for computers spills over into everything they do. At their Boeing office, they work in a wall-less area referred to as "the cave" so they can interact with one another and work more efficiently. But no matter how they do it, they

remain focused on one thing: helping protect computer systems from hackers and making sure, along with Boeing's other cyberwarriors, that the company and its customers always have the upper hand in this war. ■

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Matthew Gill: There was always a computer in my house and I just never stopped using one.



Jeff Henbest: It's amazing to be able to work with all of your friends—people you already trust and know will always pull their weight.



Raffi Erganian: Our friendship transformed us into a group that has been able to work well together.



Paul Ambrosini: In the sixth grade, I built my first computer for a science project using parts bought commercially.



Jarrad Sims: I loved computers as a kid and with encouragement from my father enrolled in the Cisco Certified Network Associate Academy my high school offered.



Tin Tam: I got interested in computers when I was four years old. At that age, I didn't even have a computer but I'd go to the local library and mess around in the computer lab.

A tactical edge

Boeing is playing a crucial role equipping warfighters for combat

By Peggy Mason and photos by Richard Rau

For the combat soldier, knowing where the enemy is can be a lifesaving advantage.

Take the following combat scenario that could soon become reality because of Boeing's work on a program for the U.S. Army:

A ground sensor is placed near a road where enemy forces are expected to travel. The sensor, three or four feet (about a meter) high, is camouflaged by natural cover. A soldier checks data relayed from the sensor and detects a potential threat just out of his range of vision. Another soldier requests that an unmanned aerial vehicle be deployed to get a closer look.

Soon, the aerial vehicle is transmitting data that allow the soldiers to determine that the area in question is clear of hazards. But other soldiers continue to scan the immediate area, this time by maneuvering a small unmanned ground vehicle to check places where the enemy could be lurking—in and around buildings, alleys and vehicles.

Throughout the process, soldiers are transmitting up-to-the-minute information to their units, using a network integration kit that acts as a "secure cell phone" to link soldiers to incoming sensor and communication data and allows the soldiers to relay information.

"These capabilities empower soldiers at every level to make faster, smarter and safer decisions," said Boeing's Paul Geery, vice president and program manager for the Army's Brigade Combat Team Modernization program—a program once known as Future Combat Systems. But more has changed than just the name.

About eight years ago, Boeing and the U.S. Army developed the concept of Future Combat Systems. The Army's vision of future warfare centered around a highly linked ground force that could transmit and receive real-time information on everything from enemy troop locations to the identification of a sniper's nest. Future Combat Systems would have equipped 15 brigades, with new manned and unmanned vehicles linked by an unprecedented, fast and flexible battlefield network.

Pentagon and Army officials canceled the vehicle development component of the program about a year ago and restructured its remaining components into the Brigade Combat Team Modernization program, which will provide new capabilities to all of the Army's brigade combat teams. The restructuring better defined what the Army and Defense Department required, and it focused even more on the needs of soldiers in the field. The most crucial element of Future Combat Systems—the network—remained intact. It will provide real-time situational awareness not only to

commanders but to those who need it most—soldiers in battle.

"The cancellations were formidable, a crucible for the program," said Virginia Barnes, previously the vice president and deputy program manager for the Brigade Combat Team Modernization program. "But through it all, our mission remains the same: to get network-enabled capabilities into the hands of soldiers as soon as possible."

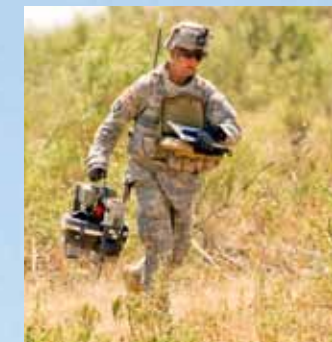
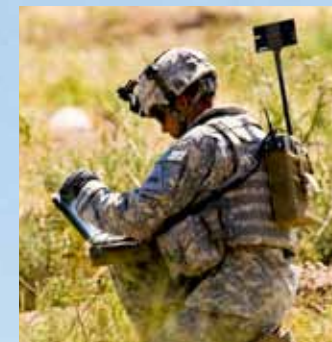
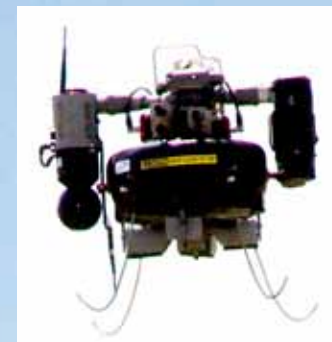
A significant milestone came in February when Boeing received a \$138 million contract for low-rate initial production. Starting in 2011, a team led by Boeing, with support from Science Applications International Corp., will equip the Army's first Infantry Brigade Combat Team with networked capabilities that include:

- Small Unmanned Ground Vehicles—robotic systems capable of reconnaissance missions in dangerous or difficult situations such as entering buildings, caves and tunnels
- Class I Unmanned Air Vehicles—small, soldier-operated UAVs that can hover for reconnaissance and surveillance while providing target acquisition
- Unattended Ground Sensors—multi-mode surveillance sensors for target detection, location and classification, with an imaging capability for identification
- Network Integration Kits—integrated computer systems with the latest communications and radio systems and battle-command software, providing the initial network connectivity needed to transfer sensor and communication data.

Program components are already being tested at Fort Bliss, Texas, and the White Sands Missile Range in New Mexico; the tests are in the third year of a four-year testing process. The Army Evaluation Task Force, including soldiers who have served in Iraq and Afghanistan, is rigorously testing the components to ensure they can withstand combat.

"Our aim is to get these capabilities to the soldiers at the tactical edge and empower them to make decisions based on information and knowledge," Geery said. "The feedback we get from the Army's Evaluation Task Force during our development ensures we stay on track." ■

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PHOTOS: (Above, from left) A Class 1 Unmanned Aerial Vehicle—this one the size of carry-on luggage—can scan an area and relay the video to soldiers; a soldier in the field checks incoming information that provides situational awareness of the surrounding area; after the Class 1 Unmanned Aerial Vehicle lands, a soldier can easily carry it to the unit's vehicle or secure area; a soldier at White Sands Missile Range, N.M., monitors information from Brigade Combat Team Modernization capabilities being tested.

(Below) Soldiers can maneuver the Small Unmanned Ground Vehicle (foreground) into areas that could be hazardous by using a hand-held controller similar to a video game controller.



New horizons

Boeing and Lufthansa look to the future as they celebrate 50 years of working together **By Lauren L. Penning**



“Every airplane we’ve ever built has Lufthansa in it.”

— Jim Albaugh, president and CEO of Boeing Commercial Airplanes

Imagine traveling in a world where airplanes are lighter, stronger and smarter, where most of their fuel is made from renewable sources, and where parts of an airplane morph into optimal shape in flight. It may seem far-fetched. But key partnerships in aviation could help make it reality.

“Imagining a better world is central to our continued innovation,” said Jim Albaugh, president and CEO of Boeing Commercial Airplanes, at a celebration in Hamburg, Germany, last month of Lufthansa’s 50 years in the jet age in partnership with Boeing.

The two companies have a long history of innovating together.

“Boeing’s and Lufthansa’s success story has always been linked to our history of technology together,” said

Wolfgang Mayrhuber, chairman of the Executive Board and CEO of Lufthansa, which took delivery of its first Boeing jet, the 707, in 1960.

Since then the airline was the launch customer for the 737 and has had a significant role in the design of the 747-400 and 747-8 Intercontinental. Lufthansa has operated the Boeing 247, 707, 727, 737, 747 and DC-10 models. Aerologic, Lufthansa’s joint venture cargo airline, extends the airline’s influence to the 777 line as well. Aerologic is the largest operator of the 777 Freighter, with four in operation and four more on the way.

To date, Boeing has delivered 318 airplanes to Lufthansa and Lufthansa Cargo.

“Every airplane we’ve ever built has Lufthansa in it,” Albaugh said.

Celebrating this history with Lufthansa and Boeing were engine manufacturers General Electric, Rolls-Royce and Pratt & Whitney. At a Sustainability Summit attended by nearly 200 media representatives and other stakeholders just prior to the anniversary gala, Paul Steele, director, Aviation Environment for the International Air Transport Association, asked a cross-industry panel to focus on achievements they believe the aviation industry will celebrate 50 years from now.

All agreed that collaborating on modernization of air traffic management, new aircraft designs and new fuel technology is key to the aviation industry of the future. Lufthansa noted its recent membership in the Sustainable Aviation Fuel Users Group—a group Boeing

helped found that is focused on developing a sustainable aviation fuel supply. Formation of this group, along with other steps taken by industry-leading companies—including Boeing’s role in six biofuel flight tests—is advancing the future of aviation, panelists said.

Lufthansa will be the first airline to operate Boeing’s newest passenger version of the jumbo jet, the fuel-efficient 747-8 Intercontinental. A partner on the 747 since the airframe was first designed more than 40 years ago, Lufthansa again collaborated with Boeing on requirements for the “dash 8.” Experts from Lufthansa, Boeing and other future operators met in working groups throughout the 747-8’s development to focus on improvements to the airplane that will increase its

efficiency and reduce operating costs. One example: the cost savings and improved aircraft availability from longer intervals between major 747-8 maintenance visits. Additionally, new technology used in the wing and engines will reduce fuel consumption and cut carbon dioxide emissions by 16 percent, according to Boeing and Lufthansa, while producing a 30 percent smaller noise footprint.

The 747-8 Intercontinental is the latest example of successful innovation between Boeing and Lufthansa, a partnership that began 50 years ago. It is not likely to be the last. ■

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PHOTOS: (From left) Lufthansa’s first Boeing 707 rolls out of the Renton, Wash., plant in 1960. **BOEING ARCHIVES** Top executives of the two companies took turns flying a 747-8 Intercontinental simulator at last month’s celebration in Hamburg of the 50-year partnership between Boeing and Lufthansa. **JOERG MUELLER** A Lufthansa 737 served as a backdrop for the event. **JOERG MUELLER**

GRAPHIC: Lufthansa is the launch customer for the new 747-8 Intercontinental (above), with 20 on firm order and purchase rights for an additional 20. **JOERG MUELLER**

Partners in flight

The chairman and CEO of Lufthansa talks about his airline's long and close partnership with Boeing

Dear colleagues, friends and employees of Boeing,

It is with great pride that Lufthansa celebrates 50 years of true partnership with Boeing. It began with great excitement and curiosity on March 2, 1960, when our first 707 in the blue and yellow colors of Lufthansa landed in Hamburg, Germany—and launched Lufthansa into the jet age.

Ever since, our industry has developed and thereby changed the world. Together, we and Boeing played a role in the process and influenced history. The driving force behind all the improvements was technology—a field that Boeing focused on. Our engineers at Lufthansa are proud to have always been welcomed to work side by side with the Boeing engineers, inserting operational experience.

By raising the customer's voice, they were able to play an active role in Boeing's endeavour to shape our industry, and as a result, Lufthansa has been an aircraft launch customer many times. Since the arrival of the 707 we have always operated Boeing airplanes on both continental as well as intercontinental flights.

With the Boeing 747-8 we will continue that tradition. We are excited to welcome this new generation of Boeing aircraft into our fleet soon.

The world has changed, the products have changed and the industry has changed. But our partnership with Boeing has remained strong and stable through-



out the decades. We have formed close ties and have become business partners and friends. Our highest respect and thanks go to all of you for your excellent work. Boeing and Lufthansa are strong brands; both have a great history and a great future. We at Lufthansa and all member airlines are looking forward to working with you for at least another 50 years to come.

Happy 50th anniversary and thanks from your friends at Lufthansa—keep innovating, keep up the competitive spirit and be Boeing.

*Wolfgang Mayrhuber
Chairman of the Executive Board
and CEO of Deutsche Lufthansa AG*

PHOTO: During a celebration last month in Hamburg, Germany, of the 50-year partnership between Boeing and Lufthansa, Jim McNerney (left), Boeing chairman, president and CEO, Wolfgang Mayrhuber (center), chairman of the Executive Board and CEO of Deutsche Lufthansa AG, and Jim Albaugh, president and CEO of Boeing Commercial Airplanes, discuss the 747-8 Intercontinental. Lufthansa is the launch customer for the bigger and more efficient jumbo jet. JOERG MUELLER



Balancing act

To achieve a good work-life balance, find what works for you

By Susan Birkholtz and photos by Marian Lockhart

Finding the right balance between work and the rest of your life can be a high-wire act—put too much weight on one side and you could lose your footing.

Add to this balancing act the pressure and longer work days that result from a challenging business environment, and it is more important than ever to manage stress and find a work-life balance.

But what is a good balance?

"It's difficult to define work-life balance because it means different things to different people," said Rene Vaughn, who works for Boeing and helps oversee the Employee Assistance Program and Family Care Resources. "For one person,

it could mean not letting electronic accessories rule his or her life. For another person, it could mean finding time to work out each day. And for yet for another person, it could mean having time to spend with family."

Kirsten Aranda, Human Resources leader for Boeing Shared Services Group and a single mother of three, said each person must define what work-life balance means to him or her. "I've found techniques that really help me find balance even though I work more than 40 hours a week," she said. "I blend my work and family time during the week with no set start and stop times for work, but I carve out specific family time."

Putting a different spin on it, Karen McCune, vice president of Work-Life Services for OptumHealth Behavioral Solutions, Boeing's Family Care Resources provider, said she encourages people to think about work-life effectiveness instead of work-life balance. "When you talk about balance, you think about a scale where everything needs to be 50-50 all the time," she said. "But I think it's more beneficial for people to ask themselves, after considering their current family situation and their current work situation, 'Am I being effective in both?'"

If your answer to that question is "no," this three-step process might help:

Step 1: Identify stresses

If you are stressed, it can affect your ability to be effective on the job and at home.

Figure out what aspects of your life, if any, are causing you stress and try to find solutions.

Step 2: Create a plan

Formulate a personal plan to achieve work-life balance. Don't be afraid to ask for help when developing your plan. The Boeing Employee Assistance Program can help employees define work-life balance and strategies to achieve it.

Step 3: Seek support

Boeing offers employees and their families a wide variety of resources to help achieve work-life balance, including the Employee Assistance Program and Family Care Resources. (These two programs are confidential and managed by outside parties; no personally identifiable information is shared with Boeing.) The programs—available to employees and their families at no cost—are designed to help manage stress for improved productivity both at work and at home. ■

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For more information, employees can visit the Well Being Resource Center at <http://wellbeing.web.boeing.com> on the Boeing intranet.

PHOTOS: Kirsten Aranda, Human Resources leader for Boeing Shared Services Group (shown at work, left, and at home), makes work-life balance a priority.

Sky command

Four modified 747s have served for nearly four decades as airborne command posts

By Jarrod Bartlett

“It’s our job at Boeing to partner with our customer and other teammates on the E-4B team to ensure that when called upon, the E-4B is ready to respond.”

– Glenn Winkler, Boeing E-4B program manager



For more than 35 years, modified U.S. Air Force Boeing 747s known as the E-4 have been on patrol around the world, providing a secure mobile command post during times of war and national emergencies, but also for diplomatic missions and routine patrols.

“The E-4B must be available 24 hours a day, seven days a week, at the highest level of readiness,” said Col. Martin Doebel, National Airborne Operations Center commander. “This is a daunting task for military maintainers, airborne communication systems technicians and Boeing’s contractor logistics support personnel. It’s a task that’s been performed without interruption and with outstanding results these past 35 years.”

The first aircraft was delivered to the U.S. Air Force in December 1974 and assumed alert status in early 1975. Three more E-4s followed. In a typical year, the four E-4s will fly more than 50 overseas missions, including stops in more than 25 countries.

Currently, the fourth and final jet is undergoing extensive modifications, including improved video and teleconferencing capabilities, an upgraded conference room, and a digital communications system that will replace an analog one that is destined for a museum. The modifications include about 350 miles (560 kilometers) of new wiring. The other three aircraft have already received the upgrade.

“It’s our job at Boeing to partner with our customer and other teammates on the E-4B team to ensure that when called upon, the E-4B is ready to respond,” said Glenn Winkler, Boeing E-4B program manager. “With only four aircraft in the fleet and one of them undergoing scheduled maintenance at all times, it’s even more important for us to have a customer focus that delivers a capable, ready, reliable aircraft.”

The modified Boeing 747-200s were originally deployed during the Cold War to help counter nuclear threats to fixed,

land-based command centers. Over the past 20 years, the mission has changed in response to emerging defense challenges. Today the E-4B, based at Offutt Air Force Base, Neb., serves as the National Airborne Operations Center where strategic decisions are made and communicated in war or during disasters.

“There is an enduring requirement for the president, secretary of defense and chairman of the Joint Chiefs of Staff to have assured, continuous and reliable communications among themselves and with U.S. Forces worldwide, and to have immediate access to decision-making information,” Doebel explained. “It’s safe to expect the E-4B will continue providing U.S. leadership a reliable, highly capable, survivable and enduring node of the National Military Command System through the early 2020s.”

The E-4B is one of the most sophisticated communications aircraft in the world. Operating the aircraft are Air Force personnel and an extended maintenance team, who are on

call around-the-clock to keep the planes ready. Boeing’s Global Transport & Executive Systems supports the E-4B with maintenance, modifications and upgrades at the Wichita, Kan., and Oklahoma City facility, and provides field services at Offutt Air Force Base. Global Transport & Executive Systems employees in Wichita also provide Programmed Depot Maintenance on each jet every five years.

“I’m proud to support the E-4B program because of the critical role the aircraft plays in national security,” said Bruce Johnson, a 34-year Boeing employee and team leader on the Wichita flight line. “Providing the best possible maintenance on this aircraft is our way of showing the pride we feel.”

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PHOTOS: The last of four E-4B aircraft is currently undergoing modifications at Boeing’s Wichita, Kan., facility. JOSH PLUEGER

Boeing Company – BA

NYSE: Industrials/Aerospace & Defense

As of 5/21/10

\$64.56

Stock snapshot

52-week range:	
52-week high	\$76.00
52-week low	\$38.92

International competitors

EADS* – EAD.PA	
As of 5/21/10	15.85
52-week range:	
52-week high	17.01
52-week low	10.85

*Prices in euros

U.S. stock indexes

S&P 500	
As of 5/21/10	1,087.69
52-week range:	
52-week high	1,219.80
52-week low	869.32
S&P 500 Aerospace and Defense Index	
As of 5/21/10	348.67
52-week range:	
52-week high	396.13
52-week low	323.90
Dow Jones Industrials	
As of 5/21/10	10,193.39
52-week range:	
52-week high	11,309.00
52-week low	8,057.57

Special edition: The Lean+ story

Growth, productivity and cash management are among the topics of a Lean+ Special Edition webcast on June 23. Boeing Chief Financial Officer James Bell and Bill Schnettgoecke, Boeing's Lean+ Enterprise Initiative leader and vice president of Operations and Supplier Management for Defense, Space & Security, will be special guests on the webcast, which is accessible to employees via the Lean+ website at <http://leanplus.web.boeing.com>.



PHOTOS: (Left) Boeing Chief Financial Officer James Bell. BOB FERGUSON/BOEING
(Right) Bill Schnettgoecke, Boeing's Lean+ Enterprise Initiative leader. RICHARD RAU/BOEING

Boeing stock, ShareValue Trust performance

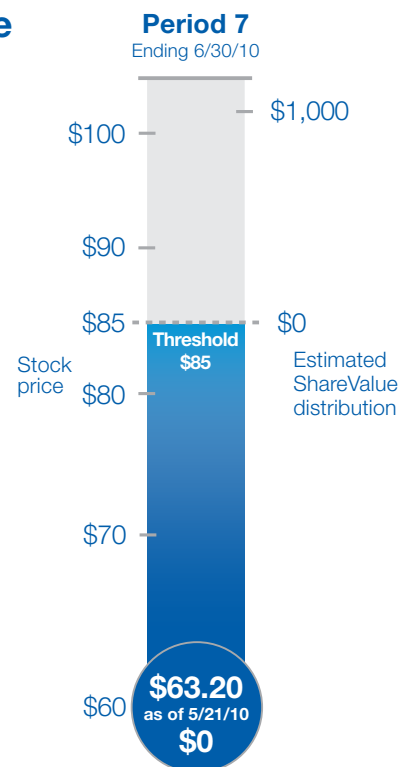
ShareValue Trust, or SVT, is an incentive plan that allows eligible participants to share in the success of their efforts to improve productivity and grow the business.

The program—which runs for 14 years and ends in 2010—features seven overlapping investment periods. The program is currently in Period 7.

This graph shows an estimate of what a “full 4-year participation” ShareValue Trust distribution (pretax) would be for Period 7 if the end-of-period average share prices were the same as the recent price shown.

The share price shown is the average of the day's high and low New York Stock Exchange prices. Updates to participant/employment data will be made periodically.

For more information on the ShareValue Trust, visit www.boeing.com/share.

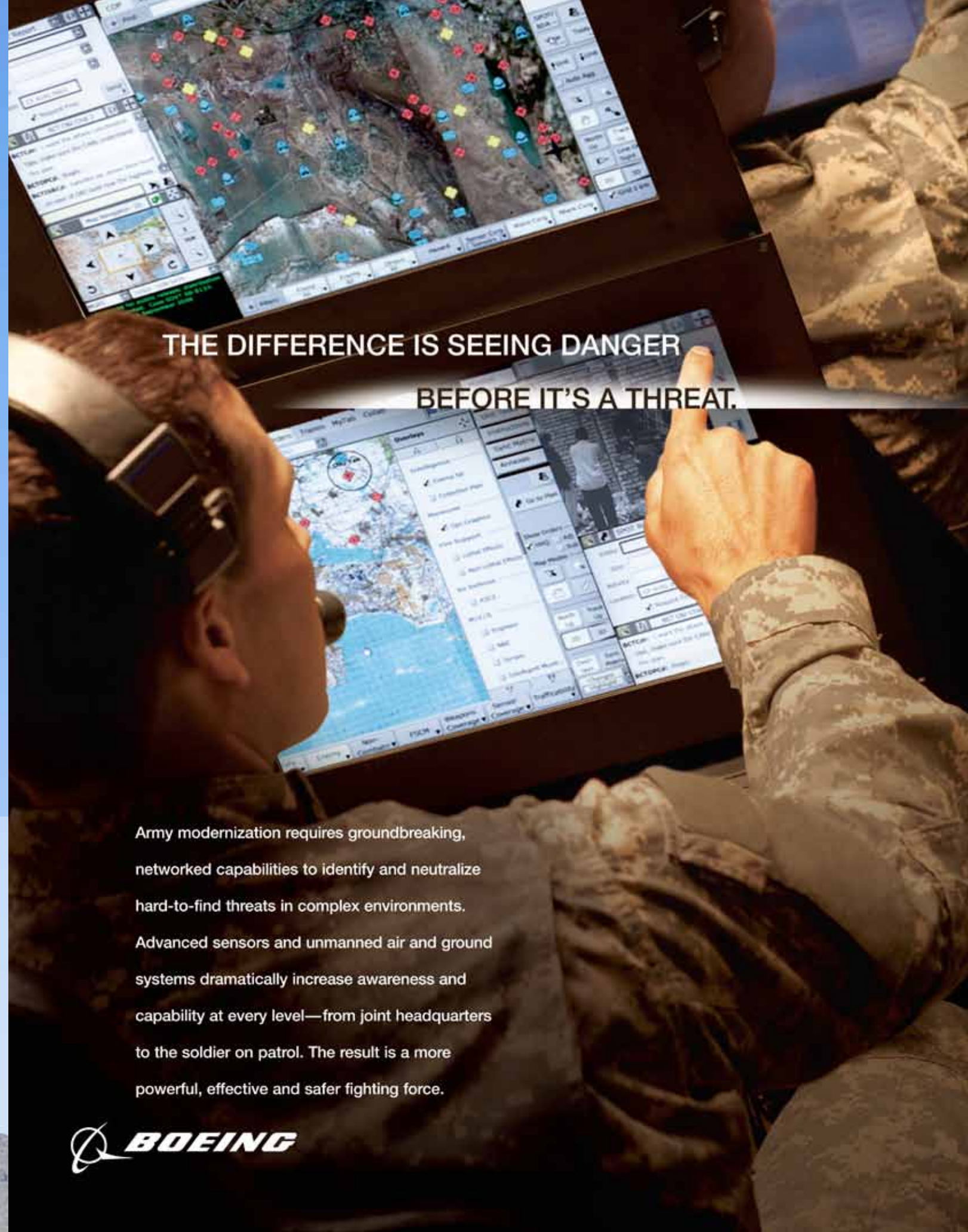




IN THE LINE OF FIRE

Sixteen containers, each holding 2,000 pounds (900 kilograms) of water, are airdropped from a C-130 transport in the first operational test of a new delivery system to fight wildfires. Developed by Boeing's Phantom Works organization, the Precision Container Aerial Delivery System can be used by any aircraft with a rear cargo ramp, including the Boeing C-17. The containers are accurately delivered using GPS navigation information and can be dropped at night and from higher altitudes than current aerial firefighting

retardants. This test took place in April at the Yuma Proving Grounds in Arizona, and all of the containers, which are largely biodegradable, opened and delivered water on target, according to William Cleary, the program manager for Boeing. Although more testing is scheduled, Cleary said the system may be close to being certified for use in fighting wildfires. Employees can view a short video of the drop test at <http://videowm.boeing.com/autopost/misc/PCADSoptestRT.asx> on the Boeing intranet. PHOTO: U.S. ARMY



THE DIFFERENCE IS SEEING DANGER
BEFORE IT'S A THREAT.

Army modernization requires groundbreaking, networked capabilities to identify and neutralize hard-to-find threats in complex environments. Advanced sensors and unmanned air and ground systems dramatically increase awareness and capability at every level—from joint headquarters to the soldier on patrol. The result is a more powerful, effective and safer fighting force.



As we honor those
who gave their lives for our country,
we remember them,
always.

 **BOEING**