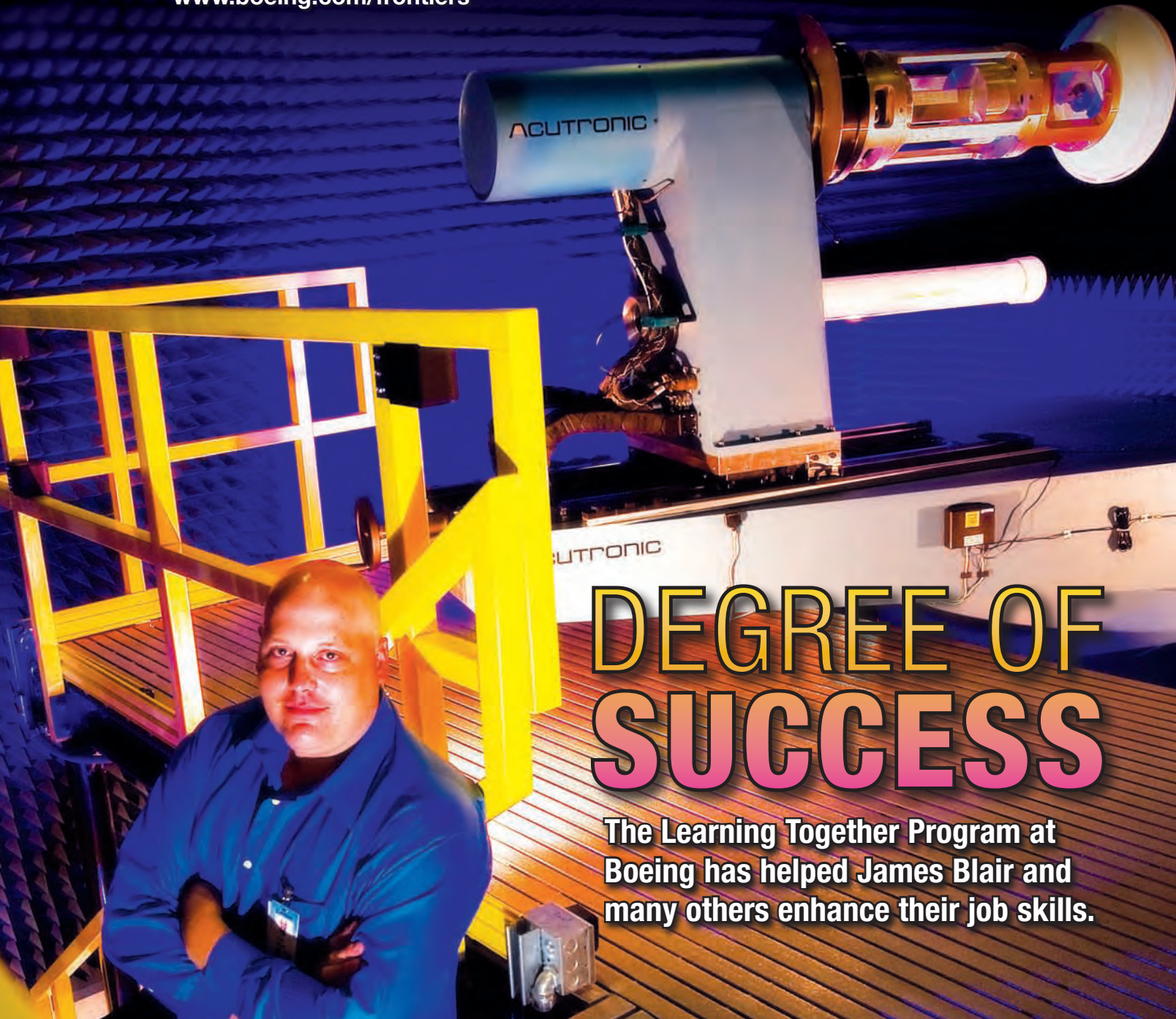


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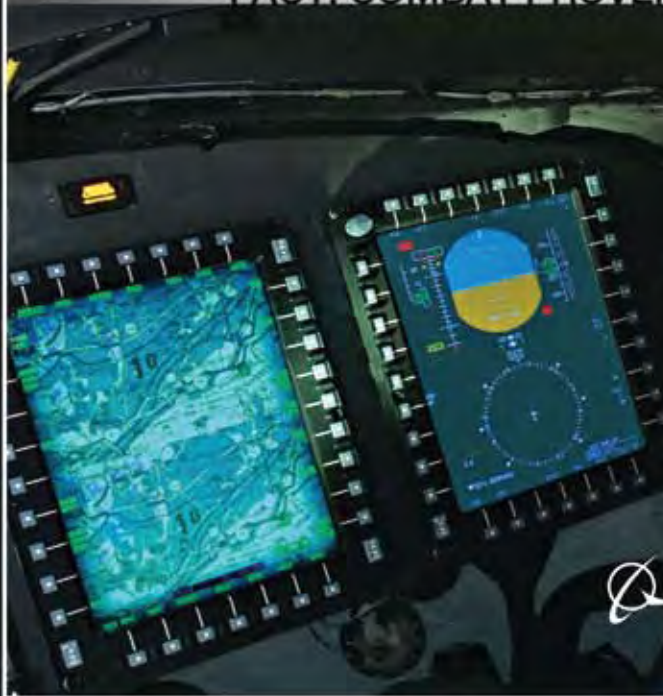


DEGREE OF SUCCESS

The Learning Together Program at Boeing has helped James Blair and many others enhance their job skills.



FACT: COMBAT PROVEN, PRODUCTION READY.



The search and rescue mission of the U.S. Air Force has never been more urgent. It's not surprising then that the HH-47, with its combat-proven capabilities, was first selected to fulfill this critical requirement. Offering superior range, speed and payload, the HH-47 also takes advantage of existing production—so it can be fielded more rapidly. For the warfighter in harm's way, there's not a minute to lose.



This new Integrated Defense Systems print ad supports the selection of HH-47 as the U.S. Air Force's next-generation combat search and rescue platform. The ad reinforces the key reasons the HH-47 was originally selected by the Air Force and should be selected again in the CSAR-X competition. The ad will appear in key military trades, congressional publications and targeted base papers.

ON THE COVER: James Blair is a test director and lead integration and test engineer for the Weapons Programs Compact Radar Program in Huntington Beach, Calif. Photo by Bob Ferguson



BOB FERGUSON PHOTO

COVER STORY

It's what you know | 12

The Learning Together Program allows Boeing employees to choose education programs that enhance job performance, intellectual growth and professional development. Read how Terence St. Marie (above), a test and evaluation specialist on the C-130 Avionics Modernization Program, and other Boeing employees have used Learning Together to boost their careers.

FEATURE STORY

Green all over | 40

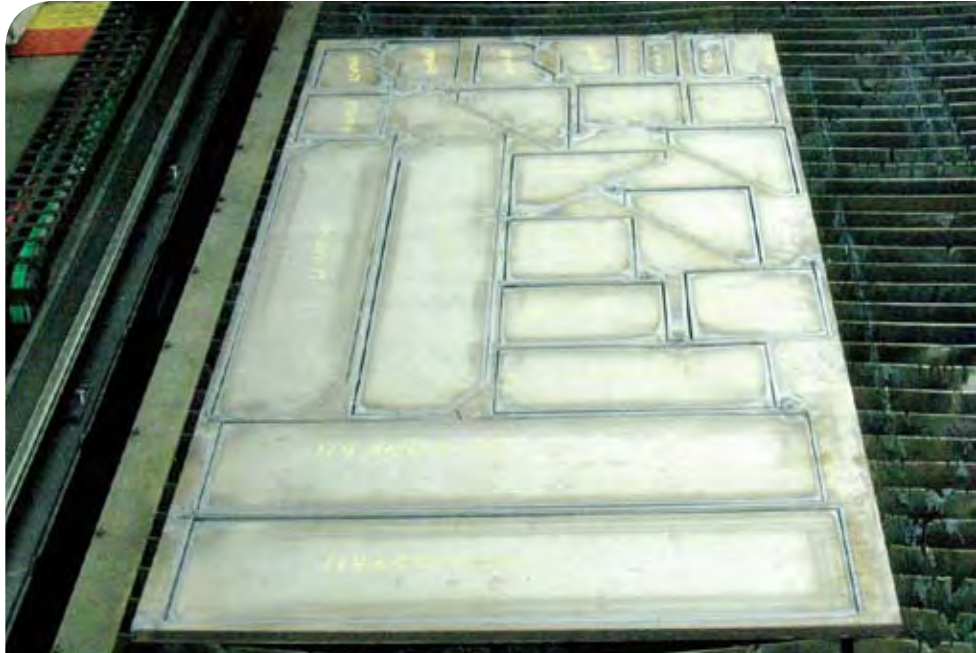
How is Boeing using technology to lead the aerospace industry in environmental improvement efforts? Not only is the company continuing its legacy of creating products that use less fuel and have smaller noise footprints, but it's active in alternative-energy developments, aviation-system improvements, operational efficiencies—and more.

Taking things personally | 20

At the Flight Operations, Test & Validation organization's weld shop, employees handle emergent requirements such as fabricating or strengthen a fixture, fixing tooling, or cutting and welding a unique brace, bracket or connector. These teammates also have taken it upon themselves to find better ways of getting their jobs done.

Meeting lofty goals | 22

What does it take to meet "impossible" goals? To meet ambitious targets for saving time, the 787 Interiors team eschewed traditional methods in favor of new, team-generated ideas. That helped the team build and install 787 interior components faster and more efficiently than people believed possible.



20

A new pattern burner used by Flight Operations, Test & Validation employees at the Developmental Center in Seattle lets welders cut multiple shapes in a single operation. The speed and precision of the digitally controlled cutting torch allows closely spaced cuts, which minimizes scrap. This change reflects one of many process improvements the team has implemented. JIM ANDERSON PHOTO



Boeing's Joint Helmet-Mounted Cueing System lets fighter pilots easily control aircraft targeting systems and sensors that detect, acquire and engage surface and airborne targets. BOEING PHOTO

25

That's using your head | 25

Today's fighter pilots are computer-savvy. They can transfer that skill set of heightened situational awareness and precise eye-hand coordination to the cockpit using Boeing's Joint Helmet-Mounted Cueing System. With this tool, a pilot needs only to point his or her head at the target—and weapons will be aimed at where the pilot is looking.

Keep in touch | 28

The Boeing Service Company Satellite Operations and Ground Systems team acts as mission control for the Iridium, DIRECTV and Global Positioning System satellite constellations. The team makes sure these services are in operation around the clock.

INSIDE

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6 Calendar

7 Notebook
8 Historical Perspective



36 As a resolution advocate, Jay Jones has completed the required rigorous training that allows him to perform mediation duties when Alternative Dispute Resolution cases arise. The ADR program recently marked its 10th anniversary. JIM COLEY PHOTO

Thanks, from the boss | 30

Teammates in Integrated Defense Systems' Airborne Early Warning and Control program are receiving impromptu visits from program executives. These visits are meant to recognize program teammates who recently exemplified one or more of the Boeing Leadership Attributes.

A passion to serve | 32

John Morgenstern is a Boeing Support Systems field service representative deployed with U.S. Marine Squadron One, which is responsible for the operation of the helicopters supporting the missions of the U.S. president. A 44-year Boeing veteran, Morgenstern is passionate about his job.

**10 New and Notable
45 Stock Charts**

**46 Milestones
50 Spotlight**

Protecting what's ours | 33

Earlier this decade, two Boeing laptops containing unencrypted personally identifiable information—data that can be used to identify, contact or locate an individual—were stolen. Since then Boeing has taken a number of corrective actions to safeguard PII and to mitigate the loss of PII from the stolen laptops.

Let's talk it over | 36

Alternative Dispute Resolution, a Boeing process to resolve disputes between employees and managers quickly and amicably, is celebrating its 10th anniversary. Among ADR's many benefits: quicker resolution of issues, reduced costs, fewer employee complaints to external agencies and improved morale.

Connections for the future | 38

A network-enabled air traffic management system could let representatives from U.S. agencies that use different computer systems simultaneously see key information in time-sensitive situations such as disaster-relief scenarios. Boeing has had a hand in developing the architecture that could enable these interagency connections.

Frontiers

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"If everyone is educated in factory safety rules, the benefit will be for us all!"

—Ken Gross, Everett, Wash.

HEADS UP! SAFETY FIRST

I would like to comment on your front cover photo of the May 2008 issue. As a 30-year crane operator at the Everett, Wash., factory, safety is at the forefront of my responsibilities. My co-workers and I spend much of our time warning employees to stay out of the "crane envelope." Personal protective equipment such as hardhats are required in this envelope. Your photo showed five employees failing this requirement. I only hope this is not thought of as business as usual, or more of my time will be spent herding employees around our crane loads. If everyone is educated in factory safety rules, the benefit will be for us all!

—Ken Gross
 Everett, Wash.

Editor's note: Boeing Frontiers apologizes for this depiction, and we pledge to strengthen our commitment to showing employees following all appropriate safety procedures. According to Boeing Business Process Instruction BPI-1789, the crane envelope represents "the area under the load being lifted, including the load and lift tools. This envelope also includes the surrounding floor area where, if an object should fall, there may be a risk of employees being struck." BPI-1789 also states that the general rule of thumb to define this safety zone is as follows: "The envelope includes the area within 1 1/2 times the height of the closest edge of the load, or 1 1/2 times the maximum vertical height of the load being lifted, whichever is greater."

A PHABULOUS ARTICLE

We just received our May 2008 issue of Boeing Frontiers and were delighted to see the article "A Phabulous Fighter," about the F-4 Phantom, on pages 8 and 9. It was especially significant to me since my father was Herman D. Barkey, who was in the picture with Dave Lewis and Bob Little. I remember that day quite well. Fifty years—how time flies!

—Bonnie Barkey Moore
 Chesterfield, Mo.

CORRECTIONS

- Because of an editing error, the second through fourth paragraphs were deleted from the article "The buzz builds" on Pages 24 and 25 of the April

2008 issue. The first four paragraphs should read as follows:

In Airplane Programs Finance, they call it the "buzz."

They're referring to the energy generated by a network of Lean focals, facilitators and employees that's fueled impressive progress in eliminating waste and creating new resource capacity. Much of the capacity has come in small increments, minutes and hours at a time.

Airplane Programs Finance has sponsored more than 360 Lean projects in the past year, engaging 800 people throughout the organization. This work supports the companywide Lean+ and Internal Services Productivity growth and productivity initiatives.

"We won't wait for the perfect plan, but just start trying and practicing at a local level," said Lean Coordinator Linda Clarke. "We work small projects that are meaningful to the individual."

To see a corrected version of this story, please visit this address on the Boeing Frontiers site on the World Wide Web: www.boeing.com/news/frontiers/archive/2008/april/i_ca01.pdf

CALENDAR

June 10–12: Unmanned Systems North America 2008. San Diego. See <http://symposium.auvsi.org>

June 15–19: 18th Annual Symposium of the International Council on Systems Engineering. Utrecht, The Netherlands. See www.incose.org/symp2008

July 14–20: Farnborough International Airshow. Farnborough, U.K. See www.farnborough.com

Aug. 23–26: 2008 Air Carriers Purchasing Conference. Chicago. See www.acpc.com

Sept. 9–11: American Institute of Aeronautics and Astronautics' Space 2007 Conference and Exhibition. San Diego. See www.aiaa.org/content.cfm?pageid=230&lumeetingid=1872

Sept. 9–11: World Airline Entertainment Association 29th Annual Conference & Exhibition. Long Beach, Calif. See www.waea.org/events/conference/2008/

Sept. 15–17: Cargo Facts 2008. Miami. See www.cargofacts.com

Sept. 17–21: Africa Aerospace and Defence Exhibition. Cape Town, South Africa. See www.aadexpo.co.za

Letters guidelines

Boeing Frontiers provides its letters page for readers to state their opinions. The page is intended to encourage an exchange of ideas and information that stimulates dialogue on issues or events in the company or the aerospace industry.

The opinions may not necessarily reflect those of The Boeing Company. Letters must include name, organization and a telephone number for verification purposes. Letters may be edited for grammar, syntax and size.



SNAPSHOT

AN ANCIENT ARMY ON TOUR

Basking in the orange glow of the sunset, this UPS 747-400 Freighter landing at the cargo carrier's West Coast air hub in Ontario, Calif., is hauling a unique shipment of historical significance. Packed within 42 crates specially constructed for movement in the 747-400 is a detachment of 2,200-year-old life-size terra cotta warriors, along with horses and other artifacts, unearthed near the tomb of Chinese Emperor Qin Shi Huang. UPS flew the warriors from Shanghai to Anchorage, Alaska, then on to its Ontario air hub. At that site, workers loaded them on three UPS Freight trucks, which took them to the Bowers Museum in Santa Ana, Calif. These items also will be shown at museums in Houston, Atlanta and Washington, D.C.

UPS PHOTO

QUOTABLES

“It’s making us a stronger company.”

— Jim McNerney, Boeing chairman, president and CEO, on the benefits of the four companywide growth and productivity initiatives, in the April 25 *Wall Street Journal*. This article noted that in 2007, Boeing’s income grew 84 percent over 2006 while its revenues rose 8 percent.

“It was very satisfying to see how well it performed.”

— U.S. Marine Corps Lt. Col. Paul Rock, the commander of Marine Medium Tiltrotor Squadron 263, which recently returned from Iraq, on the MV-22 Osprey’s performance in Iraq, in the May 3 *Dallas Morning News*

“These guys are pumped.”

— Pat Shanahan, vice president–general manager, 787 Program, on the mood on the floor of the 787 factory in Everett, Wash., in the May 20 *Seattle Times*

IAM PROMOTIONS

No promotions listed for periods ending April 25 and May 2, 9, 16 and 23

ETHICS QUESTIONS?

You can reach the Office of Ethics & Business Conduct at 1-888-970-7171; Mail Code: 14-14; Fax: 1-888-970-5330; TDD/TTY: 1-800-617-3384; e-mail: ethicsline.ethics@boeing.com; Web site: <http://ethics.whq.boeing.com>



The DC-8 lifts off from Long Beach airport in California on its first-ever flight, 50 years ago last month, as smoke emanates from the airplane's Pratt & Whitney JT3C engines.

BOEING ARCHIVES PHOTO

Welcome to the jet age

Douglas Aircraft's DC-8 made its first flight 50 years ago last month

By PATRICIA M. MCGINNIS

The morning was slightly overcast at Long Beach (Calif.) Municipal Airport on May 30, 1958—50 years ago last month.

It was a special day—and not just because it was Memorial Day (which at the time was always commemorated in the United States on May 30). On that day, Douglas Aircraft—one of the companies that makes up the Boeing of today—joined the commercial jet age, as the DC-8 jetliner made its first flight.

Thousands of people began to arrive at the airport hours before the scheduled 10 a.m. flight time. To allow the maximum number of employees and their families to witness the event, it was planned for the holiday.

With company President Donald W. Douglas Sr., news media and a record crowd (estimated at 95,000 spectators) watching, the large airplane began to roll down the runway. Chief Pilot A. G. “Heimie” Heimerdinger was at the controls, accompanied by co-pilot William Magruder, systems operator Paul Patten, and flight engineer Bob Rizer.

The DC-8 lifted off the runway at 10:11 a.m. Exhaust smoke plumed from the airplane’s four Pratt & Whitney JT3C engines. There were noticeable gasps amongst cheers from the crowd as the plane ascended. As it lifted off, Douglas quietly said, “Well, she’s up.”

The DC-8 reached a cruising speed of approximately 350 mph during the 2 hour, 7 minute flight to Edwards Air Force Base in California, where testing was to continue.

Donald Douglas Sr. saw the value in jets but was reluctant to enter the commercial jetliner business. At the start of 1953, Douglas Aircraft had a backlog of more than \$2 billion in orders. Military sales were at an all-time high. The propeller-powered DC-7C commercial jetliner was in production and scheduled for delivery in early 1956; that airplane would become the first commercial transport able to fly nonstop westbound across the United States against the prevailing winds.

Douglas wanted the DC-7Cs delivered and in service before investing millions in new, unproven jet technology. However, Douglas established a special project office in 1952 to study a commercial jet, and by the end of the year the company had invested \$1 million in preliminary jet design and study.

In 1954, Douglas was delivering aircraft to nearly half the world's airlines. When Boeing's jet-powered Dash 80 airplane rolled out that year, Douglas continued the DC-8 study with customer input. On June 7, 1955, the company decided to take the same leap of faith in the potential of the jet age that Boeing President Bill Allen took on the Dash 80: The decision was made to build the DC-8, and first flight was set for December 1957. To cut costs, the company chose to use the first eight aircraft for flight test. Ship one was to be the prototype; this airplane was later leased to National Airlines.

The DC-8 design team, led by Arthur Raymond, vice president of Engineering, featured several original members of the DC-1/2/3 design team. Along with Raymond were Chief Engineer Ed Burton, Assistant Chief Engineer Harold Adams and Chief Project Engineer Ivar Shogran.

The DC-8's luxurious interior, developed by Douglas engineers, was described as a "penthouse in the sky." Passengers sat six in a row in "Palomar chairs," which company engineers designed to enhance comfort. The cabin featured an 8-foot ceiling with large 18- by 15-inch windows.

But where would the airplane be built? The Douglas plant in Santa Monica, Calif., was busy producing DC-6 and DC-7 series aircraft. The decision was made on April 2, 1956, to build a new assembly facility at the Long Beach plant for DC-8 production. A new facility of about 1 million square feet was completed in 13 months at a cost of more than \$20 million. Also helping Douglas' effort was the city of Long Beach, whose citizens approved a \$5.5 million bond to finance an extension to the Long Beach Airport runway to accommodate the jet.

By the time of the rollout, 17 airlines had placed orders worth \$700 million for 138 aircraft. Donald Douglas Sr. termed the DC-8 a "billion dollar expression of faith in the economic future of the nation and the world."

Initially the DC-8 was offered in five models: Series 10, 20, 30, 40 and 50. All were essentially the same size and could accommodate 124 to 189 passengers. As was common with Douglas Commercial designs, a stretched version of the basic Series 50 was offered, as the Series 61.

Two more "stretch 8" models, with increased wingspan and aerodynamic improvements, were added, called the Series 62 and the Series 63. After DC-8 production had ended, a number of these stretch 8s were converted with CFM International engines to become the three models of Series 70.

Of the original 556 DC-8s built, more than 200 are still in service. ■

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In this 1955 photo, Donald W. Douglas Sr., president of Douglas Aircraft, holds a model of the DC-8. Upon watching the first take-off of the real-life DC-8, Douglas simply said, "Well, she's up."

BOEING ARCHIVES PHOTO



DC-8: Tale of the tape

Wingspan: 139 feet 9 inches (42.6 meters)

Length: 150 feet 6 inches (45.9 meters)

Height: 42 feet 4 inches (12.9 meters)

Maximum takeoff weight: 265,000 pounds (120,200 kilograms)

Speed: 550 mph (885 kilometers per hour)

Range: 3,550 miles (5,713 kilometers)

Number of airplanes produced: 556

Just the facts

Boeing continues stating its USAF tanker position

By STANLEY HOLMES

The Government Accountability Office soon will complete its review of Boeing's protest of the selection of Northrop Grumman and the European Aeronautic Defence and Space Company to build the next generation of U.S. Air Force air refueling tankers. That decision is scheduled for June 19.

Since Boeing filed its protest in March, the company has gone to great lengths to explain why it believes the KC-767AT is the superior tanker. What's more, Boeing officials have vigorously explained how a series of irregularities in the acquisition process resulted in the choice of the wrong aircraft.

It's important to note that Boeing's protest is about a flawed process. It's as much about the call for clarity in procurement practices as it is a call for answers to questions in this competition. It is not a protest of the Air Force. As Integrated Defense Systems President and Chief Executive Officer Jim Albaugh points out, the Air Force will always be a valued customer. "Our long-term relationship with the Air Force

has been built upon a strong foundation that starts with our employees, who have proven over the years their commitment to delivering the best products to our Air Force customer. That will never change," he said.

At the same time, Boeing will continue defending its right to protest and telling its story to policymakers, employees and the American public via print and television media, the tanker blogs on the World Wide Web and the Boeing intranet, and an ongoing ad campaign.

What is Boeing's case? The Boeing KC-767 offers the Air Force and the warfighter the world's foremost tanker aircraft—one seasoned with decades of experience in how best to refuel the warfighter en route to the combat zone. That experience has resulted in the latest high-tech design, one that balances the real-world promise of superior technology with the low-risk reliability of knowing how to build the aircraft on time and under budget. If that's not enough, Boeing can point to a long, impressive track record of building and delivering tankers—a record that is unmatched. ■

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THE TANKER DECISION.
WHY IT DOESN'T
ADD UP.

In March, Boeing filed a protest challenging the selection of the U.S. Air Force KC-767 tanker competition. This decision to protest wasn't made lightly. However, the KC-767 acquisition process was flawed. Irregularities in the bid and award process were identified. For a month, the Air Force selected the Northrop Grumman/European Aeronautic Defence and Space Company (NATOPS) KC-45 tanker through the KC-767 is considered best value. Boeing is asking another "interim" bid to be awarded.

LET'S LOOK AT THE FACTS.

MISSION CAPABILITY: The KC-767 can carry 100,000 gallons of fuel and 100,000 lbs of cargo. It can also carry 100,000 lbs of cargo and 100,000 lbs of fuel. The KC-45 can carry 100,000 lbs of cargo and 100,000 lbs of fuel. It can also carry 100,000 lbs of cargo and 100,000 lbs of fuel.

SIZE: The KC-767 is 100 feet long, 100 feet wide, and 100 feet high. The KC-45 is 100 feet long, 100 feet wide, and 100 feet high.

	Capacity	Range	Size	Cost
KC-30	-	-	-	-
KC-767	+	+	+	+

PAST PERFORMANCE: Boeing has built more than 100 commercial tankers for the U.S. Air Force. The KC-767 has been used in 100 combat missions. The KC-45 has been used in 100 combat missions.

SIZE: The KC-767 is 100 feet long, 100 feet wide, and 100 feet high. The KC-45 is 100 feet long, 100 feet wide, and 100 feet high.

The facts are clear. Boeing is a world leader in tanker aircraft. Our tanker and delivery record is unmatched. It is the best process of the warfighter in the world. It is a decision that doesn't add up. And we don't accept it.

BOEING

To help explain why Boeing is protesting the U.S. Air Force's decision on new refueling tankers, the company is using ads such as the one above, which addresses inconsistencies in how bids were evaluated.

For more tanker talk

Want to continue the discussion on tankers? Boeing has established blogs for employees and the public:

- Employee blog: <http://kc767tanker.blog.boeing.com> on the Boeing intranet
- Public blog: www.boeing.com/tankerfacts



Meet the 777 Freighter

Boeing last month introduced the new 777 Freighter at a celebration event in Everett, Wash. "Today is a tribute to the dedication and hard work our employees, customers and suppliers put into making this airplane a reality," said Larry Loftis, vice president, 777 program. The 777 Freighter will be capable of flying 4,885 nautical miles (9,045 kilometers) with a full payload and general cargo market densities, making it the world's longest-range twin-engine freighter. That range means significant savings for cargo operators: fewer stops and associated landing fees, less congestion at transfer hubs, lower cargo-handling costs and shorter cargo-delivery times. To date, Boeing has secured 78 firm orders from 11 customers for this airplane. The first 777 Freighter is scheduled for delivery to Air France in the fourth quarter of 2008.

The right path

Attendees at Lean+ Conference get acquainted with new 'Roadmap'

By LYNN STEINBERG

In a ballroom buzzing with activity, hundreds of Boeing employees, suppliers and customers closely examined their copy of the newly developed Lean+ Roadmap, designed to help them on their continuous-improvement journey.

Then they navigated between 12 stations around the room, each represented by an icon on the Roadmap: "Learning, Sharing and Replicating," "Leaders Teaching Leaders," "Engaged and Empowered People," "Common Language," and more.

At each station, they learned about a different aspect of Lean+—Boeing's overarching continuous-improvement approach and one of four companywide growth and productivity initiatives—and how it helps the company better serve its customers and be more competitive.

They saw how Lean+ creates an environment focused on growth and productivity and how it helps employees prevent and eliminate waste, use the right tool for the job, and maximize the knowledge and skills they bring to the workplace.

The activity, a highlight of Boeing's spring Lean+ conference last month in St. Louis, was developed to familiarize conference attendees with the Roadmap and all it has to offer. The online, interactive guide, available at <http://leo.web.boeing.com/Roadmap> on the Boeing intranet, helps align improvement efforts across the company and introduces employees to Lean+ concepts and tools, videos, training information and other resources.



Attendees at last month's Lean+ conference in St. Louis visit a Learning station and chart their progress on the "Lean and Six Sigma Learn-Do Training Path." The stations corresponded to features on the new Lean+ Roadmap. RICH RAU PHOTO

"It's a one-stop shop—the place where all of Boeing comes together for continuous improvement," said Bill Schnettgoecke, vice president and Lean+ leader. And that's exactly what happened at the three-day conference, sponsored by Integrated Defense Systems and hosted by IDS' Precision Engagement & Mobility Systems business. More than 1,000 employees, customers and suppliers came together to make new connections, learn from one another, and apply their newfound skills and knowledge to the opportunities and challenges they face in the workplace.

It was the first time that Lisa Fischer, an 18-year Boeing veteran, had attended a Lean+ event. "Seeing the Roadmap laid out, having information at each station—visually, it helped me," said Fischer, a Human Resources generalist in Engineering, Operations & Technology. "This is our journey. This is everything we need to help us get there."

The next Lean+ conference takes place Oct. 7 to 9 in Seattle. ■

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IN BRIEF

WOMEN ENGINEERS RANK BOEING TOP U.S. EMPLOYER

Readers of *Woman Engineer* magazine, the most widely read recruitment magazine for female engineers in the United States, ranked Boeing No. 1 among U.S. companies for which they would most prefer to work.

"This is a tribute to our Boeing Engineering team's efforts to establish an inclusive, creative culture that provides great opportunities and responsibilities to all engineers," said John Tracy, Boeing chief technology officer and senior vice president of Engineering, Operations & Technology, who leads the Engineering function.

The magazine's readership, made up of more than 56,000 college-student, entry-level, and professional female engineers, rated employers on how they establish a positive working environment for women through career development and mentoring; promotional opportunities; family-friendly benefits and healthcare offerings; education reimbursements; flex time; and telecommuting options and retirement savings plans. These companies also were rated on their diversity programs. Rounding out the survey's top five were Lockheed Martin, Johnson & Johnson, Microsoft and General Electric. Boeing finished sixth in the magazine's 2007 survey.

ST. LOUIS ELECTRONICS RECYCLING EVENT SET

Boeing Employees for Environmental Protection (BEEP), a Boeing-sponsored club in St. Louis, will conduct an electronics recycling collection event on June 12.

Unwanted electronic equipment can be dropped off from 7 a.m. to 9 a.m. in the 270G parking lot (across Campus Parkway from the 270 building) in St. Louis and from 2:30 p.m. to 4:30 p.m. in the 505H parking lot in St. Charles. Please note that a Boeing employee badge is required in order to access the St. Charles dropoff location.

BEEP is partnering with Web Innovations and Technical Services (WITS), a St. Louis-based nonprofit corporation that specializes in reuse and recycling of electronic equipment, for this event. WITS charges a donation of \$10 for each television and \$5 for each monitor, laptop and microwave oven; all other electronics items are taken for free. Please note that this event is for personal items only—and not for Boeing-owned equipment. WITS cannot accept anything with a Boeing property sticker. BEEP and WITS conduct collections in March, June and September.

For more information about BEEP, visit <http://beep.stl.mo.boeing.com/aboutBEEP.jsp> on the Boeing intranet. To learn more about WITS, visit www.witsinc.org.

Knowledge for growth

Employees who used Learning Together explain how this program can help your career

By SEAN AZIZ

Learning is considered a lifelong pursuit at Boeing. Each new lesson, whether it's on the job or in a classroom, opens new opportunities and reveals new insights.

At Boeing, this pursuit of learning is pivotal to shaping a business that reaches around the globe and across cultures, bringing generations and intellect together to hurdle challenges and deliver innovations that make Boeing a global leader in technology and aerospace.

"We are all on a journey of learning and growth," said Norma Clayton, vice president, Learning, Training and Development. "The strength and success of our company are driven by the knowledge, skills and ideas that come from our employees. Making a significant investment in our employees' career growth is a smart business decision, because it's the talent of our people that leads to the creative and innovative thinking at Boeing."

One resource Boeing employees use to pursue new skills is the Learning Together Program. Under this program, Boeing will pay for tuition and many related expenses—including application fees, entrance exams, books, and graduate fees—for employees enrolled in accredited colleges, universities or trade schools. Learning Together allows Boeing employees to choose education programs that enhance job performance, intellectual growth and professional development.

With this being the season for U.S. college graduations, *Boeing Frontiers* presents a look at several engineers who recently accelerated their growth through Learning Together. In these short profiles, these employees discuss the lessons that sparked their success. ■

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More about Learning Together

The Learning Together Program plays an instrumental role in maintaining a work force with cutting-edge skills, education and experience—which gives Boeing a competitive advantage. To learn more, visit the Learning Together site on the Boeing intranet at <http://learningtogether.web.boeing.com> and click on the "Getting Started" tab in the left column.



Terence St. Marie

To ensure Boeing's customers can accomplish their missions precisely and safely, Terence St. Marie taps into his extensive reservoir of knowledge. St. Marie began his career with Boeing in 1985 as a flight-line technician on the B-1B bomber program after serving as an avionic and inertial/radar navigation specialist in the U.S. Air Force. Now a test and evaluation specialist on the C-130 Avionics Modernization Program, St. Marie, based at Edwards Air Force Base, Calif., is bringing new insights to his job as he pursues a master's degree in aeronautical science. Thanks to Learning Together, St. Marie recently completed his bachelor's degree in professional aeronautics from Embry-Riddle Aeronautical University in Florida. "While it can be demanding balancing both work and school, it has paid off," he said. "Since completing my bachelor's and demonstrating my commitment to personal growth, the level of responsibility in my job has increased and so have the opportunities."

BOB FERGUSON PHOTO

Shane Gillis

When Shane Gillis, engineer, 787 propulsion aerodynamics, graduated with a master's in engineering mechanics from the University of Wisconsin, he was prepared to take on new challenges. One challenge was integrating his insights in Computational Fluid Dynamics into the 787's innovative design. Gillis' experience in CFD and knowledge of gas turbine engines from his service in the U.S. Navy earned him a position on the propulsion aerodynamics team. "Understanding how the new composite airframe will perform in-flight provides the program a significant level of predictive ability," said Gillis, based in Everett, Wash. "Learning how CFD software is written during my graduate program has allowed me to generate results that have meaning and value."

GAIL HANUSA PHOTO



Scott Arbiv

If you're going to support the development of next-generation communications systems, you need the ability to integrate an array of experiences. That's something that Scott Arbiv, systems integrator at the Massachusetts Institute of Technology Lincoln Laboratory in Lexington, Mass., is adept at doing. "Successful integration in any area requires the ability to draw upon and harmonize often diverse elements," Arbiv said. Using Learning Together, Arbiv recently completed a master's degree program in electrical engineering, with a focus on communications systems, from the University of Southern California. "Ultimately, knowledge confers freedom, and a master's degree, to me, is a key step in a never-ending process of learning," he said. Education has also given him real-time perspective in his role at Boeing. "Now having greater direct contact with management, a view of the big picture, and a stronger understanding of network systems, I see myself as well-placed for interesting and challenging work now and in the future."

BOB FERGUSON PHOTO



Neva Welch

Boeing has implemented aggressive targets for reducing its impact on the environment both for its operations and the life cycle of its products. Helping ensure this success is Neva Welch, an environmental scientist who specializes in hazardous waste management. Responsible for making sure that hazardous wastes generated at the Auburn, Wash., site are identified, managed and disposed of in a compliant manner, Welch plays an important role in Boeing's commitment to significantly reducing the effect its operations have on the environment. Earning a master's in engineering technology from Central Washington University—through Learning Together—Welch learned more about manufacturing techniques, materials, and the controls used in manufacturing a product. This knowledge allows Welch to support the company's environmental initiatives. "In addition to providing direction on how to dispose of waste, I am able to engage employees and work with them on developing new ideas on how we can reduce waste, conserve energy, and recycle more," she said.

MARIAN LOCKHART PHOTO



Jeremy Hare

Working on the 777 program has offered a breadth of understanding in innovative approaches that set the standard for developing airplanes and delivering value, said Jeremy Hare, a 777 liaison engineer. "I have had the opportunity to work with and learn from some of the brightest engineers in the industry," said Hare, who recently completed a master's degree in aerospace engineering from the University of Michigan. Hare, based in Everett, Wash., joined Boeing in 2005 as an intern and quickly decided that Boeing was the place to start his career, based on a number of key factors, including the Learning Together Program. "The Learning Together Program demonstrates that Boeing is not only committed to developing the professional growth of its employees, but also adds support to pursue an unlimited number of personal goals. The encouragement to enhance my skills as an engineer, while striving to achieve my personal life goals as well, has been substantial," he said.

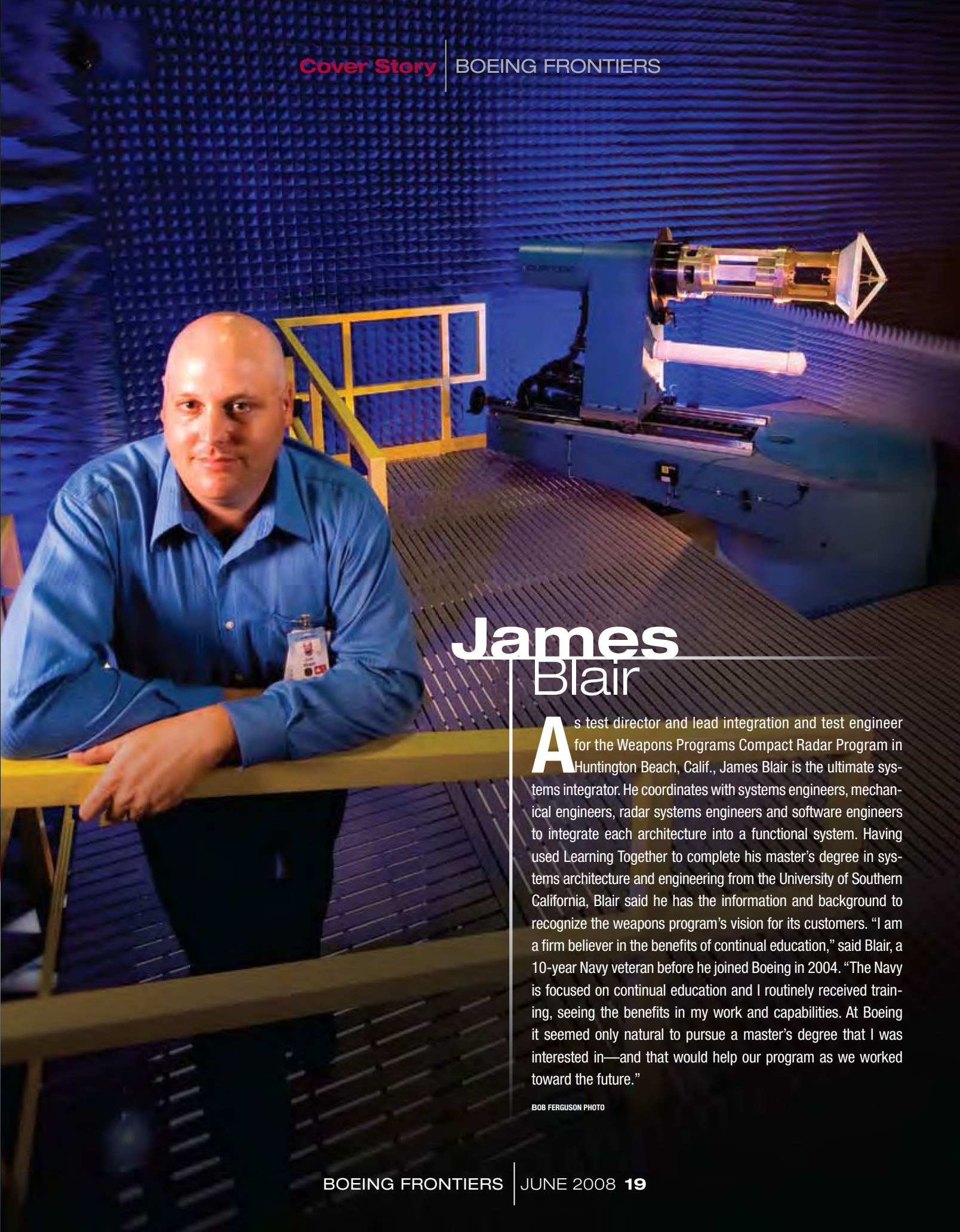
GAIL HANUSA PHOTO



Jerry Gravitt

For Jerry Gravitt, an F-15 industrial engineer in St. Louis, efficiency is essential to keeping this military aircraft's program healthy, relevant and competitive as international opportunities increase. Gravitt is responsible for supporting the transition to a new 'pulse' manufacturing line and identifying and deploying best practices across the program. "As we implement processes to reduce costs on the F-15 production line and put the systems in place that create a culture of continuous improvement, we will be well-positioned to continue producing one of the finest military products and enter regions where we might not have been," he said. Gravitt used Learning Together to earn a master's in engineering management from Washington University. With this knowledge, Gravitt was able to focus on the people side of the equation and implement his lessons real-time. "I think one of the most significant things I have learned in my graduate program is that to get people on board with your ideas you must be able to effectively communicate and deliver on those ideas," he said.

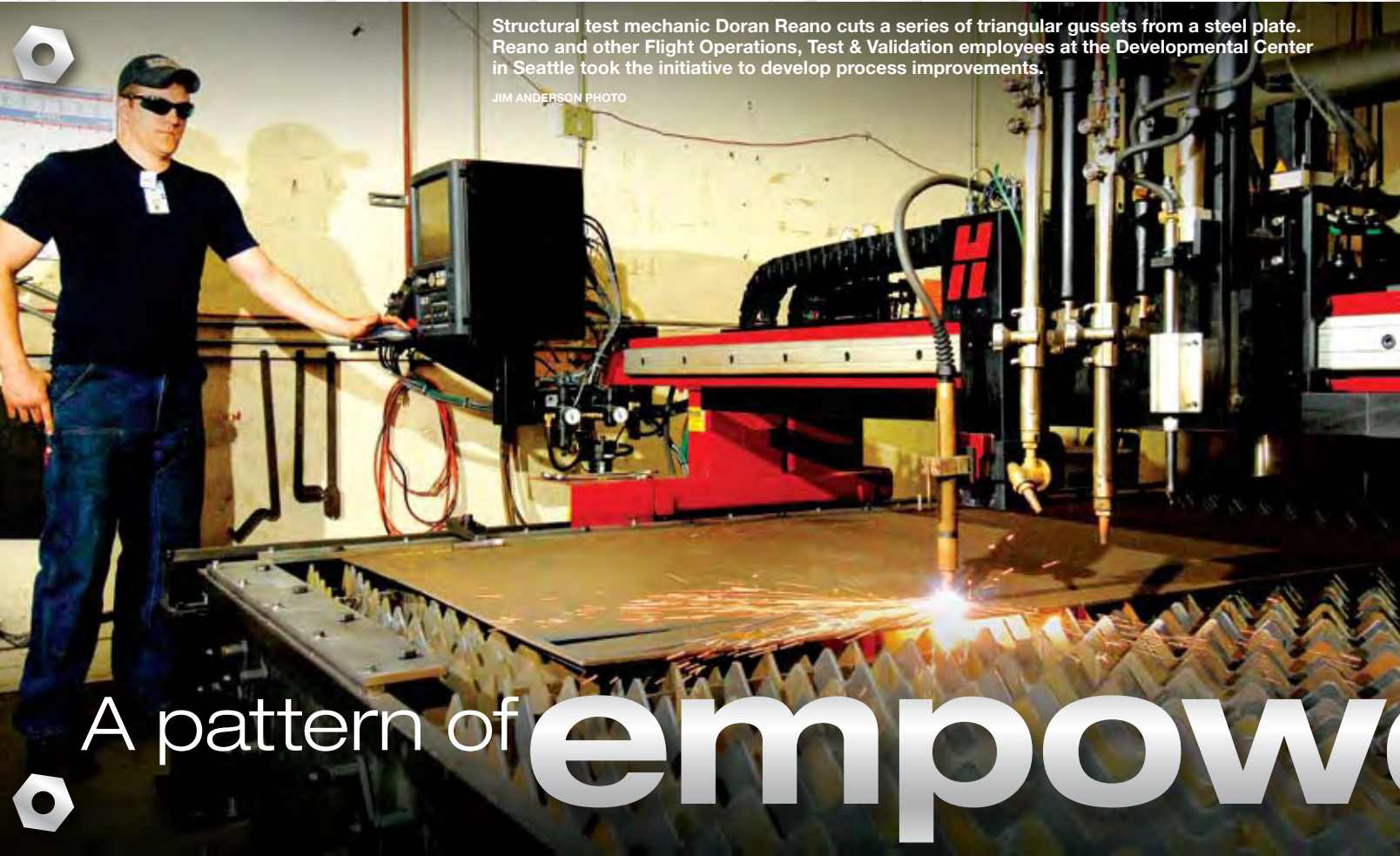
PETER GEORGE PHOTO



James Blair

As test director and lead integration and test engineer for the Weapons Programs Compact Radar Program in Huntington Beach, Calif., James Blair is the ultimate systems integrator. He coordinates with systems engineers, mechanical engineers, radar systems engineers and software engineers to integrate each architecture into a functional system. Having used Learning Together to complete his master's degree in systems architecture and engineering from the University of Southern California, Blair said he has the information and background to recognize the weapons program's vision for its customers. "I am a firm believer in the benefits of continual education," said Blair, a 10-year Navy veteran before he joined Boeing in 2004. "The Navy is focused on continual education and I routinely received training, seeing the benefits in my work and capabilities. At Boeing it seemed only natural to pursue a master's degree that I was interested in—and that would help our program as we worked toward the future."

BOB FERGUSON PHOTO



Structural test mechanic Doran Reano cuts a series of triangular gussets from a steel plate. Reano and other Flight Operations, Test & Validation employees at the Developmental Center in Seattle took the initiative to develop process improvements.

JIM ANDERSON PHOTO

A pattern of empow

Flight Operations, Test & Validation team takes process improvement personally by devising, implementing better ways to get job done

By JEFF WOOD

It takes sturdy fixtures to hold an airplane fuselage section or wing box in place as it undergoes the rigors of a structural test. Equally strong is the sense of empowerment that helped Flight Operations, Test & Validation employees at the Developmental Center in Seattle dramatically improve processes.

The FOT&V weld shop is where structural test fixtures come together. It's also where engineers come when the need arises to fabricate or strengthen a fixture, repair tooling, or cut and weld a unique brace, bracket or connector.

"We're an emergent requirements shop," said team leader Bill Speck. "For long-lead developmental program requirements we work to the program's schedule. But much of the work that comes in on a daily basis is generated by unforeseen needs." Often those requests are urgent, coming at crucial points in a test program.

WORKING WITH UNWIELDY MATERIALS

The weld shop's raw materials include steel plates that can measure 8 feet wide by 12 feet long and up to 6 inches thick—and weigh

up to 8,000 pounds (2.4 meters, 3.7 meters, 15 centimeters and 3,600 kilograms, respectively). Welders and mechanics team across job classifications to fashion these unwieldy materials into fixtures that meet engineering specifications with precisions in thousandths of an inch.

However, outdated equipment locked the weld shop into a time-consuming, repetitive, and labor-intensive process that also required coordination between several organizations. In addition, wear and tear on aging cutting torch guide systems limited the precision of the cutting process, so many weld-shop products had to be sent to other areas to be machined to specified dimensions.

Shop members worked with FOT&V manager Monte Melvin and got the go-ahead to research new equipment that not only would reduce the time it takes to cut parts, but eliminate several steps in the process.

"These were ideas that came from the employees," Melvin said. "They knew there was a better way to get the job done, and I cleared the way for them to make the case for new equipment."

The team was particularly interested in a digitally controlled, automated cutting torch, or "burning," system that works directly from an engineering data set or drawing to cut any shape in a single operation.



Structural test mechanic Greg Staples examines the pivot fittings fabricated at the FOT&V weld shop. Hydraulic actuators used in validating 787 wing box designs will attach to the fittings.

JIM ANDERSON PHOTO

ement.

After performing research, the team was ready to see a few burning systems in action. Right-sizing was an important consideration, Speck said. He pointed to a sign on the office wall that states an FOT&V guideline: “Spend Boeing money as if it is your own.”

Visiting several fabricating operations in the Northwest, the team interviewed operators to identify the kind of system that would meet FOT&V’s needs. For example, the team specified a system with both plasma and oxy-acetylene cutting torches, configured for cutting any plate thickness. To meet safety and ventilation requirements, the team specified a system with a downdraft table that extracts exhaust gases. To realize the full potential for process simplification, the team specified a system with control software that allows the operator to select and edit preset shapes to match the patterns and dimensions of emergent engineering requirements.

Facilities equipment engineer Ken O’Donnell recognized that installing the team’s choice of

equipment would require significant modification of the facility. However, the budget allotted for the equipment upgrade would not cover the modification costs. O’Donnell did some additional research and identified a similarly capable burning system that could be installed in existing infrastructure. He consulted with the weld shop team, and all agreed the alternative pattern burner met the team’s requirements. “Ken went the extra distance to make this improvement happen,” Speck said.

With the equipment identified and the facilities plan in place, capital focal Walt Heckel joined the team to guide the request through the steps required to obtain funding for project go-ahead.

“I made sure that the people who needed to evaluate the proposal got the full story of the benefits the new system could deliver,” Heckel said. “We don’t replace equipment just because it’s old. With proper maintenance, equipment can continue to do the job for many years. But this equipment would actually in-

crease the capabilities of the work group, so the emphasis was on the benefits to the wider FOT&V operation.”

BIG PAYOFF

Those benefits proved to be significant. Since the pattern burner was installed, redundant touch labor has been reduced 92 percent. Flow times have been cut by 83 percent. Many tasks that previously had been sent out to other organizations or suppliers are now completed at the weld shop. Speck estimated the first time the pattern burner was used in support of a major program, the cost savings added up to more than half the cost of purchasing and installing the equipment.

Now that the new system and processes are in place, the team’s ongoing empowerment continues to earn dividends. For example, mechanic Doran Reano noticed the slats that support work pieces during the cutting process needed to be replaced frequently. Reano designed slats that have a saw-tooth edge, rather than the standard straight edge. The saw-tooth slats are less likely to be damaged when the cutting torch passes over them. The new design also helps prevent plates from moving when heat from the cutting torch causes the plates to expand. Beyond a maintenance savings, the saw-tooth slats increase the precision the machine can achieve.

Speck said the equipment upgrade and process improvements succeeded because employees and managers across multiple functions and organizations took personal ownership of their part of the process.

“Each team member at every step along the way took the time to understand our goals in requesting the upgrade,” he said. “By making those goals their own, they were able to come up with solutions that exceed our original expectations.” ■

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Start your engines

While team members observe, Jeff Kelsey of 787 Interiors demonstrates installation of main cabin ceilings in a replica 787 fuselage in Everett, Wash. The 787 Interiors team developed designs and processes that allow interior components to be installed quickly and efficiently.

WILL WANTZ PHOTO

Bucking tradition to meet time and cost goals in designing, building 787 interiors

By KATHERINE SOPRANOS

The 787 Interiors team got used to hearing that its time-saving goals and installation methods were “impossible” to achieve. But by bucking tradition and throwing out the blueprints, the team proved otherwise—creating solutions to build and install 787 interior components faster and more efficiently than people believed possible.

The goal to install interior components—such as passenger seats, galleys, overhead bins and cabin linings—efficiently in a short time is based on the objectives of assembling a 787 airplane in a matter of days, and to allow airlines to reconfigure their airplanes quickly. To meet its goal of cutting recurring costs for interiors installations by 50 percent, the 787 Interiors team took a different approach in designing and installing parts.

“To meet the vision we established for our team in 2001, we changed the culture of how we work together, how we do the work and how we get the results,” explained Nancy McCutchin, 787 Interiors manager. “The idea was to bring Lean+ processes and teams together in the beginning of the program to develop strategies and solutions to meet our installation goals, which were radical and aggressive. Some engineers thought we were crazy.”

Ultimately, the plan evolved to focus on establishing common interfaces between interior components on the 787. Currently, each of an airplane’s interior components has different interfaces—the way the piece connects to the airplane—and requires time and tools to install and configure to customers’ requirements. With the 787 interior’s common system, it will be swifter and more cost-effective to tailor and install interiors to each customer’s special requirements, using components designed to be installed efficiently.

“In this competitive environment, customers expect products to be the best. We have to learn how to far exceed prior design solutions to continue making our products appealing and competitive,” said Brian Melnyk, senior manager of 787 Interiors—Manufacturing Quality. “This is about changing the way we work. It’s the only way we can remain competitive.”

INSPIRATION FROM AUTO RACING

Traditionally, interior components were designed by engineers. Then, Manufacturing separately reviewed them for production or installation issues. Sometimes issues with parts weren’t discovered until the installation process began on a real airplane.

The team knew it had to make improvements. But with such aggressive goals, just changing the design wouldn’t be enough. The team had to improve the processes, too.

Inspired by the efficiency, speed and split-second accuracy of professional car-racing pit stops, the team decided to implement a “pit stop” concept for 787 Interiors.

“Our vision was to design interior architecture that allows both our factory and the airline customer to easily build, reconfigure, refresh and service the interior with the speed and precision of an auto-race pit stop,” McCutchin said.

The intent was to design simple components that fit intuitively and could be installed easily, quickly and safely—in many cases with few or



787 Interiors manufacturing technicians Echo Ashworth (foreground, left) and Jenn Jacobsen collaborate with Final Assembly and 787 Interiors team members on interior component solutions at the Payloads Validation Center, an Everett, Wash., non-production site to prototype interior concepts. WILL WANTZ PHOTO

no tools—and without affecting production. To achieve these goals, the team for the first time brought Manufacturing and Engineering together at the beginning of the Interiors process—before parts design began.

Engineering and Manufacturing found that by sharing up front their ideas, challenges and processes, they could design and build interior parts that helped resolve potential design or production issues before anyone touched the real airplane.

Collaboration among all the interior stakeholders, including suppliers, not only helped uncover issues early on and avoid rework, it also answered important questions: What worked? Does a part function the way it was designed to? What would and could be improved further?

“Once we got together and saw each other’s perspectives, we could find common ground and gained a new respect for our collective challenges,” said Joe Tinoco, a design engineer in 787 Interiors.

The results, said Melnyk, are more mistake-proof parts that are simple, lighter and ergonomically easier to install. “We’re even down to a very small number of tools—single drivers and fasteners instead of a cartful,” he said.

“Once we got together and saw each other’s perspectives, we could find common ground and gained a new respect for our collective challenges.”

– Joe Tinoco, design engineer in 787 Interiors

The cost and time savings from improved designs benefit the customer. “By becoming more efficient, we are more competitive as a company and a work force, giving our customers less-expensive, better-value airplanes,” Tinoco said. “For an airplane’s life-cycle maintenance, the ‘pit stop’ philosophy speeds removal and replacement of parts for customers. For example, a damaged flight-attendant seat can be changed out at the gate with little schedule interruption, whereas in the past it could result in a canceled flight.”

DESIGNS PUT TO THE TEST

Since 2004, the team has put its designs—and the speed and ease it takes to install the parts—to the test in “Race Day” events at the Payloads Validation Center in Everett, Wash. At this nonproduction facility, design and manufacturing engineers create prototype interior concepts and install those parts into validation vehicles—replicas of the 787 fuselage.

In March, the team held its fourth auto racing-themed event, called the “Pit Crew Academy,” that included manufacturing technicians. The weeklong event demonstrated the installation process for nearly 25 787 interior components, including lavatories, floor coverings, dimmable windows and crew rests. Simulations installing Airplane No. 3 parts in the mockup vehicles validated the designs and improved production processes. Manufacturing technicians installed many parts with fewer or no tools, often reducing hours of work into seconds.

“By working together, the teams developed designs that met or exceeded our aggressive target goals,” McCutchin said. “The Pit Crew Academy validated the process from parts delivery to installation plans and provided manufacturing technicians hands-on experience prior to touching the real airplane.”

The Pit Crew Academy’s validated designs create a chain reaction of process and time-savings improvements, starting with Final Assembly.

“The academy re-emphasized the ease and speed that parts can be installed in the airplane,” said Bob Rohwer, senior manager of 787 Final Assembly—Manufacturing Engineering. “Our team welcomed the simplified interfaces between the airplane structure and interiors made possible by enabling architecture.”

He added that the Pit Crew Academy also served as a dress rehearsal for the content and format of initial interior component work instructions for manufacturing technicians.

Now, if someone wonders how Interior’s seemingly impossible, lofty goals were achieved, McCutchin has the answer.

“Thanks to our talented and innovative design teams,” McCutchin said, “mission ‘impossible’ accomplished, and vision achieved.” ■

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Changing for the better

Brian Melnyk and Nancy McCutchin were part of the 787 Interiors team that championed a culture change and a new way of doing business—which resulted in substantial efficiency gains. Here they offer insight on how to make improvements.

Melnyk: “You have to have extraordinary targets and shake yourself free from making incremental changes in order to make a true shift in finding a better solution. Diverse thoughts also bring success. People bring different views on how to do something. Amalgamating these ideas and beliefs results in successful designs. Be willing to accept risk, and drive by the belief that you’re doing the right thing for the company.”

McCutchin: “We have terrific products today. How do you convince people that they need to get better? Give them target numbers that seem unreasonable—downright crazy—and give them the tools to achieve them. Providing the tools to ‘find the way’ was the most important part. Without the tools, the teams may have floundered and not been as innovative. We did a lot of ‘try-storming.’ We created a safe environment to learn by trying different things—and designed better solutions.”

— *Katherine Sopranos*

The ideal ‘pit stop’

What exactly do you look for in an airplane interiors “pit stop” exercise? These—according to representatives of Engineering and Manufacturing:

- Parts fit through aircraft passenger doors
- Fit is intuitive; no adjustments
- Parts fit the correct way only
- Common interfaces
- Simple fastening methods
- Easy, simple, reliable installations
- Quality designed in
- Parts “designed for manufacturing”
- Easy to modify



The Joint Helmet-Mounted Cueing System allows fighter pilots to easily control aircraft targeting systems and sensors that detect, acquire and engage surface and airborne targets.

BOEING PHOTO

First look, *first shot*

Helmet-mounted cueing system is a must-have for today's fighter pilots

By TIM DEATON

What happens when a member of “Generation Xbox”—with years of experience defending freedom from computer-generated adversaries—grows up to become a fighter pilot? He or she is able to transfer that skill set of heightened situational awareness and precise eye-hand coordination to the cockpit using Boeing’s Joint Helmet-Mounted Cueing System.

Equating JHMCS to a video game might be an oversimplified analogy. But the operational skills and concepts are similar. With its visor “head-up” information display and head-tracking technology, JHMCS allows fighter pilots to easily control aircraft targeting systems and sensors that detect, acquire and engage surface and airborne targets. The pilot needs only to point his or her head at the target and weapons will be aimed at where the pilot is looking. The system can also be employed to accurately cue the pilot to ground targets.

The system continuously displays aircraft performance, targeting, weaponry and threat warning information, regardless of where the pilot is looking. In a dual-seat aircraft, each crewmember can wear a JHMCS helmet, perform operations independently and have continuous awareness of where the other crewmember is looking.

“This is the greatest situational awareness device ever invented,” said Phil King, Boeing JHMCS program manager. “Today’s computer-savvy pilots are accustomed to this type of technology, so it’s a natural fit with their abilities.”

JHMCS originally was designed in the 1990s to assist pilots engaged in aerial combat. “With the onset of Operation Iraqi Freedom, the need for precision strikes with smart weapons against ground-based targets became evident,” King said. “We worked with our industry partners (Rockwell Collins, Elbit Systems and Vision Systems International) to add that capability to the JHMCS system. Demand for the system continues to be strong, because it has proven to be one of the most valuable tools available to our warfighters.”

In addition to the helmet and visor display unit, JHMCS includes a computer, head-tracking hardware and associated cables installed on the aircraft. The hardware is approximately 90 percent common across all platforms. Currently JHMCS is being installed on up to 500 Boeing F-15C/D, F/A-18 and Lockheed Martin F-16 fighter aircraft each year.

“JHMCS is one capability that the pilots absolutely love, and they are reluctant to fly without it now,” said Todd Depoy, U.S. Air Force JHMCS program manager. “Even though it was originally designed for air-to-air use, through deployments we have learned it provides a great surface capability to improve close air support and keep our pilots out of harm’s way.”

JHMCS was originally projected to be a \$500 million program with total deliveries of about 2,000 systems. To date, the program has delivered more than 2,500 units with nearly \$800 million in orders. Boeing is under contract for at least the next two years and is on the verge of securing business for an additional three years.

The JHMCS program is staffed by just 25 full-time employees and two managers, but the team uses its small size to its advantage. Members are empowered and encouraged to take on additional responsibilities and gain valuable program-level experience. In so doing, they are able to learn all aspects of the business.

“JHMCS is a microcosm of a larger program,” said Tim Conway, Electronics Unit equipment engineer. “Instead of large departments of people supporting logistics, engineering, program management, integration, finance, contracts, etc., our team fits into a single conference room. The small size allows us to participate in varied aspects of a project that might not be possible on larger programs.”

Timothy Bozarth, chief engineer, said variety is one of the rewards of working on the program. “We have visibility into all aspects of the business: technically, programmatically and contractually,” he said. “Working directly with suppliers to accomplish design changes or working with the warfighters to resolve issues that are uncovered in the field helps us to get a full sense of the impacts of our decisions.” ■

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Today, you can change someone's life for the better.

Tomorrow's good too.

Today. Tomorrow. Pick a day, any day. And join the Employees Community Fund at community.web.boeing.com/ecf. Your contributions support programs like the Seattle Lighthouse for the Blind. Serving the needs of the blind, Deaf-Blind, and blind with other disabilities for over 85 years, the Seattle Lighthouse provides training and employment opportunities, while encouraging personal responsibility and economic independence. Please join us and make a difference.

Today and every day.







Boeing workers and subcontractors install a new radome at Diego Garcia in the Indian Ocean under the U.S. Air Force Global Positioning System Ground Antenna Replacement project. The radome protects the satellite dish from the weather. Boeing also replaced the radomes at Ascension Island in the South Atlantic, Kwajalein Atoll in the Pacific Ocean and Cape Canaveral, Fla.

BOEING PHOTO

Stay in *touch*

Meet the satellite support team that keeps you connected 24-7

By Ed MEMI

A fighter pilot releases a smart bomb and hits his target dead-on with no harm to civilians. A driller on a North Sea oil rig gets crystal-clear reception on a phone call from his wife thousands of miles away. A sports enthusiast feels like he's right there at a big game, thanks to the razor-sharp images of high-definition TV.

Chances are none of them give a thought to the satellite link that connects them instantly and reliably any time of day or night. That's the job of a Boeing team that keeps watch on the Iridium, DIRECTV and Global Positioning System (GPS) satellite constellations 24-7.

The 650-person Boeing Service Company Satellite Operations and Ground Systems (SO&GS) team acts as mission control for the satellite constellations by tracking and monitoring their status, keeping them in operation, ensuring signals can be received and processed, and supporting ground facilities and antenna tracking sites. Lessons learned in operating these satellites and ground systems can be applied to the operations and support contract for NASA's mission control center and training facilities at Johnson Space Center in Houston.

Don Hull, director of SO&GS, with operations in Colorado, Texas, Virginia and Arizona, said his engineers and technicians absolutely love their work. "Think of all these satellites circling the globe with all types of data constantly being transmitted. It's technically very interesting and challenging work," he said.

Here's a look at the systems the SO&GS team supports.

IRIDIUM

Iridium is the largest commercial satellite constellation in the world, with 66 satellites and multiple backup satellites. Positioned about 400 miles (640 kilometers) above the earth, they provide voice and data communications capability anywhere in the world.

The Iridium network is used by fishermen, oil industry workers and the military to operate satellite phones and data communications equipment in areas where cellular phones can't be used, such as in the middle of the ocean or desert. Tens of thousands of aircraft and boats are equipped with Iridium-based systems.

A team of 230 Boeing and contractor employees issue an average of more than 400,000 commands a year to these satellites, said Jim Compton, program manager for Iridium operations and maintenance. "Those commands might include software updates or even changing the orientation of the satellites—actions designed to keep the satellites healthy," he said.

DIRECTV

David Larsen gets a lot of satisfaction when he watches DIRECTV at home. Not only because the images are so vivid and lifelike, but also because he heads a team of 18 at the DIRECTV control center. DIRECTV satellites transmit digital satellite television and audio to millions of households and businesses across the United States.

The two DIRECTV satellites that Boeing operates are in geostationary orbits, 22,300 miles (35,900 kilometers) over the equator, so they stay in the same spot over the earth, giving viewers a clear, high-definition TV picture. Larsen's team ensures the satellites are exactly where they're supposed to be in the sky. If there's an anomaly, they fix the problem or provide a "workaround" to ensure there are no interruptions in service. "It is exciting to be operating a product that is used and enjoyed by millions every day," Larsen said.

GPS

Another team, of 220 Boeing and 80 contractor employees, maintains the GPS hardware and software. GPS is a constellation of 33 satellites about 10,000 miles (16,100 kilometers) high. The team does for the master GPS control center everything short of commanding the actual satellite. Indeed, the team, led by GPS Operations Director Mike Shiikitus, won the 2007 Boeing Atlas Award for excellence in sustainment operations.

In 2007, the team began installation of a program that is replacing GPS' legacy mainframe system with a distributed hardware/software architecture. The new program has built-in automation capabilities that can reduce the workload for U.S. Air Force crew operators. The group also supports the satellite during launch, when on-orbit problems occur or when the satellite reaches the end of its life.

Leland Horn, senior manager of GPS Sustainment, said the biggest challenge in the future will be managing obsolescence of a system that must always be operational. "It's like replacing parts on your car while driving down the highway. You can't exactly stop the

GPS system to replace software or hardware," he said.

Originally developed for the military, GPS is now used by millions worldwide for business and recreation. "It's easy to take it for granted because it's so convenient and easy to use," Hull said. "Push a button on your dashboard unit, and you have instant turn-by-turn driving directions, thanks not only to the satellite system but to the folks who keep the system running." ■

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Top: Misa Iovanov (standing), orbit analyst, works with Mission Director Donna McLamb to plan a maneuver activity in the Iridium Satellite Network Operations Control facility in Leesburg, Va. In the background, Boeing controllers monitor the health of the 66 Iridium satellites that provide voice and data communications capability worldwide. BOEING PHOTO

Bottom: DIRECTV Mission Operations Manager David Larsen and lead orbit analyst Jennifer Siefert are shown at the ground-system monitoring and control console in Houston reconfiguring telemetry, tracking, and commanding antennas at remote Earth stations. PATRICK ARMSTRONG PHOTO





Mike Harlan – When a new program plan was developed to meet delivery dates in Project Wedgetail, Mike Harlan, AEW&C flight-test team leader, and his team were brought in to develop a flight-test plan. For his quick work, Harlan was contacted by the head of AEW&C, Maureen Dougherty, who told him his contributions had been recognized by the leadership team. “It was quite a surprise to be recognized,” Harlan said. “I was part of a team of really smart and innovative people who rolled up their sleeves and found a way forward through a challenging situation.” JIM ANDERSON PHOTO

Jeanne Simeona – Responding to an immediate need for a critical skill manager in Turkey, Human Resources representative Jeanne Simeona expeditiously worked through the procedures needed to find the right candidate for the job. Consequently, the position with the Peace Eagle program was filled quickly; and the program’s leader, Mark Ellis, brought Simeona’s good work to the attention of the AEW&C leadership team. “I’ve suggested to HR management that these leadership recognitions be made a best practice,” Simeona said. DANIEL THOMPSON PHOTO

Leadership

How an IDS program thanks employees for exemplifying leadership

By BILL SEIL

Employees in Integrated Defense Systems’ Airborne Early Warning and Control program are receiving impromptu visits from program executives. But there’s no reason for these teammates to panic. These visits are meant to thank people for a job well done.

AEW&C program executives spend time each week learning leadership lessons from their employees. Their staff meetings include time to recognize program teammates who recently have exemplified one or more of the Boeing Leadership Attributes.

“After we’ve identified someone and discussed how they specifically demonstrated a leadership attribute, one of us volunteers to contact that employee in his or her work area,” said Maureen Dougherty, vice president/program manager, AEW&C. “It’s nothing formal. We just want to say ‘thanks,’ let them know that they’ve been recognized, and reinforce the leadership qualities they demonstrate.”

Dougherty said recognizing leaders this way has been a practice in AEW&C for about a year. It was, in part, a response to the Employee Survey, which showed that employees wanted better recognition for good work. It also challenged the leadership team to spend more time focusing on the leadership attributes. “Many of these stories are inspiring and give us ideas on how we can improve our own leadership skills,” Dougherty said.

Response to the program has been good. Employees are taken by surprise when an executive shows up at their work stations to say “thank you” for demonstrating strong leadership in a tough environment. It also gets a positive response from nearby co-workers. About half the people recognized are managers, and half are nonmanagers.

In most cases, the executive contacting the employee is not part of that employee’s chain of command; instead, the executive is there representing the leadership team. Dougherty noted that this strengthens integration and collaboration across the organization.



Angia Vawter – Angia Vawter, an AEW&C procurement agent, was assigned the task of coordinating with the P-8A Poseidon program to find a common supplier to provide electronic warfare self-protection equipment for specific groups within the programs. The challenge was to develop common requirements for highly complex equipment in a short time frame. Vawter and her colleagues were recognized by her director, Steve Alberts. “This really shows how much our leadership team values individuals who are working hard to meet difficult challenges,” Vawter said. DANIEL THOMPSON PHOTO

champs

“The programs and systems we’re working on are so complex and geographically dispersed, it’s critically important that we have strong leaders throughout the organization.”

– Maureen Dougherty, vice president/program manager, AEW&C

The team recognizes three to five employees each week. The recognition is strictly verbal—no award, object or gift is presented—and Dougherty believes the simplicity of the approach makes it more meaningful.

While there’s no requirement that AEW&C groups use this recognition strategy, Dougherty said some are taking a similar approach. Word about its success has been spreading across IDS.

Dougherty emphasized that leadership must go beyond the management ranks for a program to be successful. “The programs and systems we’re working on are so complex and geographically dispersed, it’s critically important that we have strong leaders throughout the organization,” she said. “We need people who can use their skills and experience to step up and take on the big challenges.”

She added, however, that people must be thoughtful enough to understand when they should be leading and when they should be following. The best leaders know how to do both. ■

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Leadership, defined

The six Boeing Leadership Attributes define the company’s character and culture. Here are these attributes.

A Boeing leader

- **Charts the course.**
- **Sets high expectations.**
- **Inspires others.**
- **Finds a way.**
- **Lives the Boeing values.**
- **Delivers results.**

Sole passion



Boeing Field Service Representative John Morgenstern makes sure the CH-46 helicopters attached to Marine Squadron One are mission ready.

DAVID GROESBECK PHOTO

Field service rep still learning—and loving his job after 44 years

BY RANDY JACKSON

Whenever John Morgenstern watches the president of the United States board one of the helicopters assigned to U.S. Marine Squadron One, his pride takes flight with the aircraft.

Morgenstern is a Boeing Support Systems Field Service Representative deployed with U.S. Marine Squadron One, which is responsible for the operation of the fleet of helicopters supporting the missions of the president of the United States.

The exact number of Sikorsky VH-60s—the aircraft publicly known as Marine One when the president is aboard—is classified. But the entire squadron includes seven CH-53s and seven Boeing CH-46s. Morgenstern called the CH-46 the workhorse of the unit. It's affectionately dubbed The Phrog (pronounced “frog”) because of how it looks taking off near the Potomac River—the eastern boundary of the squadron's Virginia base. “Like a frog leaping from a pond,” he said.

A die-hard CH-46 maintenance and mechanical expert, Morgenstern spends anywhere from 60 to 100 days per year away from home in support of the presidential mission. He sits in the back of a Boeing CH-46 helicopter often with U.S. Secret Service agents and U.S. Marine squadron members who have become his extended family.

Morgenstern is passionate about his job and has been for each of the 44 years he's served as a field service rep for Boeing. “In my initial interview, back in 1957, I told the interviewer that being a field service

rep was the only thing I wanted to do; and he replied, ‘That sounds like a pretty short-sighted career plan.’ So I said, ‘You asked me what I wanted to do, didn't you?’ I was sure I had blown the interview,” Morgenstern said, smiling.

Three weeks later, fresh out of college, he got the job.

U.S. Marine Brigadier Gen. Andrew O'Donnell called Morgenstern a true standout. “He is without a doubt the most professional and impressive technical representative I've worked with in my 27 years of aviation experience,” he said. “He's an icon... a legend. His willingness to travel on a moment's notice in support of the presidential mission and Boeing products is impressive. His ethic and dedication are always of the highest level.”

Asked what the most memorable moment in his tenure with Boeing and Marine Squadron One has been, Morgenstern recalled meeting Pope John Paul II during what would be the pontiff's last visit to the United States.

“I got a chance to meet the Pope and shake hands with him while I was supporting the security detail in the CH-46. It was an awe-inspiring experience,” said Morgenstern.

Morgenstern is proud of his work and the company that has given him the opportunity to have an impact on so many lives. “I never stop learning,” he said. “The world has been my classroom, and I've been fortunate to pass on the Boeing work ethic to some of these young U.S. Marines and mechanics who get up every morning and look forward to doing the best job they can.”

If you can't see the pride in Morgenstern's face, just follow his car. His license plate reads B-O-E-I-N-G. ■

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Protecting what's ours

Global Privacy works to strengthen safeguards of personal information

By SUSAN BIRKHOLTZ

Boeing has accomplished a lot in its continuing efforts to protect personally identifiable information (PII) since two Boeing laptops containing unencrypted PII were stolen in 2005 and 2006. This information can be used to identify, contact or locate an individual; examples of PII include a person's name, Social Security number, date of birth, home address, credit card number, driver's license number or bank account information.

Immediately after each laptop theft, the company took swift measures to prevent the lost personal information of the current and former employees and retirees from being used to harm their financial standing. Affected people were immediately offered the opportunity to sign up at no cost to them for credit monitoring through Experian, a major credit bureau, to alert them to any suspicious activity. Thankfully, there have been no reports of identity theft or misuse of this data to date, and the laptop lost in 2006 was recovered, with data intact.

Perhaps the best evidence of the strides that have been made is that, although Boeing laptops unfortunately continue to be lost or stolen on a daily basis, no PII loss has recurred.

"The 2005 and 2006 incidents led us to take a close look at the processes, policies and controls related to how—and by whom—sensitive data like PII is handled in the organization and protected from potential loss and misuse," said Rick Stephens, senior vice president, Human Resources and Administration. "We knew we had to assure our employees as well as our customers that we were putting the right safeguards in place to protect the information they entrust with us. I think we have come a long way in a relatively short period of time."

This "close look" included an external audit by a world-class information security vendor to assess Boeing's privacy practices. The company also conducted an international risk assessment of privacy-compliance practices. And, to underscore the seriousness of its commitment, in 2006 Boeing established a Global Privacy Office as well as a chief privacy officer position, currently held by Deb Overlin, reporting to Stephens. Overlin works closely with Information Security as well as Shared Services Group's Security and Fire Protection organization, whose many duties include information and computing security and export compliance monitoring.

Overlin and this extended team have taken a number of corrective actions, the first being successfully mitigating the loss of PII resulting

“Each of us is personally responsible for protecting sensitive information by clearly understanding and strictly adhering to all company policies and procedures related to data security.”

– Deb Overlin, Boeing chief privacy officer

from the stolen laptops. Here’s a look at some of their many actions.

- An incident response procedure was updated and formally documented so actual and suspected incidents involving the theft, loss, compromise or unauthorized use of Boeing or non-Boeing information are reported promptly.
- As of 2006, any work activity associated with PII must be performed only on company premises. Downloading and saving PII to transportable devices such as laptops, PC hard drives or thumb drives is no longer permitted.
- To build employee awareness about the importance of protecting sensitive data, new training modules were introduced and others were expanded or revamped.

Boeing in 2005 introduced “Boeing Privacy Directions—Awareness,” which is mandatory for managers and HR and Information Technology teammates—groups that typically need to have access to PII and other sensitive information in their daily jobs. In addition, Boeing introduced an Information Protection training module in 2006 and revamped its Computing Security and Laptop Protection module in 2007. Also in 2007, Boeing introduced training for the handling of employee personal data in the European Union.

Existing Information Security training, mandatory for employees and non-Boeing individuals with access to company computing systems and networks, is updated every year; the 2008 update has been rolled out.

- Global Privacy in 2007 identified and categorized PII users into high, medium and low risk according to their ability to access this information in various Boeing systems. PII users are subject to certain requirements based on their risk level. Employees can determine their PII user risk level and associated system names by clicking on the My Profile tab in TotalAccess. Managers can review their employees’ risk level through Manager HR Services on TotalAccess.
- The number of employees with access to PII was significantly reduced. In addition, the number of applications containing PII has been cut by 75 percent.
- In 2007, all employees were required to

upload Whole Disk Encryption (WDE) software on their laptops and PCs, regardless of their PII user-risk level. WDE encrypts system hard drives, thereby protecting all stored data by preventing unauthorized access to systems.

- All current and former users of employee data were required to delete any PII from their PC or laptop hard drives or move it to a secure server. To assist in this task, Information Security deployed a self-scanning tool for employees to perform a self-check to identify any residual PII.
- Global Privacy is updating PRO-98 Personal Information Protection Practices, which describes the company’s employer-employee information practices related to personal data. To access Boeing Policies and Procedures, look for the POLs, PROs and Processes icon on either <http://my.boeing.com> (look for the Boeing Web links box in the left column) or <http://inside.boeing.com> on the Boeing intranet.
- An earlier update to PRO-98, consisting of the addition of “Directions for use of PII,” was made in 2006, and includes information that specifically relates to the use, access, visibility, storage and destruction of PII.

LOOKING OUTSIDE BOEING

Boeing also applies the same strict requirements on partners, vendors and suppliers who perform work on Boeing’s behalf. Global Privacy and SSG Information Protection have shared the lessons the company has learned with these vendors and suppliers so they can improve their policies and guarantee the security of Boeing’s information.

Global Privacy also has worked with Boeing Supplier Management and Contracts to develop standard contractual language on information protection requirements for PII, and has drafted supplier/vendor requirements for notification of any data loss incidents to Boeing and affected individuals.

Additionally, between August and November 2007, an SSG Information Protection and Information Security team conducted assessments of Boeing’s top 10 benefits providers to ensure they have adequate data protection practices in place and that they are meeting Boeing’s expectations.

The team began assessments of another

12 suppliers on April 1; these are expected to be completed in late July. The risk potential of the remaining 55 suppliers will be evaluated to determine if additional assessments are required. Also under consideration: assessments of Boeing subsidiaries’ privacy practices.

A LOOK AHEAD

Currently, Global Privacy is partnering with Information Security to make more secure the way PII users access this information. Within the next year or so, Boeing employees whose job descriptions require that they access PII will be required to use the applications and files containing this information through a secure remote desktop environment. Also in the works is a hard-drive-free device from which PII users can access this information; this route eliminates the possibility of downloading and storing PII.

While much has been done since those first laptops were stolen, Overlin recognized that even more can be done to make employee PII more secure—but employees need to do their part as well.

“Each of us is personally responsible for protecting sensitive information by clearly understanding and strictly adhering to all company policies and procedures related to data security,” said Overlin.

“As we move forward, we must make these practices part of our culture by actively applying the training to the work we do each day, and by remaining informed about our company policies and resources that are available to us. I’d like to say thanks to those employees who do their part every day to keep Boeing information safe.” ■

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How not to lose your laptop

As the days get longer in the United States and the rest of the northern hemisphere, everyone's in a hurry to enjoy the additional hours of daylight. But good weather can bring increased risk to protecting your Boeing equipment and Boeing information.

"It is imperative that you take a few extra minutes to really secure your company-issued laptop," said Deb Overlin, Boeing chief privacy officer. "Nothing can ruin a good evening faster than coming back to find your entire work-world has been stolen."

Here are a few common-sense tips:

- Don't leave your equipment in your vehicle parked in a public lot. Even if your laptop is locked in the trunk, the vehicle remains a target for thieves.
- Don't leave your equipment in an outside parking space overnight. Take the time to take it into your residence.
- Don't leave your gear in your locked garage. Make a habit of taking it inside your residence before continuing on with your evening. A few seconds of prevention is worth it.

Overlin noted that the loss of any portable equipment, including BlackBerrys and thumb drives as well as laptops, must be reported to Boeing Security immediately to ensure that valuable company information does not fall into the wrong hands. "This equipment is your responsibility; treat it as you would your wallet, purse or car keys," she said. "It's just as valuable."

Safe at home

There are plenty of things you can do at work to help safeguard personally identifiable information (PII). But what about at home? Here are some tips from the U.S. Federal Trade Commission on how to keep this information secure at home.

- Avoid using easily available information for passwords such as your mother's maiden name, your birth date, the last four digits of your Social Security number or phone number, or a series of consecutive numbers.
- Secure personal information in your home—especially if you have roommates, employ outside help or are having work done in your home.
- Ask about information security procedures at businesses you frequent, doctor's offices or other institutions that collect your PII. Find out who has access to the information and verify that it is handled securely. Also, ask about the disposal procedures for those records.
- Don't give out personal information on the phone, through the mail or on the Internet unless you've initiated the contact or are sure you know that you are dealing with a legitimate organization.
- Deposit your outgoing mail in post office collection boxes or at your local post office, rather than in an unsecured mailbox. Promptly remove mail from your mailbox.
- Tear or shred your charge receipts, copies of credit applications, insurance forms, physician statements, checks and bank statements, expired charge cards that you're discarding, and credit offers you get in the mail.
- Keep your purse or wallet in a safe place at work. Do the same with copies of administrative forms that have your sensitive personal information.
- If you have a home computer, regularly update your virus-protection software. Also, install patches for your operating system and other software programs to protect against intrusions and infections that can lead to the compromise of your computer files or passwords.
- Do not open files sent to you by strangers, or click on hyperlinks or download programs from people you don't know.
- Use a firewall program, especially if you use a high-speed Internet connection, to stop uninvited access to your computer. Without it, hackers can take over your computer, access the personal information stored on it, or use it to commit other crimes.
- Try not to store financial information on your laptop unless absolutely necessary. If you do, use a strong password—a combination of letters (upper and lower case), numbers and symbols.
- Before you dispose of a computer, delete all the personal information it stored. Use a "wipe" utility program to overwrite the entire hard drive.

Got a beef?

Jay Jones, who works in procurement for the 737 Fuselage & Wing Assembly team, is a resolution advocate. That means he's completed the required rigorous training that allows him to perform mediation duties when Alternative Dispute Resolution cases arise. The ADR program recently marked its 10th anniversary.

JIM COLEY PHOTO



Fix it!

10 years of Alternative Dispute Resolution at Boeing yield surprising results

By GEOFF POTTER

A Boeing process to resolve disputes between employees and managers quickly and amicably is celebrating its 10th anniversary.

Boeing encourages people to use the process, known as Alternative Dispute Resolution, because it has many benefits, including quicker resolution of issues, reduced costs, fewer employee complaints to external agencies and improved morale.

The goal of the ADR program is to resolve workplace disputes in a fair, calm, professional and timely way—and improve dialog between employees and management. Since the four-step process was introduced at Boeing in 1998, ADR has resolved hundreds of disputes. The vast majority of them—89 percent—are settled quickly, by the end of the second step. What's more, over the past five years, a whopping 93 percent of those providing feedback—including employees and managers—said they would use the program again to resolve a workplace dispute.

The confidential program is available throughout the United States for all nonunion employees and all managers not at the executive level.

Many kinds of issues can be resolved through ADR (see box on Page 37 for a more complete list), but they tend to begin when employees believe that a manager has made an unfair decision, or Boeing policies and procedures were not applied properly.

HOW IT WORKS

How exactly does ADR work?

Let's say you have a problem. Maybe you feel you weren't treated fairly, or a company policy was not applied properly. Maybe you've received a Corrective Action Memo, been suspended without pay, or didn't receive the salary adjustment you feel you deserve.

First, meet with your manager or Human Resources generalist to discuss the issue and the rationale for the action or decision. If that discussion doesn't resolve your dispute, you can request ADR services to suggest a remedy.

If you decide to use ADR, you simply contact one of Boeing's four ADR case managers within 30 calendar days of the incident or decision that initiated the problem—or within 30 days after actively working all other means of resolution with management. First, complete the Intro-

“It’s surprising the number of managers who end up saying this is a good process for employees, even though they’re the one the employee has a dispute with.”

– Spencer Dunn, Boeing Global Diversity & Employee Rights, Alternative Dispute Resolution lead

duction to ADR Course (#TR011223), available via the TotalAccess site on the Boeing intranet. Then, simply submit a request form. The case manager determines whether the issue is eligible for the ADR process.

It’s important to note that ADR is completely voluntary. You can stop it at any time, and you should feel free to use it without fear: You and any witnesses are protected from retaliation of any kind for participating in the process. Further, the confidentiality of everyone involved is protected as much as possible; information is shared only on a need-to-know basis.

The ADR process has four steps:

- One-on-one discussion
- Internal mediation
- Panel review or external mediation
- Binding arbitration

In the first step, you meet with a manager (along with a next-level manager and/or a Human Resources representative, if you wish). If discussing it resolves the dispute—as it often does—the process ends there.

If not, you can request taking the next step, internal mediation. Here, the employee and the manager meet with a trained Boeing employee called a Resolution Advocate to find a mutually agreeable solution. Nearly 90 percent of disputes are resolved after this point in the process.

Additional steps can include a review by an executive or senior-level manager, and the dispute ultimately may be placed before a professional, external mediator or, more often, a five-member internal panel. As a last resort, the dispute is turned over to a profes-

sional arbitrator who makes the final, binding decision.

“It’s surprising the number of managers who end up saying this is a good process for employees, even though they’re the one the employee has a dispute with,” said Spencer Dunn, the ADR Lead in the Global Diversity & Employee Rights group, which runs the program. ■

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7 Things to know about ADR

Think you’ve got a case for which Alternative Dispute Resolution would be of help? Here are some important things to know.

1. If you decide to use ADR, you must do so within 30 days of the incident or decision that initiated the problem.
2. The ADR process is completely voluntary. You can stop the process at any time.
3. You and any witnesses are protected from retaliation for participating in the process.
4. Although many kinds of disputes can be resolved through ADR, they usually involve
 - Allegations of unfair decisions by a manager.
 - Allegations that Boeing policies and procedures were not applied properly.

ADR is not designed to challenge existing policies or procedures nor to implement new ones.

5. Not eligible to use ADR are employees represented by collective bargaining agreements, and executives.
6. ADR has resolved more than 1,000 workplace conflicts since the process was introduced at Boeing in 1998.
7. To submit an ADR request or to find out whether it may work to resolve your issue, take the online training. Visit TotalAccess on the Boeing intranet and click on “My Work.”

Eligible for ADR?

What kind of issues are eligible for Alternative Dispute Resolution?

Issues eligible for resolution through ADR include compensation, most corrective action decisions, violation of specific company policies, and claims for alleged actions such as negligence, defamation, invasion of privacy, infliction of emotional distress and retaliation for “whistle blowing,” to name a few. For the complete list, refer to PRO-780; to access Boeing Policies and Procedures, look for the POLs, PROs and Processes icon on either <http://my.boeing.com> (see the Boeing Web links box in the left column) or <http://inside.boeing.com> on the Boeing intranet.

Issues not eligible for ADR include layoffs, benefit and pension claims, discharge due to criminal conviction, worker’s compensation and unemployment claims, and Equal Employment Opportunity issues (unless approved by EEO). Also, ADR is not designed to challenge existing policies or procedures nor to implement new ones.

For more information, as well as on-line training for Alternative Dispute Resolution, visit TotalAccess on the Boeing intranet and click on “My Work.”



'A new world'

During a recent demonstration of Network-Enabled Operations capabilities, Paul Comitz, Boeing program manager for NEO, shows how operators from various agencies and air traffic control centers can instantaneously display the same information on their respective screens across a network-enabled air traffic management system.

THOMAS GOERTEL PHOTO

Boeing plays a role in developing the foundation of a next-generation, network-enabled air-traffic-management system

By DARYL STEPHENSON

Uncertainty. That's not what you want when you have to make quick decisions that affect the lives of millions of people over a large region.

Let's say a major hurricane has just struck the southeast United States. Amid widespread devastation, search and rescue as well as relief operations are under way. But the going is hard, because the storm is still bringing wind and rain, and it's dark.

Among the many problems that air traffic control authorities have to solve is the answer to one pressing question: Where are verified, open runways where military C-130 aircraft can be staged for relief efforts? In today's world, officials from different agencies and command centers likely would have to get on conference calls, exchange faxes and e-mails, and deal with data that might not be accurate or up to date in an hours-long search for the answer.

But what if an individual air traffic controller could plot those open runways and a path to fly to and from them on a display? And what if

that controller could publish this data on a network that would let other agencies' operators, who use different systems, see that same information at the same time on their displays? Uncertainty would give way to certainty. Instead of hours, it likely would take just a few minutes to dispatch the C-130s to those open runways—and people who need relief would get it much more quickly.

This type of rapid response could happen only in a network-enabled air traffic management system. The U.S. Federal Aviation Administration, through its Joint Planning and Development Office (JPDO), wants to implement such a system, called the Next-Generation Air Transportation System, or NextGen, by 2025. But the foundation of such a system—an architecture that enables different systems from different agencies to talk to each other—is ready now. Developed by Boeing and an industry/government partnership over the past two years, the concept of Network-Enabled Operations (NEO) has been validated through proof-of-concept demonstrations and a recent series of eight prototype demonstrations for government, industry and news media visitors at the Boeing Integration Center-East in Crystal City, Va.

The JPDO is sponsoring the Joint NEO Program to leverage government investment in network-enabled technologies while incorporating industry's knowledge and best practices. The government team includes major stakeholders in U.S. aviation—the U.S. departments of Transportation, Defense, Homeland Security, and Commerce—the FAA, and the National Aeronautics and Space Administration. The Joint NEO Industry Team, led by Boeing, includes Computer Sciences Corp., Lockheed Martin and Raytheon.

The above example, involving rapid decision making and response after a hurricane, is drawn from one of two operational scenarios featured in the NEO prototype demonstrations. (The other is a multi-threat security scenario in which a possible coordinated attack on the United States is suspected.)

The message delivered from the NEO demonstrations is that “we are at the point of maturing the technology to begin spreading it out in actual operational implementations at selected sites,” said Kevin Brown, Boeing vice president and general manager of Air Traffic Management.

‘PRECISION INFORMATION’

“This is a new world that’s about to start,” said Mike Lewis, Boeing director of ATM Business Development. “Network-centric operations for NextGen is about moving to an operation that exploits shared precision information. We’ve created an architecture and an information-sharing network, technology tools, and operational concepts that exploit the network capability to immediately share information. Networked operations are fundamental to making NextGen work. You can’t get there without a net-centric approach. The information-sharing architecture is ready now for operational implementation. And for the operators who would use this, this is a major step forward.”

One of the appealing features of the NEO architecture is that “it embraces existing information systems and adapts them to an environment in which there is a coherent, common exchange of information,” said Paul Comitz, Boeing Advanced ATM program manager for Spiral 1 development of NEO. “It’s a brokered, standards-based architecture. What this means for the agencies and their operators is that they don’t have to buy and learn new systems. They use their own.”

Because the NEO architecture is standards-based, it’s “relatively easy to add systems to the environment,” Comitz said. “The net-enabled services are not pinned to a sin-

gle system. As we build a portfolio of services, the services can be combined for more complex operations.”

One aspect of that combination is a concept called “mash-ups,” in which experts take existing data and services and combine them to create new applications in response to new and unexpected situations. “We’re very excited about this,” said Comitz, because it gives the operators the power to redesign the system to immediately solve real problems that can’t be foreseen.

Such a capability would be a very powerful tool in dealing with ATM issues in a natural disaster or in a multi-threat scenario involving a possible coordinated terrorist attack, in which the unexpected is likely to happen. The two NEO prototype demonstration scenarios, in fact, were designed to “flex the system” and produce complex situations that would challenge the operators and stress the NEO architecture, said Gene Hayman, Boeing Advanced ATM manager of Business Development.

“These were live exercises with actual operators in their actual operational settings,” Hayman said. “They were designed to be as realistic as possible, so that the operators could demonstrate the capabilities that would be needed to accelerate the implementation of NextGen.”

The feedback from the operators and their agency leaders has been that the NEO tools provide a clear advance in shared situational awareness and a significant improvement in the ability to make coordinated decisions rapidly and correctly, Hayman said.

LOOKING AHEAD

Now that the NEO concept has been validated, what’s next? The NEO team is advocating four operational implementations of the concept as part of the next phase of the program, said Neil Planzer, Boeing ATM vice president of Strategy. They are:

- Select areas in the Gulf of Mexico or Florida region as shared special use airspace in which airline operations centers, military command centers and FAA traffic flow management would share real-time information.
- Create temporary flight restrictions that allow the rapid deployment of unmanned aerial systems, without encroaching on airspace for civil carriers.
- Use the NEO network to distribute Enhanced Traffic Management System information to reduce ground delays for aircraft.
- As a contingency operation, allow state

and local authorities to connect to the NEO air picture on laptops and develop solutions to emergency requirements in real time.

The NEO team estimates it can complete these implementations in 12 to 15 months at a cost of about \$20 million.

“These near-term implementations will begin the process of transforming the U.S. air transportation system,” said Planzer. “Beginning with these targeted implementations, we’ll progress to a full national airspace systemwide deployment.” ■

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“The net-enabled services are not pinned to a single system. As we build a portfolio of services, the services can be combined for more complex operations.”

– Paul Comitz, Boeing Advanced Air Traffic Management program manager

Creating a better



At Boeing, technology leads to environmentally progressive products, services and operations

By JAY SPENSER

From their development of solar cells and fuel cells to advanced aerodynamics, lightweight materials and alternative fuels, Boeing people are tackling environmental challenges with unprecedented energy and enthusiasm.

Over the past four decades, Boeing has made its jetliners about 70 percent more fuel efficient with an approximately 90 percent smaller noise footprint. The 787 Dreamliner and 747-8 Intercontinental will continue this progress with a further reduction in fuel consumption, emissions and noise.

But that's only part of the environmental technology story at Boeing, which is committed to leading the aerospace industry in developing clean, green products for the future. Boeing experts also are pursuing alternative energy developments, reimagining the world's aviation systems to make them more efficient, and implementing process improvements to operate greener. The result is tangible technology that delivers solid environmental benefits today—and will be transformative tomorrow.

"As a technology leader, our greatest contribution will be innovation, as we find ways to make our products, services and operations ever more environmentally progressive," said Jim McNerney, Boeing chair-

man, president and CEO. "This issue is critical for our business success. Reducing the greenhouse-gas emissions (which lie at the heart of climate-change concerns) is one of the greatest challenges—and opportunities—that Boeing has encountered."

Taking the lead in helping coordinate Boeing's environmental activities is the company's Environment, Health and Safety (EHS) organization. Formed in 2007, EHS has the charter to integrate and expand the focus of previously separate environmental groups and initiatives across the enterprise. EHS now is spearheading a companywide environmental strategy that embraces Boeing products, processes and facilities even as it reaches out to customers, suppliers and communities.

"Our employees have tremendous talent and passion, and we are working on environmentally progressive technologies across every part of this company," said Mary Armstrong, EHS vice president. "Our job is to help provide pathways and connections for that passion to create truly innovative environmental solutions for our customers."

Also in 2007, Boeing unveiled a new enterprise technology strategy that seeks to ensure the right technologies are developed, now and in the future. To implement this competitiveness-enhancing strategy, Boeing this year created eight technology domains covering the different areas of company research and development (R&D). One of these domains is devoted to environmental technologies.

"As an aerospace leader, enhancing our environmental capabilities and performance is the right thing to do," said Environment Technology Domain Leader Vanessa Gemmill. "But it's more than that—it's also the key to our future growth and success as an aerospace company. At Boeing, we plan to be ready with a balanced portfolio of environmental

future



Boeing is active in myriad activities that support environmental improvements. They include (from left) flying a manned airplane powered by clean, quiet hydrogen fuel cells; continually improving the environmental performance of its factories, such as its satellite plant in El Segundo, Calif.; creating products that use less fuel and have smaller noise footprints, such as the 747-8 Intercontinental airplane (shown here is the airplane's interior); spurring the development of aviation biofuels by leveraging research like that of the Hawaii Agriculture Research Center on *Jatropha curcas*; and creating solar cells, through its Spectrolab subsidiary, that turn the sun's energy into electricity.

FROM LEFT: BOEING PHOTO; BOB FERGUSON PHOTO; BOEING PHOTO; ALLEN BIRNBACH PHOTO; BOB FERGUSON PHOTO

“As a technology leader, our greatest contribution will be innovation, as we find ways to make our products, services and operations ever more environmentally progressive,”

— Jim McNerney, Boeing chairman, president and CEO

technologies when our customers, the world and we ourselves need them.”

INNOVATING FOR THE ECOSYSTEM

Boeing is one of the world's leading manufacturers of solar cells, a fact that might surprise some people. Solar cells made by wholly-owned Boeing subsidiary Spectrolab, a part of Integrated Defense Systems, power everything from satellites and interplanetary missions to renewable energy plants in California, Arizona and Australia.

Tim Vinopal, IDS chief engineer for the environment, noted that Spectrolab's concentrator cells currently hold the world's record with 40.7 percent efficiency in converting sunlight to electricity. “Great as this is, we're expecting further improvements thanks to new technologies now being pioneered by Boeing,” he said. (For more about Spectrolab, see Page 30 of the November 2007 *Boeing Frontiers*).

In addition, Boeing is investigating biofuels as another alternative energy source that can reduce carbon-dioxide emissions from aerospace products.

“We and our partners from other industries are working on advanced-generation aviation biofuels derived from sources that will not take arable land out of production,” said Darrin Morgan, who's responsible for business analysis and biofuels strategy at Commercial Airplanes. “Feasibility has been established over the past two years, and commercial production will soon begin.”

Morgan added that a number of biofuel feedstock candidates are being investigated. Particularly promising are algae that thrive in brackish water and strong sunlight, making harsh desert environments ideal for their production. These fast-growing algae produce high-energy-density fats that can be modified to create a biofuel similar to kerosene but without its environmental drawbacks.

To highlight the technical feasibility of sustainable biofuels for jetliners, Boeing conducted the first commercial aviation flight using a different biofuel mixed with regular jet fuel in February with Virgin Atlantic and GE Aviation. In addition to doing engine ground testing with Pratt & Whitney, Boeing will conduct joint biofuel demonstration flights later this year with Air New Zealand and Rolls-Royce, and in 2009 with

Continental Airlines and GE Aviation.

Fuel cells are yet another alternative energy technology being pursued by Boeing. These devices directly convert hydrogen into electricity without combustion, reducing noise, emissions and the need for conventional fuels. When running on hydrogen, they emit only heat and water vapor. When equipped with a reformer allowing conventional hydrocarbon fuels to be used, they produce far fewer emissions than do combustion engines.

Boeing is collaborating with industry to explore fuel-cell applications in jetliner electrical power systems. Capping a learning effort earlier this year, an engineering team at Boeing Research & Technology Europe in Madrid, Spain—part of the company's Phantom Works advanced R&D unit—successfully flew a manned airplane powered solely by a hydrogen fuel cell (see Page 44 of the May 2008 *Boeing Frontiers*).

Boeing technologists also are working to improve air traffic management, the global successor to traditional air traffic control. In addition to letting more airplanes safely share the world's airspace, ATM offers a critical near-term opportunity to improve aviation's global environmental performance. In fact, the International Air Transport Association estimates that ATM solutions could improve fuel efficiency by up to 12 percent with a corresponding reduction in carbon dioxide emissions.

ATM will reduce fuel use by using airspace more efficiently, minimizing delays and hold-

ing patterns over airports and using precision navigation and other airplane capabilities not now exploited. One example is the Boeing tailored arrival concept, in which jetliners descend continuously to the runway instead of descending to low altitude and then maneuvering in the airport vicinity before landing. Trials have shown that this advanced arrival technique can save up to 500 gallons (1,893 liters) of fuel per flight.

Boeing environmental R&D also is helping the company's military customers meet their sustainability challenges. Biofuels hold out strategic as well as environmental benefits for military operators such as the U.S. Air Force, which in terms of fuel use would rank as the world's second largest airline. In addition, IDS environmental R&D is making available new technologies that reduce emissions and hazardous waste creation as Boeing military aircraft are maintained and operated in service.

SMALLER FOOTPRINTS

Even as Boeing helps its customers reduce their carbon footprints, the company continues to reduce its own. According to Jeff Nunn, conservation initiative leader for Shared Services Group, on a revenue-adjusted basis since 2002, the company has cut energy consumption and carbon dioxide emissions by 24 percent, water consumption by 28 percent, and hazardous waste by 30 percent.

"More reductions are now under way thanks to the challenging five-year targets

the company committed to last year," said Nunn. "Our current goal is 25 percent further improvements in solid waste recycling rates, energy efficiency and greenhouse gas emissions intensity by 2012 at the company's major manufacturing facilities."

Boeing has a similarly ambitious goal for hazardous waste reduction—an area in which Boeing has made great strides over the decades, Nunn added.

ENVIRONMENTAL LEADERSHIP

Global challenges require global collaboration for meaningful solutions, of course. As an aerospace leader, Boeing is pressing for broad industry alignment to effectively address environmental-improvement opportunities.

In April, for example, Boeing helped gather many of its customers, partners and competitors in Geneva, where these entities committed to a pathway toward carbon-neutral growth and the aspiration of a carbon-free future.

Further demonstrating its commitment to the environment, Boeing this year joined the U.S. Environmental Protection Agency's Climate Leaders program, which requires action on carbon dioxide reductions. Boeing also is a member of the World Business Council for Sustainable Development and the Pew Center on Global Climate Change, two important forums for learning and spreading the word. ■

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In February, Boeing partnered with GE, Imperium Renewables and Virgin Atlantic Airways to conduct the first commercial flight using sustainable biofuels. Shown here is the Virgin Atlantic 747-400 that flew the historic flight from London to Amsterdam.

BOEING PHOTO



New report details Boeing's environmental focus

Boeing last month issued a report that details its performance, strategy and actions to reduce its environmental footprint and lead the aerospace industry with environmentally progressive products and services.

According to the 2008 Environment Report, Boeing's manufacturing operations have achieved significant improvements between 2002 and 2007. On a revenue-adjusted basis, Boeing has reduced energy use and carbon dioxide emissions at its major facilities by 24 percent and hazardous waste by 30 percent. On an absolute basis, the reductions are 5 percent for energy use, 4.8 percent for carbon dioxide emissions and 12 percent for hazardous waste.

The report also states that Boeing is now targeting a further 25-percent revenue-adjusted reduction of energy use and greenhouse gas emissions by 2012, with similar goals for recycling and hazardous waste.

To see the report, visit www.boeing.com/aboutus/environment on the World Wide Web.

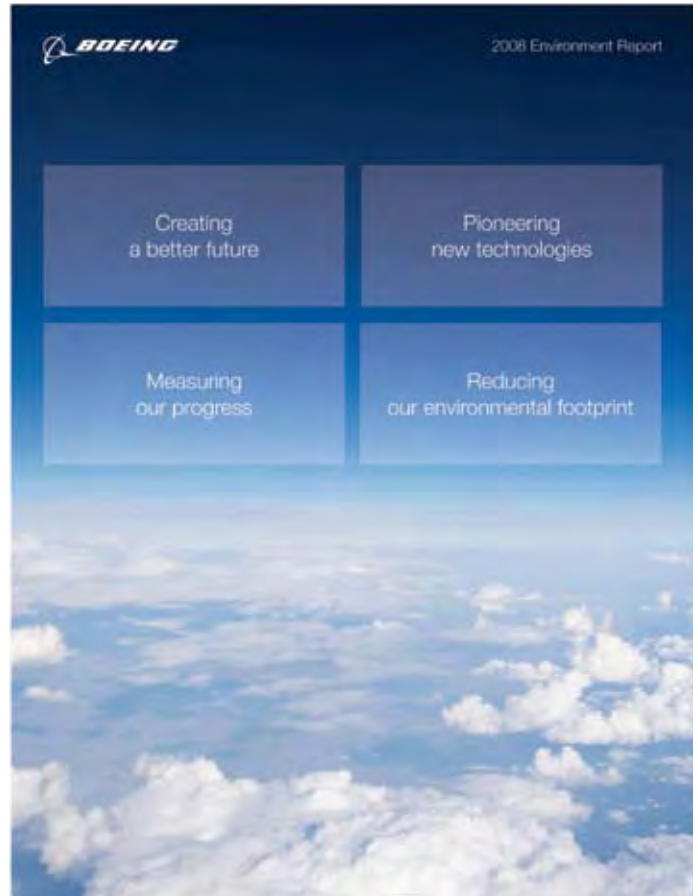
"Climate change and pollution are serious global concerns," said Jim McNerney, Boeing chairman, president and CEO. "Recognizing that, Boeing has set a clear strategy to help protect our eco-system. Our greatest contributions will continue to come from innovation—delivering improved environmental performance for customers while relentlessly reducing our own footprint."

Boeing has a record of integrating environmental performance improvements through technology advancements. Over the last 40 years, airplane emissions of carbon dioxide have been reduced by around 70 percent, and the noise footprints have been reduced by approximately 90 percent. Boeing targets improving fuel efficiency of each new generation of commercial airplane by 15 percent compared to the airplanes they replace.

"It's a good record, but it's clear we need to accelerate our efforts," said McNerney. "Because of the tremendous benefits aerospace brings to the world, our industry—and our company with it—is growing, and we are focused on achieving carbon-neutral growth and then continued reductions."

Highlights of Boeing's work with environmentally progressive technologies in 2008 include:

- The world's first flight of a commercial airplane powered in part by biofuels, in collaboration with Virgin Atlantic Airways and GE Aviation. Boeing is focused on research for advanced generations of sustainable biofuels using biomass that do not compete with food crops or water resources.
- The world's first straight-and-level flight of a manned airplane powered only by a fuel-cell. The research may benefit secondary aircraft system power use. ■



"Boeing has set a clear strategy to help protect our eco-system. Our greatest contributions will continue to come from innovation—delivering improved environmental performance for customers while relentlessly reducing our own footprint."

— Jim McNerney, Boeing chairman, president and CEO

A flight of hope

Boeing, Shenzhen Airlines, relief agencies deliver supplies after China earthquake

By SUSAN BIRKHOLTZ

An 8.0-magnitude earthquake hit Sichuan Province in China on May 12, one of that country's worst recent natural disasters. Since then, nearly 9,000 aftershocks have been detected in the quake-hit areas. The first deadly quake affected more than 45 million people. An estimated 70,000 have lost their lives, and thousands more are injured or missing.

Boeing and its employees have been quick to respond, with contributions totaling more than \$500,000 to date—and an interesting idea. Would the company's China-based airline customers scheduled to fly their new airplanes away in late May and June agree to transport much-needed medical supplies for the quake-ravaged victims?

The answer was a resounding “Yes,” and the Flight of Hope effort was born.

“We felt that bringing together relief agencies and our airline customers to make this happen was something tangible that Boeing could do to help the survivors of the China earthquake,” said Patrice Mingo, director, Strategic Programs, Boeing Global Corporate Citizenship.

Boeing has collaborated with relief agencies and airline customers in the past to deliver humanitarian aid to areas around the world. But this effort was far more challenging in terms of the short time period and the urgency of the need. “The level of effort and collaboration exhibited by so many different parts of the company was amazing. For me, it showed the power of ‘one Boeing’ in action,” said Mingo.

The complexity of bringing all the right partners together and getting the right information



To support relief efforts after the recent earthquake in China, Boeing employees on May 24 loaded nearly three tons of medical supplies into a new Shenzhen Airlines 737-800 after the airplane was delivered at Boeing Field in Seattle. ALAN MARTS PHOTO

to and from the right people in the right places was daunting at times. But the group—which, besides Mingo, includes Boeing China President David Wang, representatives from Boeing Commercial Airplanes Sales, and Puget Sound GCC focals with previous experience with humanitarian flights—persevered.

It turned out the easiest part was getting the airline customers to participate, with Shenzhen Airlines being among the first of several China-based airline customers that eagerly agreed to work with Boeing. Mercy Corps and Medical Teams International (MTI) came on board quickly after that.

“What was interesting was that our collaborative mindset was shared by our nonprofit partners,” said Mingo. As luck would have it, MTI had medical supplies available but no way to distribute them in China. Meanwhile, Mercy Corps had no supplies to transport, but they had a nonprofit partner in China who could receive the goods and deliver them where needed. “So the fit between MTI’s ability to provide the supplies and Mercy Corps’ connections to get them where needed was a collaboration within a collaboration—a happy surprise,” Mingo said.

THE FIRST FLIGHT

On May 24, the collaboration among the partners paid off. A new Shenzhen Airlines 737-800 left Boeing Field in Seattle carrying more than three tons of medical supplies.

The supplies eventually were transferred to a domestic Shenzhen flight and taken to Chengdu airport, which is nearest the quake-affected area, on May 27. Upon its arrival, the

Mercy Corps nonprofit partner unloaded the supplies and began delivering them within the earthquake region.

“This wonderful effort, made possible by Shenzhen’s graciousness in offering its new airplane, came together quickly because of our collective determination to help the survivors,” said Anne Roosevelt, Boeing GCC vice president.

“We’re grateful for this opportunity to bring hope and healing to those who have lost everything and are suffering,” MTI President Bas Vanderzalm said. Neal Keny-Guyer, Mercy Corps chief executive, agreed: “In disasters the size of the China earthquake, rapid response saves thousands of lives. Boeing’s help rushing these medicines to China means Mercy Corps can get them immediately to those who need them most.”

Roosevelt noted that Mingo and the Flight of Hope team are investigating additional opportunities, with Shenzhen and other airlines, to deliver more supplies to China within the next month.

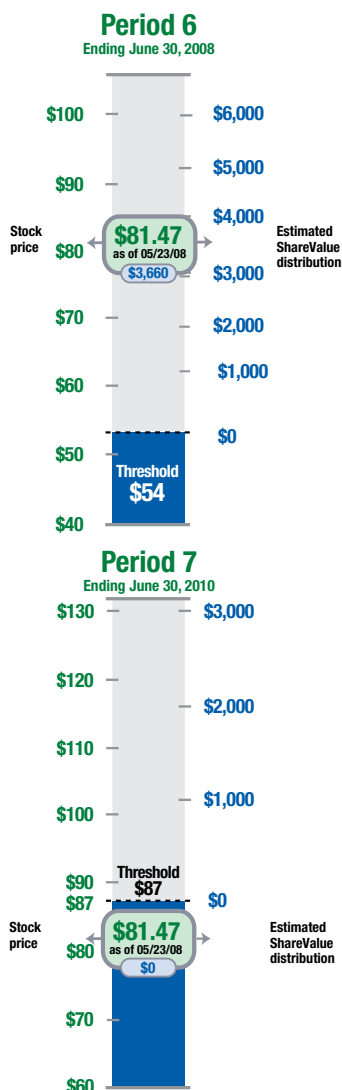
“Since the first flight on May 24, I have received e-mails from all over the globe with congratulations to Boeing on the creativity of our plan to aid earthquake sufferers in China,” Roosevelt said. “From David’s team in China to the people in the BCA Sales organization, the GCC focals who coordinated the shipment, and the communicators who worked over the holiday weekend to get out the news—all truly demonstrated the power of ‘one Boeing.’” ■

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Boeing stock, ShareValue Trust performance

ShareValue Trust is an employee incentive plan that allows eligible employees to share in the results of their efforts to increase shareholder value over the long term.

The program—which runs for 14 years and ends in 2010—features seven overlapping investment periods. The program is currently in Periods 6 and 7.



The above graphs show an estimate of what a “full 4-year participant” ShareValue Trust distribution (pretax) would be for Periods 6 and 7 if the end-of-period average share prices were the same as the recent price shown.

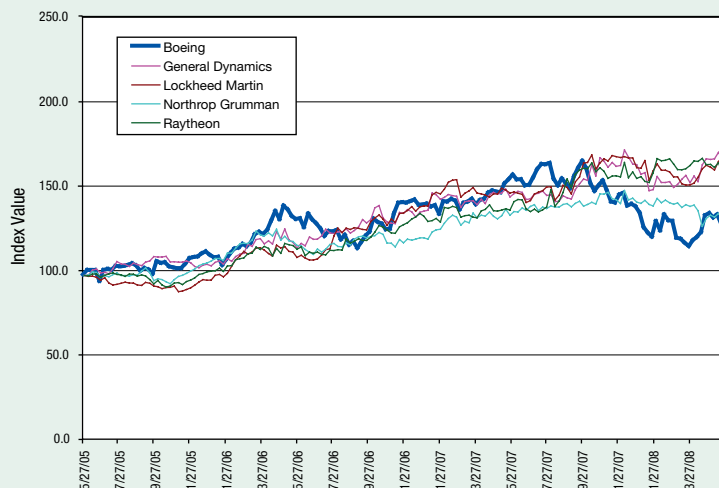
The share price shown is the average of the day’s high and low New York Stock Exchange prices. Updates to participant/employment data will be made periodically.

For more information on the ShareValue Trust, visit <http://www.boeing.com/share>.

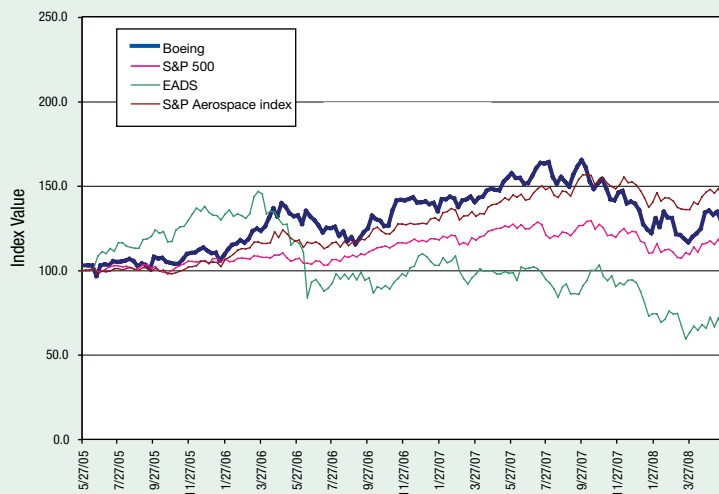
STOCK WATCH

The chart below shows the stock price of Boeing compared to other aerospace companies, the S&P 500 index and the S&P 500 Aerospace and Defense index. Prices/values are plotted as an index number. The base date for these prices/values is May 27, 2005, which generates three years of data. The prices/values on that date equal 100. In other words, an index of 120 represents a 20 percent improvement over the price/value on the base date. Each data point represents the end of a trading week.

Boeing vs. U.S.-based competitors



Boeing vs. stock indexes and international competitors



Comparisons: 4-week, 52-week

	Price/value as of 5/23/08	Four-week comparison		52-week comparison	
		Price/value as of 4/25/08	Percent change	Price/value as of 5/25/07	Percent change
BOEING	81.48	84.84	-4.0%	98.25	-17.1%
U.S. COMPETITORS					
General Dynamics	90.37	90.92	-0.6%	78.86	14.6%
Lockheed Martin	107.42	107.63	-0.2%	97.01	10.7%
Northrop Grumman	73.93	73.99	-0.1%	75.04	-1.5%
Raytheon	62.49	64.67	-3.4%	54.23	15.2%
INT'L COMPETITORS					
EADS *	14.96	15.40	-2.9%	23.36	-36.0%
U.S. STOCK INDEXES					
S&P 500	1375.93	1397.84	-1.6%	1515.73	-9.2%
S&P 500 Aerospace and Defense Index	418.97	431.27	-2.9%	416.92	0.5%

* Price in Euros



Philadelphia Composite Center of Excellence

FRED TROILO PHOTO

Like many businesses, we faced the challenges of increased utility rates and higher raw material costs—while experiencing rising production demand. But we met these challenges head-on by improving operations and managing inventory. Our efforts not only yielded excellent business results, but led to “lean and green” processes, helping our site reduce its environmental footprint.

Focusing on the curing process in autoclaves, which use high temperatures and pressure for curing composite parts, we worked with our internal customers to improve timing, loading and scheduling of parts to be processed. The results were a 25 percent increase in the number of parts loaded into the autoclaves and a reduction in the number of autoclave “runs” each week—thus decreasing fuel consumption.

We also generated cost savings and additional environmental benefits by better controlling inventory and using Lean initiatives. In the past, we often ordered raw materials well in advance of production requirements and stored them in a freezer. If we didn’t use the material before its shelf-life expiration date, Environment, Health and Safety disposed of it off-site. But with our improved material ordering and inventory management, we have cut raw material costs significantly. In addition, we made a positive impact environmentally by reducing composite waste by 47 percent. We have literally eliminated tons of waste.

From left:

Tom Shaffer
Second-shift supervisor, Autoclave Utilization

Ian Howie
Inventory Management

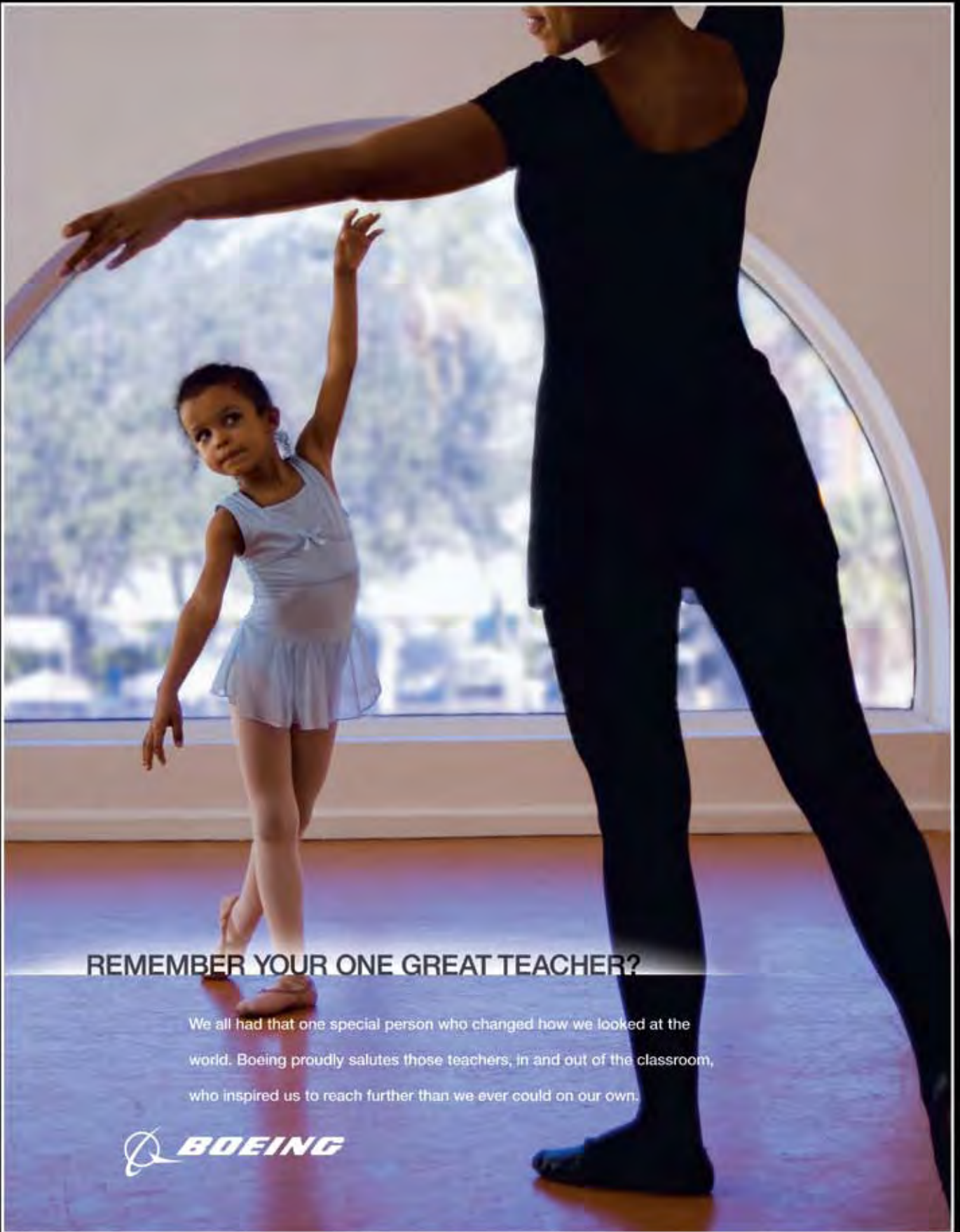
John Krause
Inventory Management

Mark Robertson
Manufacturing supervisor, Autoclave Utilization

Bob Swan
Autoclave operator

Bruce Zimmerman
Autoclave operator

Chris Aman
Inventory Management

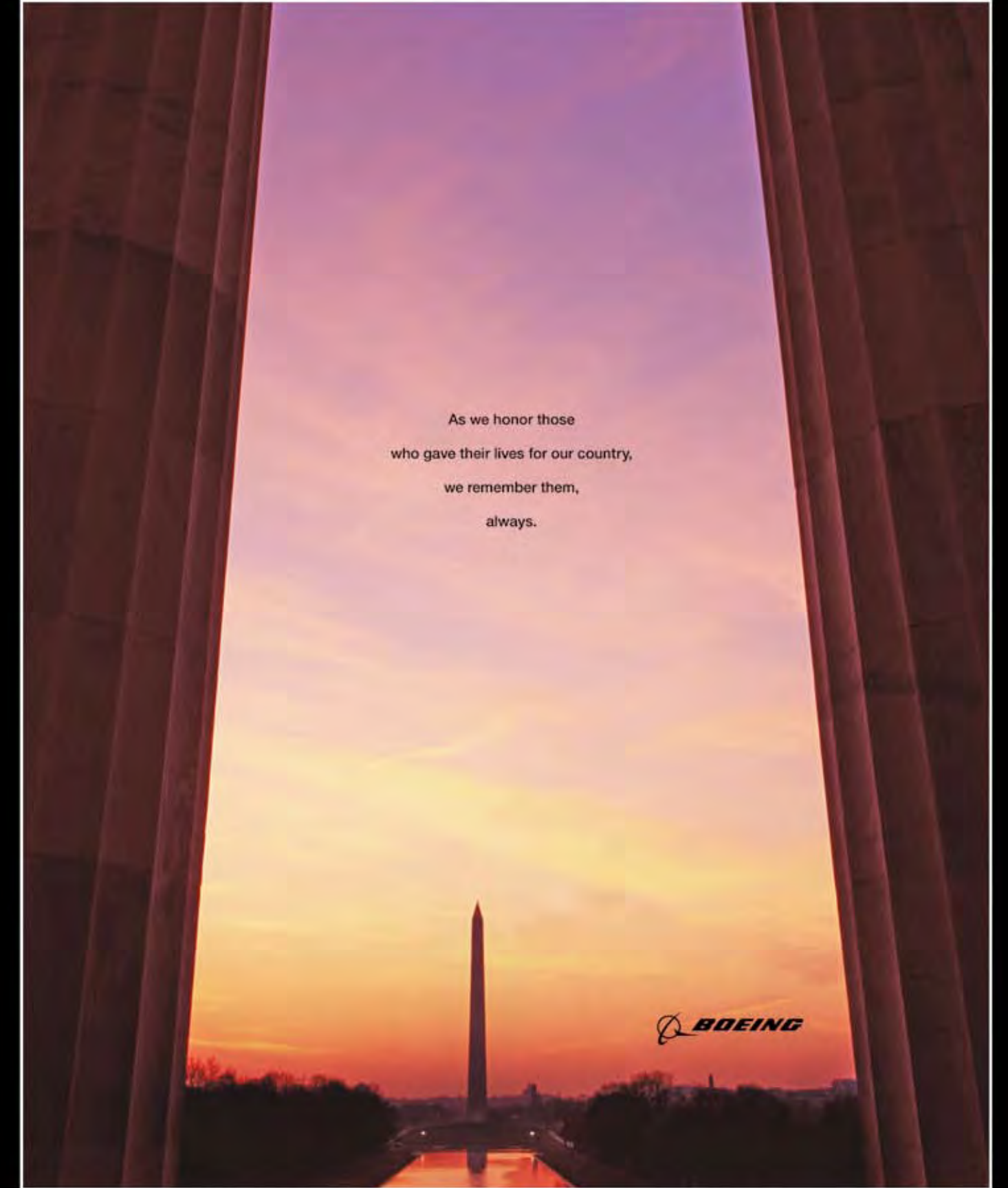


REMEMBER YOUR ONE GREAT TEACHER?

We all had that one special person who changed how we looked at the world. Boeing proudly salutes those teachers, in and out of the classroom, who inspired us to reach further than we ever could on our own.

 **BOEING**

Global corporate citizenship refers to the work Boeing does—both as a company and through its employees—to improve the world. These efforts, combined across the enterprise, can yield sustainable improvement in the communities where Boeing employees live, work and support. This ad reflects Boeing's commitment to initiatives that inspire individuals to achieve their highest potential.



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

 **BOEING**

This ad was created to demonstrate 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 79 regional, trade and military publications. The campaign also featured complementary TV and online components.