



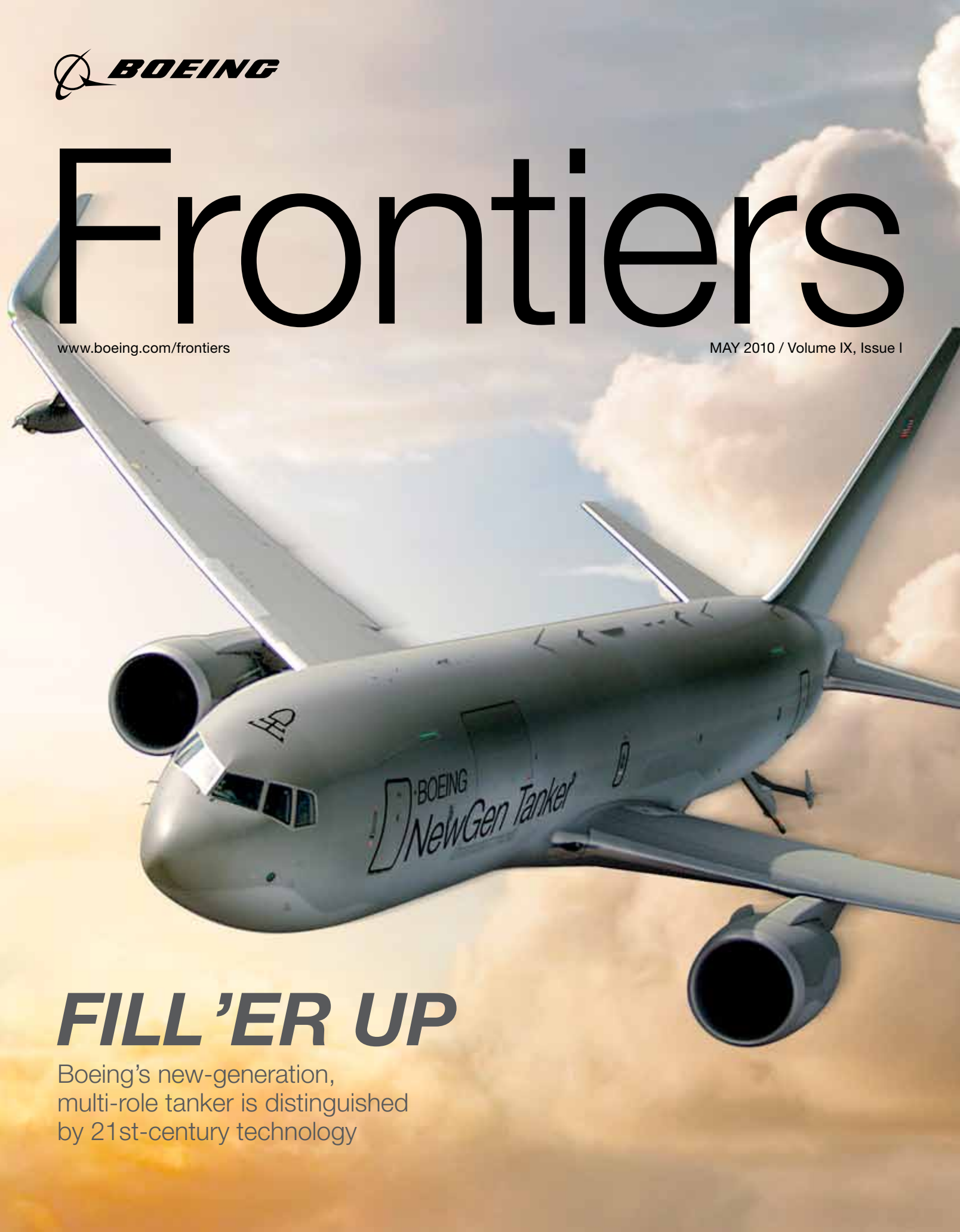
Frontiers

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MAY 2010 / Volume IX, Issue I

FILL'ER UP

Boeing's new-generation, multi-role tanker is distinguished by 21st-century technology





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FLYING UNMANNED SYSTEMS TO NEW CAPABILITIES.

Boeing is bringing next-generation capability to unmanned systems. From small tactical to high-altitude systems, Boeing is maximizing the performance envelope for remotely-piloted vehicles with greater payload flexibility, secure networked systems, autonomous operations and an open architecture design for built-in growth potential. At every altitude, Boeing is taking unmanned systems to new heights.



Phantom Ray



ScanEagle



On the Cover

20 It's a gas, gas, gas

Drawing on its rich legacy of experience, the latest technology that was developed for programs such as the 787 Dreamliner, and most of all on the skills and dedication of its employees around the globe, Boeing is putting the finishing touches on a proposal to win the KC-X tanker competition with a NewGen Tanker that is best in its class.

COVER IMAGE: BOEING'S NEWGEN TANKER IS BASED ON THE MEDIUM-SIZED 767 JETLINER AND REPRESENTS THE BEST OF BOEING'S MILITARY AND COMMERCIAL DESIGNERS, ENGINEERS, MANAGERS AND EMPLOYEES—A "ONE BOEING" TEAM THAT GIVES THE COMPANY A COMPETITIVE ADVANTAGE. PHOTO ILLUSTRATION: BRANDON LUONG/BOEING; AIRPLANE PHOTO: BOEING; CLOUD PHOTO: SHUTTERSTOCK.COM

PHOTO: BOEING WICHITA EMPLOYEES CHRIS DAHL, LEFT, AND EUGENE KIRKBRIDE ARE SHOWN BELOW. BEHIND THEM IS THE REFUELING BOOM FOR BOEING'S INTERNATIONAL TANKER. THE BOOM WAS INSTALLED AT THE WICHITA SITE. IF BOEING WINS THE U.S. AIR FORCE TANKER COMPETITION, THE COMPANY'S NEWGEN TANKER WOULD BE BUILT IN EVERETT, WASH., AND MODIFIED IN WICHITA, KAN. BOB FERGUSON/BOEING



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

Inside cover:



This Defense, Space & Security ad underscores how Boeing is leveraging its advanced capabilities to provide a wide range of uniquely capable Unmanned Airborne Systems to meet current and emerging customer requirements. The ad will appear in key trade publications.

Pages 7 and 9:



This two-page ad was created to honor the recipients of Boeing's 2009 Supplier of the Year award and ran as consecutive pages in trade journal *Aviation Week*. The first page, a close-up of a feather, symbolic of flight, represents Boeing's close attention to detail in everything it produces. The second page displays the feather in its entirety, illustrating the importance every detail makes to achieving extraordinary results.

Pages 51-53:



This three-page Boeing Defense, Space & Security ad announces the NewGen Tanker, Boeing's offering in the U.S. Air Force's KC-X competition for a new multi-mission aerial refueling tanker. The ad communicates the Boeing tanker's key competitive advantages and has appeared in numerous military and congressional trade publications.

Back cover:



Global corporate citizenship refers to the work Boeing does—both as a company and through its employees—to improve the world. This ad illustrates Boeing's commitment to initiatives that nurture the visionaries and leaders of tomorrow.



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table of contents

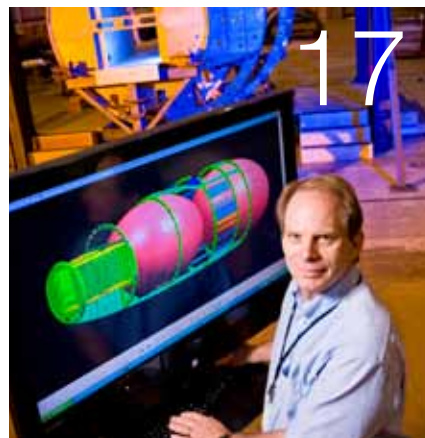


14

Sharper focus

Jim Albaugh, president and CEO of Commercial Airplanes, talks about the changing and challenging competitive landscape in the years ahead, the importance of keeping the focus on the customer, and why he wants employees to feel more comfortable talking about problems and solutions.

PHOTO: GAIL HANUSA/BOEING



17

'Eye' contact

Assembly is well under way at Boeing on an unmanned aircraft known as Phantom Eye that will be able to stay aloft for several days at altitudes up to 65,000 feet (20,000 meters) performing intelligence, surveillance and reconnaissance missions. The brainchild of Boeing's Phantom Works, the High Altitude Long Endurance demonstrator is scheduled to make its first flight in 2011.

PHOTO: RON BOOKOUT/BOEING



36

Helping hands

Starting this month, Boeing will open 40 service centers across the United States to give employees an additional way to get help with Human Resources topics. These service centers can provide employees with everything from career development assistance to answers about pay and incentives.

PHOTO: PAUL PINNER/BOEING



42 Gateway to opportunity

Germany has long been a leader in technology and innovation, and this European economic powerhouse is an important market for Boeing. The country is home to airline customers such as Lufthansa, Air Berlin and TUIfly. Many German companies develop and supply high-tech products and systems for Boeing airplanes and are partners in advanced research.

PHOTO: SHUTTERSTOCK.COM



38

Safekeeping

Boeing's technology and innovations are crucial to its business, and the job of protecting the "company's gold" falls to the Intellectual Property Management organization. Some of that gold, for example, is on the 787 Dreamliner, which has more than 1,000 patents granted or pending. With theft of intellectual property on the rise, Boeing must make sure its breakthrough technology does not fall into the wrong hands.

PHOTO: DARIEN CHIN/BOEING

INSIDE

06 Leadership Message

Boeing's health care benefits are one of its key competitive advantages in attracting and retaining talented employees. Although the company has added new programs and features to its overall health care program to help mitigate rising costs and improve quality, what's also needed is a partnership between Boeing and its employees, according to Rick Stephens, senior vice president of Human Resources and Administration.

08 New and Notable

10 Snapshot / Quotables

11 Why We're Here

12 Historical Perspective

50 Stock Charts

54 Milestones

58 In Focus

A healthy partnership

With the cost of health care coverage continuing to soar, a partnership is needed between Boeing and its employees

Rick Stephens
Senior vice president, Human Resources and Administration



Boeing offers an exceptional level of health care benefits that we can all be proud of. Our guiding principle has been—and will remain—providing access to quality health care for our employees and their dependents.

In addition, health care benefits will continue to be a key competitive advantage in attracting, and retaining, the talented employees who contribute to the success of this company. Future access to quality health care, however, will require a partnership between Boeing and our employees to maintain access to such care while remaining competitive and securing our future.

Why is this a pressing issue? Because competition from aggressive, lower-cost global competitors is increasing in our industry, and unchecked health care cost growth will diminish our ability to invest in new products and services, price them to win in the market, and, ultimately, continue creating great jobs for our employees.

The company's costs for health care coverage continued to go up steadily over the past decade. Boeing now spends more than \$2 billion per year in health care costs. Those costs have grown at an average of 7 to 8 percent annually for the last few years, outpacing the rate of inflation during the same period. More than 40 percent of those costs results from basic risk factors—such as stress, inactive lifestyles, smoking and not eating properly—that each of us can do something about every day.

Over the past few years, Boeing has been proactive in developing and adding new programs and features to our overall health care program to help mitigate health care costs and improve quality—while continuing to provide comprehensive, cost-effective benefits. Examples include a world-class program to encourage healthier lifestyles, including the Well Being initiative and advocacy programs to help with chronic diseases; verification of dependent eligibility for health care coverage; initiatives aimed at reducing drug costs; and key supplier management initiatives.

While these initiatives have had a positive impact and yielded significant savings, they have not been enough to keep up with continuous and increasing health care costs. Furthermore, the

recently passed health care law, while broadening access to care and eliminating exclusions for pre-existing conditions, will result in additional cost pressures on the company. For example, specific provisions of the new law create substantial tax penalties beginning in 2018 if a company's plans provide a level of benefits that exceeds a certain value set by the government. If Boeing and other large companies approach this so-called "Cadillac tax" threshold, they will have no choice but to adjust their benefits to remain under it—or accept the competitive consequences.

That's what makes it so important for all of us to start *now* and become more actively engaged in health care and quality of life. We can do so by becoming better—and better-informed—health care consumers. Take advantage of the wellness programs available to you through the Well Being Resource Center. During the fall enrollment period, take the time to do some thorough research to really understand the benefit options available to you and your dependents and choose the medical plan that's best for your situation. Boeing is partnering to help by providing additional tools to better inform you about options and make it easier to improve individual health care decisions.

We face this challenge together, a challenge that will require a partnership between Boeing and our employees to maintain our competitive edge and continue creating great jobs and career opportunities. As Boeing employees, each of us can do our part by becoming better health care consumers and taking advantage of the resources the company makes available to us to make smarter, informed choices. As a company, we will continue to look for ways to improve how we manage and reduce health care costs, while maintaining access to quality health care for our employees and their loved ones. ■

PHOTO: BOB FERGUSON/BOEING

THE MINOR DETAILS



Welcome *aboard*

The first P-8A Poseidon test aircraft (left) flies with a Lockheed P-3C Orion prior to landing in April at the Naval Air Station, Patuxent River, Md. The Poseidon, a military derivative of Boeing's 737 jetliner, is the U.S. Navy's newest maritime patrol and reconnaissance aircraft. The Poseidon flew to the Pax River site from Boeing Field in Seattle, where the formal P-8A flight-test program had started in October 2009. The first aircraft will complete the rest of its testing at Pax River and will be joined by two more test aircraft.

"This an important milestone for the program that moves us into the next phase of flight test," said Chuck Dabundo, Boeing vice president and P-8A program manager. "The entire team deserves thanks for its hard work to get us to this point."

The Poseidon is built at Boeing's Renton, Wash., plant. The Navy plans to purchase 117 P-8As to replace its fleet of P-3C aircraft. Initial operational capability is planned for 2013. U.S. NAVY PHOTO

ARE ANYTHING BUT MINOR.



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The Toolroom, Inc.

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Cytec Engineered Materials Inc.

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Commending the 2009 Suppliers of the Year

Their extraordinary attention to detail has given us the tools to take flight in ways never thought possible.





On the right frequency

When it comes to radio-frequency signals, all of Boeing needs to be on the same wavelength



A SPLENDID, BLENDED FLIGHT

The X-48B Blended Wing Body flight-research vehicle takes off earlier this year from Edwards Air Force Base, Calif., on a flight test. In March, the X-48B flight-research team of Boeing, NASA and the U.S. Air Force Research Laboratory successfully concluded the first phase of the aircraft's flight-test program, which started in 2007 and logged 80 flights. The aircraft is an 8.5 percent scale model of a heavy-lift, subsonic airplane with a 240-foot (73-meter) wingspan that possibly could be developed over the next 20 years for military applications such as aerial refueling and cargo hauling. *NASA*

Anything at Boeing that uses radio-frequency signals, and that covers about 80 percent of the products Boeing makes, must operate in compliance with U.S. and international regulations. That task falls to employees such as Joe Cramer, a lawyer and engineer in the Washington, D.C., office of Boeing's Frequency Management Services. In this *Frontiers* series that profiles employees talking about their jobs and the way their work fits into Boeing's goals, Cramer explains why the technical world of radio frequency is critical to the company.

Quotables

“You come here and you feel oxygen. You get this incredible bump-up in terms of what this means for the region.”

– Marco Cavazzoni, vice president and general manager of final assembly and delivery for Boeing Charleston, who was on hand in April for the placement of the first steel column at Charleston's future 787 final assembly and delivery facility, as reported in the *Charleston Post and Courier* on April 6.

“It is living up to and exceeding everything we expected of it.”

– Royal Australian Air Force Wing Commander Glen Braz, commanding officer of the first Australian Super Hornet squadron, talking about the RAAF's new F/A-18F Super Hornet, as reported in the *Townsville Bulletin* on March 27. The first five aircraft were recently delivered to Australia, which operates 71 F/A-18A/B Hornets. (See *Frontiers* story in this issue, pages 34–35.)

I'm a member of Frequency Management Services, part of the Shared Services Group, and my job is to help ensure the company's complex and extensive radio-frequency requirements are met. I do this by studying current and proposed U.S. and international laws and regulations and discussing radio-frequency spectrum issues with regulators around the world. What we do at Frequency Management Services allows Boeing to manufacture, test and operate its products and services throughout the world.

What is radio-frequency spectrum? It's the segment of the electromagnetic spectrum from 3 kilohertz to 300 gigahertz. Within this range are hundreds of frequency bands where common types of radio equipment operate without harmful interference. The bands support the operation of cell phones, radio and television broadcasting, and satellite communications. Each country controls the configuration of the bands, and coming up with the right spectrum solutions for Boeing's products can be complex.

Spectrum is used in about 80 percent of Boeing's products. It is critical to everything from commercial jetliners and satellites to advanced communications and weapons systems. On the factory floor, spectrum is used for crane controls, emergency communications and wireless access to the Internet. All GPS location applications, 787 wireless applications, aircraft communications, and unmanned vehicle command and control communications use spectrum.

Frequency Management Services makes sure that Boeing

is able to operate wireless systems so they do not interfere with one another or violate government rules.

A lot of my work is providing technical arguments to support our requirements while establishing solid relationships with our customers and regulators. It gave me both great personal and professional satisfaction when we changed the international rules to provide additional spectrum for flight testing after a four-year international campaign. This spectrum is under constant pressure by commercial wireless companies that want to use it for other purposes.

My current focus is on negotiating a treaty provision to obtain spectrum worldwide for the wireless transmission of critical aircraft sensor data on future generations of aircraft and protecting our ability to transmit critical data during flight-test certifications. ■

For more information about Frequency Management Services, see the July 2009 issue of *Frontiers*: www.boeing.com/news/frontiers/archive/2009/july/mainfeature.pdf

PHOTO: Joe Cramer on the job in Washington, D.C. FRED TROILO/BOEING

Delta force



Boeing's Delta rockets have been a mainstay of the space launch business for 50 years

by Robert Villanueva

On May 13, 1960, the first Delta rocket lifted off from Cape Canaveral's launch pad 17A carrying the Echo 1 satellite. Although that mission failed, the program quickly followed up in August with the successful launch of Echo 1A. It marked the beginning of what would become one of the most successful space launch systems ever developed.

Fifty years and some 348 launches later, Delta rockets are still flying, carrying into space everything from earth-orbiting

satellites and scientific probes to planetary rover vehicles.

Delta's origins date back to Boeing predecessor company Douglas' design for the Thor intermediate-range ballistic missile, developed in the mid-1950s for the U.S. Air Force. Thor, a single-stage, liquid-fueled rocket, made its first successful launch on Sept. 20, 1957, and provided nuclear deterrence before intercontinental ballistic missiles. Thor later was modified to become the Delta launch vehicle.

Delta would launch satellites that revolutionized weather forecasting and the first Telstar and Intelsat satellites, which enabled the TV phrase, "live via satellite."

Design changes allowed Delta to carry increasingly larger and heavier payloads to space. These included larger first-stage tanks, the addition of strap-on solid rocket boosters, increased propellant capacity, an improved main engine, adoption of advanced electronics and guidance systems, and development of upper

stage and satellite payload systems.

Until the early 1980s, Delta was NASA's primary launch vehicle for communications, weather, science and planetary exploration satellites. But in 1981, after 24 years, Delta production stopped because NASA planned to use the space shuttles to deploy satellites. That policy changed in 1986, following the *Challenger* space shuttle tragedy. President Ronald Reagan announced the shuttle program would no longer launch commercial payloads, bringing the return of Delta, and the new Delta II. It was followed by Delta III.

After three launches, the Delta III was retired to make way for Delta IV. Developed in partnership with the U.S. Air Force Evolved Expendable Launch Vehicle program, the Delta IV became operational in 2002 as the most advanced family of rockets developed by Boeing. The family includes Delta IV Medium, three variants of Delta IV Medium+, and Delta IV Heavy versions.

Each Delta IV configuration is based on a Common Booster Core first stage that is as large as the fuselage of a Boeing 727 aircraft—16 feet 7 inches (5 meters) in diameter and 150 feet (46 meters) long. Each Common Booster Core has its own Pratt & Whitney Rocketdyne RS-68 main engine, which produces 650,000 pounds (2,891 kilonewtons) of thrust. The Delta IV second stage is derived from the Delta III second stage using the Pratt & Whitney RL-10B-2 engine, with two sizes of expanded fuel and oxidizer tanks, depending on configuration.

The Delta IV is manufactured at a 1.5-million-square-foot (140,000-square-meter) production facility in Decatur, Ala. Processing and launch facilities are at Cape Canaveral, Fla., and Vandenberg Air Force Base, Calif.

The massive boosters and other hardware are delivered to the launch sites on a 312-foot (95-meter), custom-built vessel named the *Delta Mariner*. The trip to Cape Canaveral is 1,400 miles (2,253 kilometers) and takes about 10 days. The trip to Vandenberg is 4,900 miles (7,890 kilometers) and takes about 25 days.

In 2006, Delta became part of the United Launch Alliance joint venture that combines Boeing's Delta and Lockheed Martin's Atlas launch services. The venture provides launch services to U.S. government customers.

Today, Delta continues to support critical national defense, scientific and commercial missions—and remains one of the world's premier launch systems. ■

robert.s.villanueva@boeing.com

PHOTOS: (Right) The first Delta launch on May 13, 1960. **BOEING ARCHIVES**

(Insets, from left) A Delta II rocket lifts off from Cape Canaveral, Fla., carrying a U.S. Air Force GPS satellite. **CARLTON BAILIE**

A Delta IV Medium rocket lifts off from Cape Canaveral in March 2003 on its first mission for the U.S. Air Force. **CARLTON BAILIE**

The Delta IV Heavy makes its first flight in December 2004 from Cape Canaveral. **CARLTON BAILIE**



Delivering excellence

Commercial Airplanes is well-positioned in the marketplace, but ahead are important decisions—and opportunities

Jim Albaugh, president and CEO of Boeing Commercial Airplanes, spoke with *Frontiers* about staying focused in an increasingly competitive business environment and encouraging employees to talk more openly about problems and solutions.

PHOTO: MARIAN LOCKHART/BOEING



“I want to push decision-making into the organization, to the people who really understand what’s going on with the processes, with manufacturing and with the design.”



You’ve been the leader of Commercial Airplanes for eight months. What are your observations?

First, I appreciate how complex and difficult the 787 and 747-8 development programs are. Second, our engineers and mechanics bring great skill and integrity to the workplace every day. Third, I’m amazed at how enduring the relationships are with our customers. And fourth, I’m impressed with how well respected Boeing Commercial Airplanes is around the world.

Where are you focusing your efforts?

As a team, we’ve got four responsibilities. We need to help our customers by creating value for them and delivering our great products. We need to plan for the future by looking out 15, 20, 30 years and thinking about where we’re going to be with our product offerings. We need to be developing our team and we need to meet the plan that we have in place. Those are the immediate things we’re working on this year.

What’s your view on the current business environment?

The past several years have been difficult for everybody, no matter what industry you are in. The good news for Boeing is that we had such a huge backlog of airplanes made up of diverse customers that our production rates really haven’t changed very much over the past two or three years.

What we’re seeing now is the start of a new cycle. While a couple of months don’t necessarily make a trend, we’re seeing customers coming back into the marketplace. This year you’ll see passenger ridership at 2008 levels. I think next year you’ll see air freight at 2008 levels. Next year you’ll also see airlines, especially the U.S.-based airlines, start making profits. I think you’ll see significant orders come in 2012.

What growth opportunities do you see for Commercial Airplanes?

Over the next 20 years we think there will be 29,000 airplanes sold. We want to make sure we have offerings that are very attractive to our customers across all our product

lines, from the single-aisle airplanes all the way up to the large freighters.

We’re very well positioned. We have two new airplanes that we’re bringing into service, the 787 and the 747-8. Over this next decade we’re going to be doing something with our single-aisle airplane and I think we’ll be doing something with the 777-class airplane. This presents us with some real opportunities.

Another area we can grow is the services area. Lou Mancini [senior vice president of Commercial Aviation Services] and his team are working toward doubling our services business over the next five or six years.

While all that sounds very positive, at the same time the days of a duopoly with Airbus are over. Projecting out 10, 15 years, we’re going to be competing against not one company, but we’re going to be competing against five or six countries. And the reason I say countries is that we’re seeing countries and federations of countries spending a lot of money subsidizing their airplane manufacturers to compete with us. We’re going to have to be that much better to compete.

How does Commercial Airplanes fit into “One Boeing”?

The biggest leverage that Boeing Commercial Airplanes has in the marketplace is being part of Boeing. The biggest point of leverage Boeing Defense Space & Security has is being part of Boeing. A lot is made about people being defense people or commercial people. We’re Boeing people. There’s no other company in the world that has the breadth that we do. There’s no other company in aerospace as large as we are. There’s no other company that has the ability to leverage its resources like we do. That’s what One Boeing is all about.

You have spoken about the need for culture change. What does that mean for employees?

First of all, the culture in [Commercial Airplanes] is very good,

PHOTO: Mechanics Mary Leigh (left) and Betty Rautio demonstrate the process of preparing parts for loading into an autoclave at the Frederickson, Wash., plant. JIM ANDERSON/BOEING

“We want to make sure we have offerings that are very attractive to our customers across all our product lines.”



Eye in the Sky

An unmanned Boeing aircraft called Phantom Eye is designed to stay aloft for up to four days—keeping an eye out for what's below

by Chris Haddox



from the focus on the customer to the integrity of our people.

If there's one area I would like to work on, it's making people feel more comfortable talking about issues, talking about problems or bringing solutions to our attention. For a long time, the decision-making has been pushed to the top. What I want to do is push decision-making into the organization, to the people who really understand what's going on with the processes, with manufacturing and with the design.

I also want people to come to meetings knowing that if they have an issue, a problem or a solution, they're going to be heard, and they're going to be respected for what they bring to the discussion. By getting everyone doing that, we'll make much better decisions.

What are your expectations for Commercial Airplanes employees and managers?

I want everybody focused on making themselves and their teams better each and every day. I want our employees and managers holding themselves and their teams accountable

for their performance. Everybody should be focused on their customer, whether that is an internal customer or an external customer.

In the future, what do you want Commercial Airplanes to look like?

I want [Boeing Commercial Airplanes] to be viewed as a business that's always bringing greater value to the marketplace than its competitors, that's very customer-focused and customer-responsive.

Said another way, when people think about commercial airplanes, I want them to think about one company—and that's Boeing. We've been thought of in that light for a long time and I want to make sure that, decades into the future, we continue to be identified with the best in commercial airplanes and commercial air travel. ■

PHOTO: All 777 models are built on a moving production line in the Everett, Wash., factory. GAIL HANUSA/BOEING

Persistence, persistence, persistence. That's the answer that Phantom Works President Darryl Davis gives when asked why Boeing is building Phantom Eye.

A hydrogen-powered, High Altitude Long Endurance, or HALE, demonstrator, Phantom Eye is being designed and built at Boeing facilities in St. Louis and Seattle as well as Irvine and Huntington Beach in California. Its mission is to stay aloft for up to four days at altitudes as high as 65,000 feet (20,000 meters) while keeping a persistent eye on what's below for intelligence, surveillance and reconnaissance (ISR) missions.

"There is a great demand for persistence and at the same time have enough payload capability for specific missions," Davis said. "Several teams in the Pentagon and in the intelligence community are very interested in what we're doing here."

What Phantom Works is doing isn't new to Boeing, but the way it's doing it is. Boeing has taken an unmanned aircraft to 65,000 feet before. In 1988, the Condor reached 67,028 feet (20,430 meters) and stayed at that altitude for two and a half days, a record. The big difference between Condor and

Phantom Eye is the propulsion system. Condor used two 175-horsepower liquid-cooled, fuel-injected, 6-cylinder piston gas engines. Phantom Eye will use two Ford 150-horsepower 2.3-liter (140-cubic-inch) 4-cylinder engines, fueled by hydrogen. And Phantom Eye is much lighter. Takeoff weight is about 9,800 pounds (4,450 kilograms), about half that of Condor.

No one knows those engines better than Bill Bigbee-Hansen. He's an Associate Technical Fellow with Boeing Research & Technology in Seattle. Bigbee-Hansen was part of Condor's propulsion team and now leads Phantom Eye's propulsion team. Lessons learned from Condor are definitely being applied to Phantom Eye, he said. "Early decisions were made to reduce downstream costs and testing," he said. "Experience gained on Condor was leveraged as much as

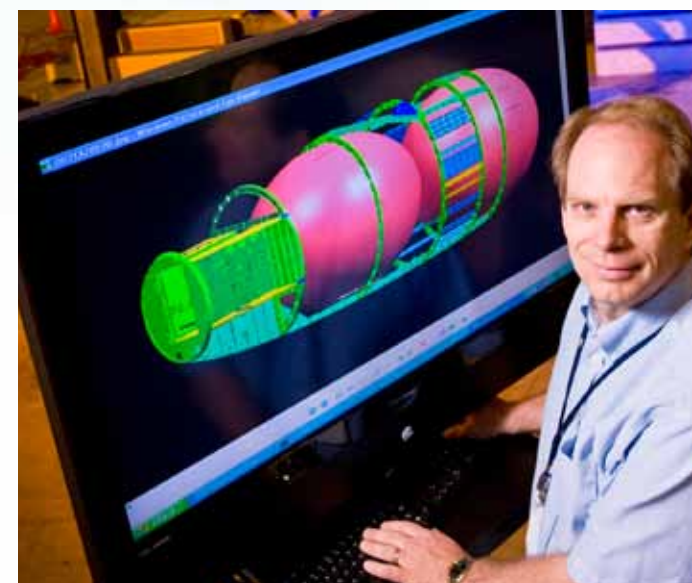
PHOTO ILLUSTRATION: The Phantom Eye demonstrator is scheduled to make its first flight in early 2011. It will fly at altitudes up to 65,000 feet (19,800 meters) for up to four days.

BRANDON LUONG/BOEING; PHANTOM EYE GRAPHIC: MICK MONAHAN/BOEING; SKY PHOTO: SHUTTERSTOCK.COM

“We’re building a plane to fly maintenance-free for 100 hours, so every connection, every sensor and every seal needs to work and hold.”

– Bill Bigbee-Hansen, Associate Technical Fellow, Boeing Research & Technology

It’s not rocket science—
or is it?



possible on Phantom Eye.”

Phantom Eye is a large aircraft with a 150-foot (45-meter) wingspan.

“At 65,000 feet a mechanic won’t be able to come to the rescue, so first-time quality has to be built into everything we do,” Bigbee-Hansen said. “We’re building a plane to fly maintenance-free for 100 hours, so every connection, every sensor and every seal needs to work and hold.”

While the propulsion system is key to Phantom Eye’s success, the airframe is deceptively simple. Several composite materials technologies for the prototype are being used, allowing for low-cost manufacturing without compromising performance.

“We have tested the engine in an altitude chamber at 65,000 feet for a total of more than 600 hours. Now we need

to bring the engine and airframe together,” Davis said.

That job belongs to Teri Finchamp. As Phantom Works’ production operations manager, she’s responsible for the manufacturing and integration of Phantom Eye and Phantom Ray, Boeing’s fighter-sized unmanned aircraft set to make its first flight in late 2010.

“It’s going great. We’re right where we need to be on both programs,” she said.

First flight is scheduled for 2011.

“The wait can be difficult,” said Phantom Eye program manager Drew Mallow. “Just imagine being able to provide global reach for an ISR mission that’s measured by days instead of hours, all from one aircraft. Now that’s persistence.” ■

chris.d.haddox@boeing.com

PHOTOS: (Above) Liquid nitrogen is used to verify the integrity of welds in Phantom Eye’s liquid-hydrogen tanks when rapidly chilled to cryogenic temperatures. BALL AEROSPACE

(Right) Bill Norby, Hydrogen Systems Integrated Product Team manager for Phantom Eye, works with a computer model showing the liquid-hydrogen tanks in Phantom Eye’s fuselage. RON BOOKOUT/BOEING

(Far right) The Phantom Eye High Altitude Long Endurance aircraft shares many similarities with Boeing’s Condor (shown here), which reached altitudes of more than 67,000 feet (20,400 meters) in the late 1980s. Phantom Eye is scheduled to make its first flight in early 2011. BOEING ARCHIVES

Bill Norby has a difficult time talking to his friends and neighbors about his work on Boeing’s Phantom Eye demonstrator. Not because it’s classified, but because it’s complicated.

“I get a lot of blank looks,” said Norby, manager of the Hydrogen Systems Integrated Product Team.

He tries to keep it simple:

“We store hydrogen as a liquid but the engine burns it as a gas. To do so, the hydrogen has to be boiled off and we raise the temperature of the gas by taking it through a heat exchanger and then feed it into the engine at near room temperature. What makes it simple is that we don’t require a compressor or a fuel pump. We use the tanks, a set of cryogenic valves, a couple of heat exchangers, and relief

valves. Future systems may be more complicated, but this one is pretty simple and well-suited for an aircraft flying at 65,000 feet for four days ...”

But what’s simple to Norby sounds like rocket science to others. In a way, it is. The design features elements used in rockets and space launch vehicles; Phantom Eye is Boeing’s first fixed-wing vehicle to use a liquid-hydrogen fuel system.

“It’s a different kind of beast, to be sure,” Norby said. “We like to say it’s ‘Condor on hydrogen.’”

Condor is the High Altitude Long Endurance, or HALE, aircraft Boeing flew in the late 1980s. It reached altitudes of 67,000 feet (20,400 meters), but its engines burned hydrocarbon-based fuel, not hydrogen. Phantom Eye’s design is similar to Condor’s

except for the girth of the fuselage, which is needed to house two 8-foot- (2.4-meter-) diameter hydrogen tanks.

“Most aircraft carry fuel in the wings; not Phantom Eye,” Norby explained. “All the hydrogen is stored in the tanks and that benefits the rest of the plane. By taking the weight out of the wings, it simplified the wing design and created more payload room.”

Work on the hydrogen fuel system began in 2004, and Norby said recent testing on the tanks has gone well. They should be delivered to St. Louis and installed in the fuselage this summer, bringing Phantom Eye one step closer to first flight in 2011.

– Chris Haddox

Best in class

To deliver a winning tanker, Boeing draws on a legacy of aerial refueling innovation and its experience across commercial and defense programs—and the skill and commitment of its employees

by Dan Beck

It's just another day for a fleet of tankers older than most of the men and women flying them.

Around the globe, U.S. Air Force flight crews are flying refueling sorties in aging Boeing-built KC-135 tankers. Ground crews at remote airfields work around the clock to keep them flying on essential missions, bringing fuel to the fight and supporting freedom in every part of the world. Altogether this day, as on every day, they will pump nearly 3 million pounds (440,000 gallons, or 1.7 million liters) of fuel to thirsty fighters, bombers, airlifters and other aircraft. That's more than 1 billion pounds (146 million gallons, or 550 million liters) of fuel a year.

Meanwhile, across Boeing, a team of employees is focused on replacing those

tankers that have now served for more than four decades. This team of engineers, technicians, analysts, accountants and aerial refueling experts are putting the finishing touches on Boeing's proposal to offer its NewGen Tanker to help the U.S. Air Force meet its aerial tanker needs and address the evolving threats of the next four decades.

"We have responded to the Air Force's new focus and needs by bringing together the best possible proposal team from both the defense and commercial airplane businesses of Boeing," said Dennis Muilenburg, president and CEO of Boeing Defense, Space & Security. "The NewGen Tanker team is drawing on thousands of years of employee experience in aircraft design, manufacturing, supply-chain management, cost accounting and program support,

"We're partnering across the company as one team to produce the best tanker offering and help Boeing deliver a winning proposal."

— Dennis V. Egan, 767-2CX deputy program manager, Boeing Commercial Airplanes

PHOTO: GAIL HANUSA/BOEING



"By offering a tanker that meets all technical requirements at the lowest price and risk, we'll delight our customer."

— Rick Lemaster, KC-X Proposal program manager, Boeing Defense, Space & Security

PHOTO: RICHARD RAU/BOEING



as well as an invaluable resource of first-hand, front-line service with the Air Force."

The proposal team knows it must hold down costs, both for the development and production of these aircraft and for supporting them over the next half-century.

"Our Boeing team and our suppliers have been finding innovative ways to bring down cost to ensure the best price for the taxpayer," said Jean Chamberlin, vice president and general manager of Boeing's U.S. Air Force Tanker Program. "Our offering builds on our past success across all of Boeing to bring the best value and lowest possible price for our derivative aircraft programs, fighters, airlifters and rotorcraft. We know that we have to earn the honor of building these tankers."

The deadline to submit bids was

extended by the Air Force by 60 days, to July 9, to allow EADS, the parent of Airbus, to bid on the tanker contract. EADS has said it will offer a tanker based on the Airbus A330 commercial jetliner. Air Force officials have said they plan to award a contract for an initial 179 tankers later this year.

With the NewGen Tanker, Boeing believes it has the right solution for the customer.

An aerial refueling tanker is essential to today's military. Not only are tankers used to support U.S. missions around the globe by refueling other military aircraft, but they also play a significant role in allowing allied coalitions to meet threats. At the same time, they must perform multiple missions beyond refueling—including transporting cargo and passengers to and from remote

PHOTO ILLUSTRATION: An artist's rendering of the Boeing NewGen Tanker. BOEING

airfields, as well as carrying patients.

The fuel that enables air warriors to complete their missions has to be where they need it, when they need it. That means tankers often are close to the fight—and must be survivable and combat-ready.

“After six decades of building tankers for the warfighter, Boeing knows how to get them close to the fight, protect them in combat and get them safely home,” Chamberlin said. “The Boeing NewGen Tanker incorporates lessons learned from real-world scenarios in action around the world. It is equipped with multiple layers of protection for the aircraft and their crews, including countermeasures, situational awareness, covert lighting, threat avoidance, component hardening, redundancy and location, fuel-tank protection, and aircrew protection.”

Rick Lemaster leads Boeing’s proposal team. Boeing understands and accepts the Air Force’s requirements for its next-generation tanker, he said. “We listened and drew on the experience of generations of tanker pilots and operators. We put to work the best of Boeing’s military and commercial designers, engineers and managers on crafting a proposal that meets the service’s requirements, the end-users’ desires and the acquisition community’s fiscal safeguards.”

The result: the Boeing NewGen Tanker. It is a multi-role tanker distinguished by 21st-century technology, such as an advanced flight deck that was developed for the new 787 Dreamliner. Not only will the NewGen Tanker meet all 372 mandatory Air Force requirements, according to Lemaster, but it

will do so at the lowest risk to the customer and at the best value to the American people.

“Taxpayers are entitled to the best value—and to saving every dime in both the short and long term—on every government contract,” Mulenburg pointed out. “The tanker program should be no exception. The Boeing NewGen tanker meets or exceeds all of the requirements and has significant operational advantages at lower costs than a larger aircraft.”

As a medium-size tanker, based on the 767 commercial jet, the NewGen tanker will require fewer costly investments in existing bases to accommodate it than a larger plane would. It can be easily integrated into those bases, providing the Air Force more flexibility, agility and responsiveness for missions. And because of its size, the NewGen tanker will be more fuel-efficient than a heavier aircraft.

Boeing has been building military derivatives of commercial aircraft for more than a half-century—from tankers to *Air Force One*. The NewGen Tanker represents the culmination of that experience.

“The proven Boeing military-derivative capability of this team ensures low risk because we have shown over four decades that we know how to design and modify commercial aircraft for military applications,” Lemaster said. “And in the warfighting business, this kind of dependability is non-negotiable.”

The NewGen Tanker will be built using proven commercial aircraft manufacturing methods on an assembly line in Everett, Wash., one that uses Lean+ techniques and is compliant with U.S. export controls.

A similar in-line method is used in Renton, Wash., to manufacture the U.S. Navy’s P-8A Poseidon, a maritime patrol aircraft that is a military derivative of Boeing’s 737-800 commercial jet.

“The in-line production system allows us to provide a truly integrated approach for the customer,” said Elizabeth Lund, vice president and general manager, 767 program. “We’re really building on the lessons learned in the past on how to bring 10X and Lean+ practices to this effort. We believe this provides us with a real advantage in the competition.”

From Everett, the NewGen Tanker will be flown to Wichita, Kan., to be finished by Boeing teams there.

Senior Air Force leaders have been clear in their public statements that regardless of who wins the KC-X contract, they want a new tanker to meet multiple missions—and they need it soon.

“We could rest on Boeing’s past reputation for building the current U.S. tanker fleet and inventing boom technology, but we know that is not enough,” said Chamberlin. “While we have demonstrated Boeing’s ability to design, build, produce and maintain a large tanker fleet that will last for many decades, the future will confirm—if we are granted the honor and privilege of building these tankers—that Boeing can execute on our promises and provide a combat-ready, multi-role tanker on Day One.”

Boeing Commercial Airplanes President and CEO Jim Albaugh, who has experience leading tanker teams from both the defense and commercial sides of the company, believes there is one other thing that distin-

guishes this Boeing NewGen Tanker team: “Our employees and suppliers are key to delivering the fuel to the fight for servicemen and servicewomen,” he said. “It is that investment, from the heart of everyone who will touch these planes, that will make it the greatest tanker in history.” ■

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PHOTO: At the Wichita, Kan., site, Boeing employees Jack Reid (left) and Mike Greer work on a 767 international tanker for Italy.

BOB FERGUSON/BOEING



“I work with a great group of dedicated people who are committed to winning this program—and who are able to adjust to change while remaining focused on our customer’s needs.”

— Joyce Martin, senior manager, Finance, St. Louis

PHOTO: RICHARD RAU/BOEING



“We have to be a cohesive team to succeed, and we need to focus on understanding the military customer’s needs. That’s key.”

— Constantine (Dino) MacRis, 767 compliance coordinator, Everett, Wash.

PHOTO: GAIL HANUSA/BOEING

Full service

The Boeing-built KC-135 tanker is now in its fifth decade of service

For more than 50 years, no aircraft has been a more enduring symbol of Boeing's aerial refueling legacy than the KC-135 Stratotanker, and today a new generation of Boeing workers continues to support these tankers, which are operated by the United States and several international air forces.

The team at Boeing's Global Services & Support facility in San Antonio provides

programmed depot maintenance every five years to each U.S. Air Force KC-135, completely overhauling the aircraft.

"We want aircrews to know that when a plane leaves San Antonio it is ready to perform its mission here and abroad," said Mike Wright, the KC-135 program manager at Boeing San Antonio. "The men and women who perform these missions need to be focused on their mission and not the reliability of the aircraft; that's our job, one we take very seriously."

The San Antonio team has used Lean+ and employee involvement techniques to reduce cycle time and get KC-135s back to warfighters in record time. They also perform cockpit upgrades. Boeing engineers in Wichita, Kan., and

Oklahoma City provide design updates. The KC-135 depot maintenance work will continue for another 10 years as part of a \$1.1 billion contract awarded to Boeing. By then, the KC-135 will have been in service for about six decades.

Boeing pilots flew the first KC-135 on Aug. 31, 1956, and the plane, designed and built by Boeing, entered service in 1957 at the height of the Cold War. Since then, the KC-135 has been the mainstay tanker during wars, conflicts and crises that have shaped history—and which continue to do so.

"There are always challenges supporting a 50-year-old airplane," Wright said. "But our team continues to support this aircraft flawlessly because they realize what is at stake."

—Jarrod S. Bartlett

PHOTOS: Steven Xaysiri, with the KC-135 Programmed Depot Maintenance program in San Antonio, preps a body skin of a KC-135 for installation. **LANCE CHEUNG/BOEING**

(Insets, from left) Refueling operator at work in a KB-29 during the 1950s. Boeing developed the world's first production aerial tanker, the KC-97 Stratofreighter. A KC-135A was the first jet-powered tanker for the U.S. Air Force. The B-29 was the first to employ the "flying boom" refueling system.

BOEING ARCHIVES



A booming legacy

Boeing has long been a pioneer of in-flight refueling
by John Morrocco



Legend has it that the first aerial refueling occurred nearly 90 years ago, when a barnstorming pilot with a can of gas strapped to his back walked the wing of his biplane, stepped onto the wing of another plane flying in close formation and poured the contents of the can into the fuel tank.

Much has changed in the art of aerial refueling since those daredevil days—and Boeing has led the way.

Commercial companies and military strategists envisioned the potential for aerial refueling and sought more practical methods of delivering fuel to another aircraft in flight to increase its range. A number of experiments were conducted during the 1920s. One, in 1929, involved Boeing Model 40s and Douglas C-1 biplanes utilizing a 150-gallon (570-liter) fuel tank and 50-foot (15-meter) hose. Subsequent experiments conducted during the 1930s perfected aerial refueling hose systems. (For more about this 1929 flight, see the March 2010 issue of *Frontiers*: www.boeing.com/news/frontiers/archive/2010/march/i_history.pdf)

The rapid development of long-range aircraft with larger internal fuel capacities precluded the need for aerial refueling. The years immediately preceding and during World War II saw a succession of such

military aircraft, including Boeing-built B-17 Flying Fortresses and B-29 Superfortresses, which subsequently became the backbone of the new postwar Strategic Air Command.

The advent of the Cold War and the need for strategic long-range capabilities beyond the range of existing aircraft led Boeing to convert more than 200 Superfortresses into aerial refueling tankers. Dubbed the KB-29, these were the first full-time aerial refueling tankers to be operated by the U.S. Air Force. In 1949, a B-50 Superfortress named the *Lucky Lady II* took off from Carswell Air Force Base in Fort Worth, Texas, and became the first aircraft to fly nonstop around the world. It received three aerial refuelings from KB-29 tankers during the 94-hour flight.

In the 1950s, with the Air Force seeking a faster and more efficient method of transferring fuel, Boeing engineers developed the "flying boom," a rigid telescoping system that could deliver fuel at a much higher rate than the smaller-diameter flexible hose system. The boom was equipped with two small wings at the end to allow it to be more easily guided to a connector on the receiving aircraft.

Boeing began converting existing bomber and transport aircraft into refueling tankers to meet a growing demand. The Boeing Stratofreighter, similar to the

passenger-carrying Stratocruiser, was adapted as an aerial refueler, with some 888 C-97 Stratofreighters built between 1947 and 1958. Most were outfitted with the flying boom and were designated the KC-97.

With the advent of the jet age, Boeing developed the KC-135, which took to the air for the first time in 1956, gradually replacing the propeller-powered KC-97. These "flying gas stations" could transfer fuel at a rate of 1,000 gallons (3,785 liters) per minute through their 47-foot-long (14-meter-long) booms. Based on the Dash-80 prototype and developed in parallel with the 707 commercial aircraft, more than 800 KC-135s were built during the next decade and several hundred are still in service today.

As those KC-135 tankers now are older than most of the men and women who fly them, the Air Force is looking for a replacement. Boeing is offering its NewGen Tanker, which will incorporate a number of innovations, including a cockpit that incorporates the advanced flight-deck displays of the new 787 Dreamliner.

Over the decades, Boeing innovations in tankers and refueling technologies have transformed the way aircraft operate—in ways that could not have been imagined by those barnstorming daredevils nearly a hundred years ago. ■

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“Incorporating lessons learned from other programs allows our team to look at the entire tanker manufacturing build process from an integrated perspective and make sure our efficiencies weave together seamlessly.”

– Jerry Lazar, U.S. Air Force Tanker Manufacturing Operations, Wichita, Kan.

PHOTO: BOB FERGUSON/BOEING



“In our weekly team meetings we focus on making processes work faster, better and more efficiently. It’s partly about Lean+, but it’s also about bringing people together. That’s a great asset for us on the 767 program.”

– Warren Pullig, Body Structures lead mechanic, Everett, Wash.

PHOTO: GAIL HANUSA/BOEING



Supply in demand

A winning tanker bid by Boeing requires working together with a strong supplier team

by Doug Holmes

Boeing has some supply-side muscle on its side in the KC-X tanker competition.

In this case, it’s the 800 or so suppliers that Boeing is counting on to help it deliver a winning proposal to the U.S. Air Force.

“Our proven, nationwide network of commercial and defense industry suppliers is ready to help us provide the Air Force with a new-generation tanker at the lowest risk for the Air Force and the lowest cost for the taxpayer,” Dennis Muilenburg, president and CEO of Boeing Defense, Space & Security, said during a meeting with suppliers earlier this year in Washington, D.C. “Our partnership proves every day that we are greater than the sum of our parts.”

Recognizing the value suppliers bring

to its offer, Boeing is making sure they are actively engaged.

One of those suppliers is United Tool & Die Co. in West Hartford, Conn., which manufactures metal tubing for several Boeing commercial and defense programs. “Good communication will be absolutely critical to success,” said Gary Guyette, the company’s production manager. “I have a weekly teleconference call with Boeing, no matter how busy we are, to discuss our progress and requirements. The supply chain is integral to making sure that Boeing gets the parts and services it needs on a timely basis.”

Another supplier, Woodward Governor, based in Fort Collins, Colo., provides Boeing with aerospace motion controls for commercial aircraft as well as

international tanker, rotorcraft and weapon programs. “One of the main factors in having a well-functioning supply chain is having a collaborative relationship,” said Craig Scott, vice president of Aircraft Systems for Woodward Governor. “If it becomes one-sided and we don’t have the ability to work together, we cannot come up with the most cost-effective and best-performing solutions.”

Putting together a winning bid for the KC-X tanker competition will require the “absolute best” from not only Boeing but also its suppliers, according to Mark DeVoss, director of Supplier Management for Boeing Tanker Programs.

“To get the best results, we need to be as inclusive as possible,” DeVoss said. “We’re able to do that successfully

through events like our annual supplier conference in Washington, D.C., employee events at supplier facilities, and frequent communication and on-site visits.”

While a Boeing win will support thousands of jobs and help many local economies, the contract means a lot to Boeing’s supply base, too.

“This is a great opportunity to support the Air Force and the other services that will rely on tanker aircraft, and be part of something bigger than you,” said Bill Begert, vice president of Business Development and Aftermarket Services for Pratt & Whitney Military Engines. The company would supply the engines for Boeing’s NewGen Tanker.

“Pratt & Whitney engines have powered military aircraft reliably and safely for more

than 80 years,” Begert added, “so we look forward to teaming with Boeing to offer the Air Force an affordable, fuel-efficient and combat-ready aircraft that will greatly improve the United States’ aerial refueling capabilities.” ■

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PHOTO: Mechanic Michael Pitchford works on the deck of a 767 at the Everett, Wash., factory. BOB FERGUSON/BOEING

'We're all in this to win'

For Jean Chamberlin, leader of the company's U.S. Air Force Tanker Program, the "One Boeing" approach on NewGen Tanker gives Boeing a critical competitive advantage.



PHOTO: GAIL HANUSA/BOEING

How is the NewGen Tanker different from what we offered in 2007?

The most significant difference is that we have 50 additional requirements that are now mandatory, over and above our previous offer in 2007. We also have listened to our customer's feedback from that offer and have made a number of improvements. The NewGen Tanker has an enhanced cockpit with large displays, and a more advanced aerial refueling system that does not require helmet-mounted displays but rather a direct 3-D view. We've taken the technology from a KC-135, where the

boom operator lies down in the back of the airplane and looks through a window to refuel the receiver, to the International Tanker, where you're relying on a helmet-mounted display, to now—the 3-D flat screen.

What do you want the team focused on?

The team is focused right now on making sure we understand our statement of work based on customer requirements; that we have properly estimated the resources required to execute that statement of work; and that we have

developed an integrated schedule that has the proper flow time, handoff and margin that will allow us to successfully meet major milestones for flight and initial operational capability in the RFP [Request for Proposal].

How is the "One Boeing" approach being utilized on this program?

There are three key elements of our "One Boeing" approach on the NewGen Tanker. The first is the effort being led by Elizabeth Lund, vice president and general manager, 767 program, to keep the 767 as affordable as possible by putting more Lean+ efficiencies in place.

Second is our effort to streamline two separate certification steps as much as possible—one for baseline commercial

aircraft and one for aircraft with military equipment. We're utilizing a "One Boeing" Test and Evaluation Organization to gather test data to satisfy FAA [Federal Aviation Administration] requirements for both certifications concurrently where we can. This will add efficiency to our test program, reduce test and certification cost, and help us deliver the FAA-certified tanker aircraft faster to the U.S. Air Force.

The third aspect of the "One Boeing" approach involves a single tanker team that I'm fortunate enough to lead. We're already operating as a fully integrated team, with people across the company supporting the proposal effort. I've had the opportunity to walk the production line in the Everett, Wash., factory to see the men and women of the 767 program working hard to install Lean+ and 10X processes into their systems. I've visited the office employees there as well as the employees in Wichita, St. Louis and Southern California who are spending countless hours to refine the proposal. On these visits one thing is clear: There is a shared commitment across The Boeing Company that we're all in this to win it and to work together to make that happen.

How has your experience managing other programs prepared you for this job?

Serving as the program manager for C-17 for two and a half years was my introduction into the Air Mobility Command, which is responsible for providing airlift and tanker capability around the clock, all over the world. That assignment certainly prepared me to understand our customer,

their hierarchy, where the requirements are set and what their expectations are. My experience leading other development programs such as Comanche, B-2 and B-1—supporting development efforts through major design milestones like Preliminary Design Reviews or Critical Design Reviews and getting into first flight and production—was also valuable in terms of learning how you control change, decrease customer risk and cost, and build a relationship with the customer.

What leadership attributes are most important to successfully manage this team?

The most important leadership attribute in starting out a new team would be "charting the course"—making sure it starts and ends with the customer. Staying focused on what the customer has told us in terms of their needs and making sure we have an offer that meets their requirements. Another aspect of this is managing our supplier base. It is important to bring our suppliers in line and have their congressional constituents understand the importance of jobs in their district. A third aspect is being able to help employees see what "One Boeing" can do—working together despite geographic differences. One of the things making a big difference in our competitive advantage over any other contractor is our ability to bring our engineering, business and manufacturing teams together to leverage the lowest-cost offer, and thus minimize risk to shareholders. ■

More information about Boeing's tanker offering is available online:

UnitedStatesTanker.com – Here you can take a virtual tour of the aircraft; keep up on the latest developments in the tanker competition, including the whereabouts of "BART," Boeing's traveling tanker demonstrator trailer; and order a "Fly Boeing Tankers" sticker to show your support.

RealAmericanTankers.com – View the site's photo gallery featuring employees across the company who are working on the tanker program. Learn about key issues related to the program and how you can get involved.

GRAPHIC: ERIC GREER/BOEING



"To keep the 767 as affordable as possible, we're implementing Lean+ efficiencies, including a new production line and additional design improvements to the 767 platform."

– Elizabeth Lund, 767 vice president and general manager, Commercial Airplanes

PHOTO: GAIL HANUSA/BOEING



"We can deliver on our promises by ensuring that our Tanker Engineering team develops an offering that will excite our Air Force customer—and be executable."

– Gregg Rusbarsky, U.S. Air Force Tanker Program chief engineer, Defense, Space & Security

PHOTO: RICHARD RAU/BOEING

Meet the NewGen Tanker

The tanker Boeing will offer the U.S. Air Force integrates state-of-the-art technology and systems and builds on the company's rich legacy of air-refueling experience



The NewGen Tanker includes several advanced systems that are designed to meet the mission requirements of the future. Starting in the cockpit, the NewGen Tanker features electronic displays developed for the 787 Dreamliner. These four large screens provide the tanker crew with flight and navigation information and improved situational awareness. At the other end of the NewGen Tanker is a fly-by-wire refueling boom based on the proven KC-10 tanker boom. The NewGen Tanker boom simplifies refueling, with improved safety and reliability, while incorporating new technology. The boom operator in the NewGen Tanker will monitor a 3-D flat-screen display to perform air-to-air refueling operations.

GRAPHIC: ERIC GREER/BOEING

A fuel receptacle allows the tanker to be refueled in flight so it can remain on station as long as necessary.

The tanker incorporates the advanced flight-deck displays of the 787 Dreamliner.

A armor and other protection measures make it safer to operate in a combat zone.

When the boom is not in use, a single aircraft can be refueled with the Centerline Hose and Drum unit.

The refueling boom has improvements that make it easier to operate and more reliable.

Blended Winglets improve the tanker's range and performance.

Two aircraft can be refueled simultaneously from the refueling pods on the wings.



Above and beyond

Boeing is part of the International Space Station team honored for one of history's great engineering accomplishments

by Adam Morgan

Like many engineering students, Elliott Harik often tried to imagine where his career might take him. It was out of this world.

Harik is a mechanical and structural engineer for Boeing on the International Space Station program. In March, the National Aeronautic Association selected the ISS team, which includes

Boeing, the station's prime contractor, for the prestigious 2009 Collier Trophy, the aerospace industry's highest annual honor.

"As a college student in the field of engineering, you try and picture where you'll end up, where your training and career might take you," Harik said. "Working for the ISS program is an opportunity that outshines just about everything else. It is a challenging and rewarding job, and it's gratifying to know that the program is being recognized publicly for its achievements."

The National Aeronautic Association selected the space station team for the "design, development and assembly of the world's largest spacecraft, an orbiting laboratory that promises new discoveries for mankind and sets new standards for international cooperation in space."



"Working for the ISS program is an opportunity that outshines just about everything else."

– Elliott Harik, mechanical and structural engineer for Boeing on the International Space Station program

PHOTO: BOB FERGUSON/BOEING

Joy Bryant, vice president and program manager for Boeing's space station program, described it as one of "the greatest engineering triumphs of history in terms of the sheer magnitude of the challenges the ISS faced, and the innovation, scientific achievement, leadership excellence and international diplomatic finesse that contributed to the success of one of NASA's most ambitious programs."

The Collier Trophy was not the only award the space station received in March. The industry publication *Aviation Week* honored the station with its 2010 Laureate Award for Space. The award commended the space station program for completing the addition of the last major modules and expanding the crew to six in May 2009.

"The ISS is arguably the signature engineering achievement of the last 60 years," the magazine noted. And that "working together, partner agencies demonstrated the station is as much an achievement in foreign relations as it is in aerospace engineering."

The magazine's award recognized the program managers from five international space agencies partnering on the ISS—the Canadian Space Agency, the European Space Agency, the Japan Aerospace Exploration Agency, Roscosmos [Russian Federal Space Agency] and NASA.

"Without the efforts of teams around the world, including thousands of Boeing employees, this kind of success would not have been possible," Bryant said.

In addition to designing and building all the major U.S. elements of the space station, Boeing is responsible for the integration of new hardware and software—including components from international partners.

Boeing officially turned over the U.S. on-orbit segment of the space station to NASA in March, with the signing of U.S. government form DD-250 at an Acceptance Review Board meeting. Often referred to as "handing over the keys," the DD-250 is equivalent to a final bill of sale that formally transfers ownership, verifying delivery, assembly, integration and activation of all hardware and software required by contract.

"It was 10 years in the making, but NASA's acceptance confirms that the U.S.-built portion of the ISS meets [NASA's] requirements and that its hardware and software are in excellent shape," Bryant said.

Michael Suffredini, NASA space station program manager, said the space agency got what it asked for, "and I would say it was delivered in fine fashion."

"Nearing completion of this orbiting laboratory," he added, "we are only beginning to understand its true value as the dividends in our investment pay off with advances in medicine, technology and international relations." ■

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"Without the efforts of teams around the world, including thousands of Boeing employees, this kind of success would not have been possible."

– Joy Bryant, vice president and program manager for Boeing's space station program

PHOTO: ELIZABETH MORRELL/BOEING



PHOTO: The International Space Station as photographed by a crew member on Space Shuttle *Endeavour* during a mission in February. NASA

High 5

Boeing delivers first five Super Hornets to the Royal Australian Air Force

by Philip Carder

John Clayton has helped build Boeing's F/A-18 Hornets and Super Hornets for 24 years. He was on the assembly line in St. Louis last May when the first Super Hornet destined for Australia began to take shape.

In March, the first five Super Hornets arrived in Australia. Nineteen more are on order for the Royal Australian Air Force (RAAF).

"There's definitely a sense of pride knowing we're doing this work for Australia, and I know the aircraft will be welcomed by the RAAF," said Clayton, who performs wire integrity testing on the aircraft.

Indeed they were.

Air Marshal Mark Binskin, Chief of Air Force, was among those at RAAF Base Amberley near Brisbane when the Super Hornets landed, escorted by four Royal Australian Air Force F-111 strike fighters.

"The Super Hornet is going to really enhance our air combat capability over the next 10 years as we transition from the older fighter force to the new," Binskin said. He also noted how quickly Boeing and its industry partners delivered the jets. "This is a record time, three years from decision to delivery. You don't get any quicker than that in this game."

The Australian government announced in 2007 it would acquire 24 of the aircraft, making it the first international Super Hornet customer. The aircraft will replace aging F-111s that have served the Royal Australian Air Force since the early 1970s.

The Super Hornet is able to perform a number of tactical missions including air superiority, day and night strike with precision-guided weapons, fighter escort, close air support, suppression of enemy air defenses, maritime strike, reconnaissance, aerial refueling and forward air control.

"This jet is a quantum leap for Amberley, for Queensland and Australia," said Glen Braz, commander of the Royal Australian Air Force's No. 1 Squadron, which will operate the Super Hornet. "Now we can dominate in every spectrum."

Dennis Muilenburg, president and CEO of Boeing Defense, Space & Security, said the Super Hornet is important for Australia and for Boeing, and continues a partnership of more than 80 years. "The exceptional collaboration and teamwork between Australia's Defence Materiel Organisation, the Royal Australian

Air Force, the U.S. Navy and the Hornet industry team was the foundation that ensured these new Super Hornets are now ready to begin their RAAF service," Muilenburg said.

Bob Gower, vice president of Boeing's F/A-18 and EA-18 programs, said the teamwork involved in the Australia Super Hornet program has been remarkable. "From day one of this program, it's been all about working together. This is a great example of executing flawlessly to satisfy our customer. We promised to deliver four Super Hornets to our RAAF customer by March 26. We delivered five."

Boeing will deliver the remaining 19 Super Hornets through 2011. All will be built in St. Louis.

Tim Watson, F/A-18 structure assembly manager, has helped build Super Hornets on the St. Louis production line since the start of the program in 1994. "It's a great feeling to build products that protect freedom every day," he said. "It's also great knowing our allies and warfighters trust Boeing and the quality products we build here in St. Louis, and that they know they are getting the best product for their money." ■

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PHOTO: The first five Super Hornets for the Royal Australian Air Force arrive at RAAF Base Amberley in Queensland, Australia. AUSTRALIAN DEFENCE FORCE



"There's definitely a sense of pride knowing we're doing this work for Australia, and I know the aircraft will be welcomed by the RAAF."

— John Clayton, sheet metal assembler and riveter, St. Louis

PHOTO: RICHARD RAU/BOEING

The 'human touch'

PHOTO ILLUSTRATION: KEVIN MAU/BOEING
PHOTO: GETTY IMAGES/PHOTODISC

Human Resources service centers help Boeing employees resolve issues quickly—and more centers are on the way

by Kent Cato and Carrie Howard

Frustrated and confused in trying to arrange an extended leave of absence, Boeing employee Robert Colliau was nearly ready to give up. Then he walked into Boeing's new Human Resources service center in Mesa, Ariz., and found Ken Berkow ready to help.

Boeing's TotalAccess Web site is great for transactional issues such as checking the balance in your savings plan or changing your address. But, as Colliau learned, some issues require a more personal touch.

"The leave-of-absence process is very confusing," said Colliau, an aviation mechanic on the Apache program who was helping coordinate the leave for his wife, Barbara, also a Boeing employee. "Ken didn't even bat an eye. This process is second nature for him and he made me feel comfortable. He went above and beyond in helping us resolve our issues. He saved us a lot of time and confusion."

By resolving questions quickly, Human Resources service centers help get employees back to work faster and with fewer distractions, improving productivity and morale, according to Yvette Whitehead, director of HR Service Delivery.

"When people get their issues resolved," noted Berkow, the HR professional who helped Colliau, "they can focus on their jobs better, and that has a positive effect on everything, even workplace safety."



"When people get their issues resolved, they can focus on their jobs better, and that has a positive effect on everything, even workplace safety." – Ken Berkow, HR professional

Based on the success of Mesa's first service center, local management asked Human Resources to set up additional centers at the site. "It's been great," said Ed Carr, quality senior manager. "If you need help and your assigned HR generalist isn't available, there's always someone to help."

Service centers already up and running in Mesa and Southern California are working so well that starting this month,

Boeing will open 40 more across the United States. The centers are staffed by Human Resources service coordinators and generalists who can help employees with issues they cannot resolve through self-help resources such as TotalAccess. Services will be available for walk-ins or by phone and e-mail, so employees who do not have a center nearby can get personal support regardless of



which site or business unit they work in.

Service centers provide excellent opportunities for Human Resources personnel to work directly with employees and make a positive impact on the work environment, according to Rick Stephens, senior vice president, Boeing Human Resources and Administration. "We're staffing these centers with HR professionals who have the knowledge to get the job done and the can-do attitude to provide excellent customer service," Stephens said.

Or as Cheryl Sisk of the Long Beach, Calif., service center put it: "People like the human touch, and that's what we provide." ■

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PHOTOS: (From far left) Robert Colliau (left), aircraft assembly technician, talks with Ken Berkow, Human Resources professional, at one of the Mesa, Ariz., HR service centers. **MIKE GOETTINGS/BOEING** Annie Truong (right), with Human Resources, helps Cheryl Dismuke, with Boeing Defense, Space & Security, at an HR service center in Seal Beach, one of four centers in Southern California. **PAUL PINNER/BOEING** Al Ortiz (left), with Defense, Space & Security, went to the Long Beach, Calif., HR service center, where Jackie Dickens helped him with Boeing TotalAccess. **PAUL PINNER/BOEING**

Human Resources service centers can provide:

- General help with HR-related questions
- Assistance with Boeing TotalAccess
- Guidance on HR policy and procedures
- Help with the leave-of-absence process, including forms, pay, benefits and return to work
- Layoff support and guidance
- Answers to pay and incentives questions, covering topics such as paychecks, work schedules, time recording, salary management and recognition programs
- Career development assistance, including Boeing hiring processes, resume writing, job training, tuition assistance and interviewing skills

Guarding the ‘gold’

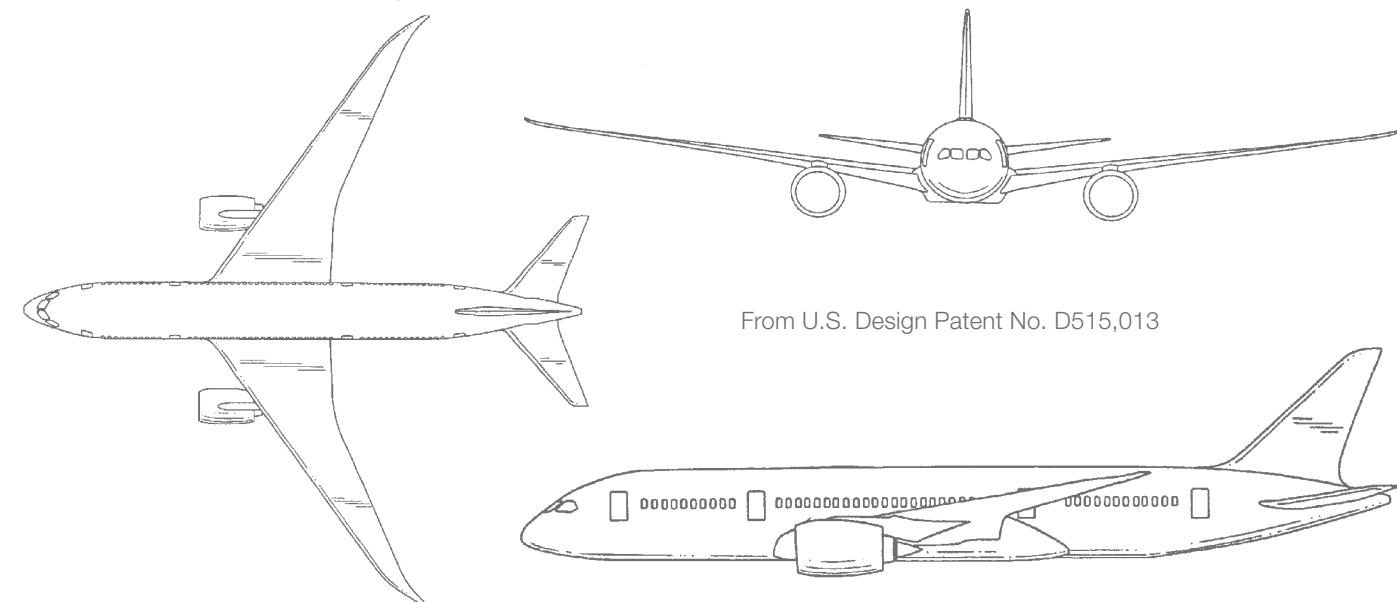
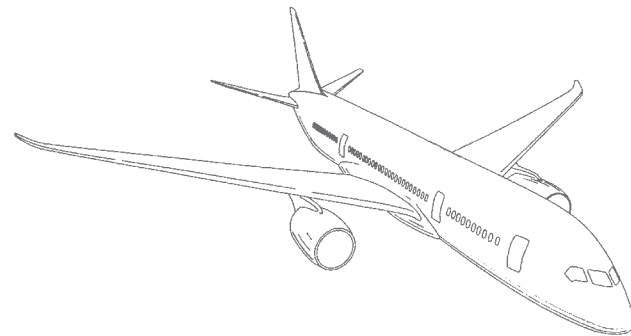
In 1903, the Wright brothers sought patent protection for their flying machine. Their disclosure contained descriptions and drawings of their glider’s three-axis flight control system, including wing “warping” to control roll, a rudder to control yaw and a forward elevator to set pitch. U.S. Patent No. 821,393 was issued to the Wright brothers in 1906, which meant no one could use their design without getting their permission and paying them a royalty.

Today, the Boeing 787 Dreamliner has more than 1,000 patents granted or pending, and additional innovations that are held as Boeing Proprietary Information, or trade secrets. Due to the advanced, highly complex nature of this jetliner, no single patent can capture all of its breakthrough technologies.

The Dreamliner will play an enormous role in Boeing’s business performance for years to come, with customers having placed 866 orders for the plane through March. Given the 787’s technological edge, Boeing has gone to great lengths to protect its intellectual property in this airplane—and to prevent unauthorized

Protecting Boeing innovations is critical to maintaining a competitive advantage

by **Cindy Naucler Glickert**

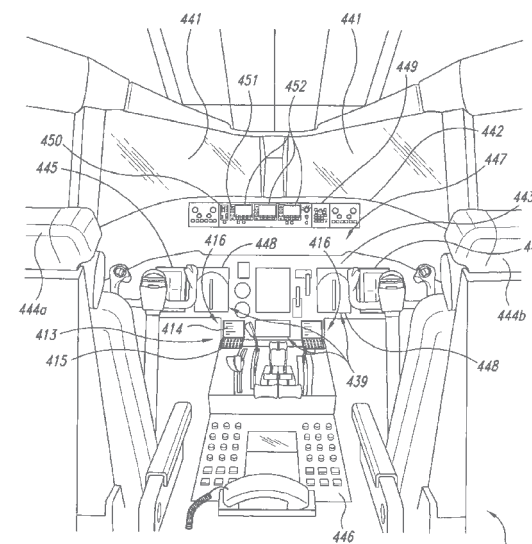


From U.S. Design Patent No. D515,013



“As innovation accelerates and we maximize and leverage its potential, it’s more important than ever for us to safeguard technology that’s critical to our business.”

– Martha Ries, vice president of Boeing Intellectual Property Management



From U.S. Patent No. 7,177,731

parties from getting hold of technologies that provide economic value to Boeing.

“As innovation accelerates and we maximize and leverage its potential, it’s more important than ever for us to safeguard technology that’s critical to our business,” said Martha Ries, vice president of Boeing Intellectual Property Management. “Protecting our intellectual property ensures we can use our technology to build our products.”

Protection of Commercial Airplanes’ Dreamliner technology is just one example of how Ries’ organization is safeguarding Boeing’s intellectual property. This team also works closely with Boeing Defense, Space & Security to protect key technologies in areas critical to its growth, including unmanned systems, cyber

PHOTO: Martha Ries, right, vice president of Intellectual Property Management, discusses protection of composites technology with Kathy Moodie, Commercial Airplanes director of 787 Assembly Operations, and Bob Nadalet, director of IP Strategy & Protection.

DARIEN CHIN/BOEING



technology and energy management. And by working earlier in the technology-development process with business-unit leaders and technologists across the company, as well as the Enterprise Technology Strategy team, Intellectual Property Management is better able to spot and protect key knowledge, Ries said.

Intellectual property—a term applied to patents, trade secrets, trademarks and copyrights—is worth more than \$5 trillion in the United States, according to the U.S. Commerce Department. Examples of Boeing intellectual property include proprietary information, such as pricing information, business plans and engineering data; invention disclosures and patents; copyrighted material; and trademarks.

Understandably, intellectual property is referred to as the “company gold” because of its strong market value.

And there are those who want to steal it. The theft of intellectual property and copyright piracy is on the rise. That’s why Intellectual Property Management at Boeing plays a critical role in protecting the company’s future competitiveness—and why it’s crucial for Boeing employees to understand how to identify and protect intellectual property, according to Intellectual Property Management leaders.

Last year, the Intellectual Property Management organization was given companywide responsibility to watch over Boeing’s competitively sensitive information. The team, whose mantra is to “identify, protect and leverage Boeing IP,” has been busy.

“Boeing is leading the industry and continues to grow the number of patents granted by approximately 7 percent annually,” said Christine Wren, director of business development for the Patent Board, a leading patent analysis group that designated Boeing as the top U.S. patentee. In 2010, Boeing was ranked the top U.S. patentee among the world’s aerospace and defense companies for the fourth year in a row. ■

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Intellectual property is a product of the mind or intellect, in a concrete or abstract form, in which one can assert ownership rights. Boeing Procedure 1003 is the starting point in any effort to protect Boeing intellectual property. To read the document, visit <http://policyplus.boeing.com/download.aspx?filename=PRO-1003.pdf> on the Boeing intranet.

Boeing Proprietary Information is also intellectual property, but it is information that is not easily patented or, in some cases, information that is so competitively critical that it is better protected as a trade secret rather than through a publicly accessible patent filing. Because of this value to the company, employees must take precautions to identify and protect Proprietary Information. For more information, refer to Boeing Procedure 6901, at <http://policyplus.boeing.com/download.aspx?filename=PRO-6901.pdf> on the Boeing intranet.

PHOTO: Chuck Cruit, director of IP Policy & Compliance, and Debbi Smith, Boeing Military Airplanes manager of Export Administration, coordinate new procedures for managing Boeing Proprietary Information in Boeing rotorcraft exports.
FRED TROILO/BOEING



“It is essential that we patent-protect our key technologies in countries where we manufacture and market our products.”

— Yen Yee, director of Patent Portfolio Management

PHOTO: PAUL PINNER/BOEING

Strategy for **SUCCESS**

To better identify and protect critical knowledge, the Intellectual Property Management organization has been organized along functional, rather than business-unit, lines. The structure strengthens its support to customers and allows Intellectual Property Management to leverage best practices across Boeing. The teams are:

- **IP Strategy & Protection:** This group works across the company to develop intellectual property strategy plans around the key technologies that will give Boeing the greatest competitive advantage and retain the freedom to develop, build and support its products. Last year, a strategy was crafted for handling composite materials technology that addresses program needs across Boeing. This included determinations on what composite technologies needed the greatest protection and what could be shared outside the company with Boeing’s suppliers and customers. “We’re focusing on protecting the growth markets that are important to the company’s future competitiveness,” said Bob Nadalet, director of IP Strategy & Protection.
- **Patent Portfolio Management:** Because Boeing operates around the world, its intellectual property activities have a global range. “It is essential that we patent-protect our key technologies in countries where we manufacture and market our products,” said Yen Yee, director of Patent Portfolio Management. This team also focuses intellectual property protection and patent filing around “IP chokepoints,” or the critical technologies Boeing needs to build its products, Yee added. The group supports the Enterprise Technology Strategy team, which works to maximize the return

from research and development. Their goal: Ensure early protection of key technologies that are important to multiple programs.

- **IP Policy & Compliance:** This group’s work includes monitoring for misuse of Boeing intellectual property outside the company, such as patent infringements, counterfeited parts, illegal Internet sales of company software or publications, and unauthorized copying, or piracy, of copyrighted materials, logos and trademarks. “Misuse or lack of awareness of IP can put the company at risk in multiple ways, including loss of our competitive advantage and loss of revenue through ‘free rides’ on our technology, and even exposure to civil or criminal liability,” said Chuck Cruit, director of IP Policy & Compliance.
- **Business Development & Licensing:** The team oversees not only the “licensing out” of Boeing-owned intellectual property, which generates revenue for the company and can open new markets or distribution channels, but also the reverse, or licensing in, of technology. The latter brings into the company external technologies and products that can cut the expense and time of research and development. “It’s to our competitive advantage to look at externally as well as internally sourced technology that will support Boeing’s key growth areas,” said Luis Valdes, director of Business Development & Licensing for Intellectual Property Management.

— Cindy Naucler Glickert

Global dynamic

Germany is an important market for Boeing and a key partner in developing new technologies

by Bill Seil

Boeing's ties with Germany began long before the company was even founded.

Wilhelm Böing, father of the company's founder, William Boeing, emigrated to the United States from Germany in 1868. In 1934, Boeing delivered its first airplane to Europe, a Boeing 247, to the predecessor of today's German airline Lufthansa.

Germany has long been a leader in technology and innovation, and Boeing is forging new business alliances in partnering with the talent and resources of German research and development. Many German companies produce high-tech products and systems for Boeing airplanes.

Shep Hill, president, Boeing International, said Germany is an important market for Boeing, as well as a great source of quality products and expertise.

"Boeing is very active in Europe, and Germany is a large, economically strong nation in that region," Hill said. "It is the home of airline customers that have made important contributions to our commercial airplane programs, and we are seeing growing opportunities in both technology partnerships and new sales opportunities."

Lianne Stein became president of Boeing Germany in late 2006, three years after the company opened its Berlin office. Months later, Jim McNerney, Boeing chairman, president and CEO, visited Boeing facilities in Germany, including the Eastern Hemisphere headquarters of Boeing subsidiary Jeppesen, located near Frankfurt Airport.

Stein said that during his visit, McNerney emphasized the need to engage with Germany's leading technology companies and research and development institutes to explore opportunities for collaboration.

"Many German aerospace companies can trace their origins back to the earliest stages of the history of flight," Stein said. "Some of the greatest aerospace advances that have occurred over the past 100 years originated here."

Stein noted that much of Germany's current technological strength comes from small and medium-size enterprises, some of which are family owned, such as Diehl Aerospace, a major contributor to the 787 program. At the other end of



Germany at a glance

Formal name: Bundesrepublik Deutschland (or the Federal Republic of Germany)

Location: Central Europe, bordering the Baltic Sea, the North Sea and nine countries: Austria, Belgium, Czech Republic, Denmark, France, Luxembourg, the Netherlands, Poland and Switzerland

Population (2009 est.): 82,329,758

Capital: Berlin

Other major cities: Frankfurt, Munich, Hamburg, Cologne

National language: German

Government: Angela Merkel leads a coalition government of Christian Democratic Union and the Free Democratic Party in her second term as German chancellor. Germany is a federal republic with regional governments in the 16 federal states.

Gross domestic product (2009 est.): \$2.779 trillion

Largest export partners: France, the United States, the Netherlands, the United Kingdom, Italy, Austria, Belgium, Spain, Poland

Economy: Germany is one of the largest economies worldwide. It is the world's second-largest exporting country with about 40 percent of the economy based on exports.

PHOTO ILLUSTRATION: Following the end of World War II, the Brandenburg Gate marked the border between East and West Berlin. Since the fall of the Berlin Wall in 1989, it has become a symbol of a reunified Germany.

BRANDON LUONG/BOEING; AIRPLANE GRAPHIC: BOEING; BRANDENBURG GATE PHOTO: SHUTTERSTOCK.COM

German brands: Well-known German brands include Mercedes, Siemens, SAP, BMW, Adidas, Audi, Volkswagen, Nivea.

Research and technology: Germany has renowned research centers such as the Fraunhofer Institute and the Max Planck Institute. It has been home to some of the most prominent researchers, including Albert Einstein and Max Planck. German engineers and inventors who have helped shape modern automotive and air transportation technology include Count Ferdinand von Zeppelin, Gottlieb Daimler, Hugo Junkers and Karl Benz.

Sources: U.S. government, German government, Germany Trade and Invest



“We have made significant progress building relationships and establishing joint technology projects with many German companies — large and small.”

— Lianne Stein, president of Boeing Germany

PHOTO: ASSOCIATED PRESS

the spectrum are large multinational corporations in Germany, such as the 160-year-old Siemens—a world leader in many technologies.

“Over the past few years, we have made significant progress building relationships and establishing joint technology projects with many German companies—large and small,” Stein said.

Boeing’s Berlin office has a very engaged staff. One of its main objectives is to position Boeing for future growth in Germany.

“Germany is a base of our competitor EADS/Airbus, which has a large footprint of production sites and employees in Germany,” Stein said. “It is imperative for the Germany team to raise the visibility of Boeing’s commitment to the German marketplace and to enhance and build partnerships and relationships in support of business opportunities in this important market.”

The Berlin office also serves as the company’s liaison with all levels of government. Establishing relationships with German political leaders and generating an understanding for Boeing’s strategy and products is critical to Boeing’s success in Germany.

Commercial Airplanes customers in Germany include Lufthansa, one of the world’s largest airlines and an important customer and valued adviser in designing new commercial airplanes. As launch customer for the new Boeing 747-8 Intercontinental, Lufthansa has provided valuable input that will help make the

new airplane a leader in its class for both fuel efficiency and passenger comfort. Another leading German airline, Air Berlin, is a major customer for the new Boeing 787 Dreamliner and the Next-Generation 737.

Jeppesen, a Boeing company, opened its first office in Germany in 1957 to better serve customers in the U.S. Army Air Corps. Today, Jeppesen GmbH, based in the town of Neu-Isenburg, has nearly 500 employees and serves as the company’s headquarters for Europe, Asia, the Middle East and Africa. It also supports the company’s main corporate U.S. headquarters in Denver.

Jeppesen is internationally known for sophisticated flight and navigational tools, including the Electronic Flight Bag. In commercial aviation, it serves more than 650 airlines and over a million pilots around the world with navigation and other operational solutions, including flight planning, weather services and crew scheduling. It also serves private pilots. In recent years, Jeppesen has expanded into the marine and rail industries.

Bernd Buehrmann-Montigny, vice president, Global Navigation Services for Jeppesen, recently was given the added role of managing director of the company’s Neu-Isenburg office. While the Boeing subsidiary has a diverse customer base and operates independently, Buehrmann-Montigny said that he and others in the Neu-Isenburg office meet regularly with members of the Boeing team in Berlin. They discuss support for Boeing customers, and collaborate on stakeholder events and developing technology partnerships within Germany.

The Jeppesen office at Neu-Isenburg is one of the largest Boeing facilities outside the United States, according to Buehrmann-Montigny. The office is well-respected within Germany and supports the local community. In addition to its business services, Jeppesen is popular among Germany’s many recreational and glider pilots.

Mark Van Tine, president and CEO of Jeppesen, said the Neu-Isenburg office over the years has helped to prepare Jeppesen in becoming a truly global company. It has led the way in building an international employee base and an understanding of diverse cultures. Today, Jeppesen has 43 offices in 22 countries, with nearly half its employees

based outside the United States.

In addition to its success selling aircraft to German airlines, Boeing sees both near- and long-term opportunities in the country for its military products. Historically, Germany and other European countries have focused on developing their own defense business and relied on European defense products to support their forces. But highly specific requirements from the German Ministry of Defense are opening up potential opportunities for Boeing products and services. For example, the German Air Force has identified a need for Combat Search and Rescue aircraft.

“Due to its proven performance in the field and its strong, global customer base, Boeing believes this requirement is best met with tandem rotor capabilities,” said Phil Dunford, vice president and general manager of Boeing Rotorcraft Systems.

Boeing Defense, Space & Security is working closely with Boeing Germany to demonstrate to the Ministry of Defense that Boeing has the right solutions for Germany’s future needs, and that it would make a valuable, long-term partner, Dunford said.

Germany is one of the largest providers of aircraft financing worldwide, and Boeing Capital Corporation, the company’s aircraft financing unit, works closely with German banks to help arrange and facilitate aircraft financing for Boeing customers worldwide.

Boeing has approximately 70 partners and suppliers throughout Germany. Sell, based in Herborn, produces airplane interior features including galleys. Other suppliers produce passenger seats, precision tools and automated fastening systems.

A number of German-based suppliers support the 787 Dreamliner program. Diehl Aerospace, headquartered in Ueberlingen, provides the main cabin lighting for the new airplane. The new, low-maintenance solid-state LED lighting can be adjusted within the cabin to make travel a more comfortable and relaxing experience. PFW, headquartered in Speyer, manufactures metallic tubing and ducting for the airplane.

Telair International, based in Miesbach, has a long history of producing cargo-handling systems for jetliners, including the new 747-8 Freighter and the Dreamlifter, a modified 747-400 airplane used to transport major assemblies of the 787 Dreamliner.



“Our suppliers in Germany are strong potential partners for developing new technologies,” Stein said. “We are working closely with them to identify areas of joint cooperation.”

However, Boeing’s involvement in Germany goes beyond business. It is active in local communities as a corporate citizen, focusing on environmental and educational projects. Boeing supports projects in Berlin, where Boeing Germany is headquartered, and in Neu-Isenburg, where Jeppesen is based.

With a dynamic base of commercial customers, a strong supplier base, growing technology partnerships and emerging opportunities in the defense sector, Boeing’s ties with Germany are

stronger than ever. A relationship that began with Wilhelm Böing has entered an exciting new era. ■

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PHOTOS: (Top) Bernd Buehrmann-Montigny, vice president, Global Navigation Services, is shown with Digital Color Print on Demand and Bookbinding equipment at Jeppesen’s Neu-Isenburg office. The facility prints an average of 3 million sheets of navigation charts per week. **(Above)** Environmental Detectives, a project supported by Boeing Global Corporate Citizenship, encourages children to explore nature and learn about environmental protection. **JEN PREUSLER**

Flying toward tomorrow

Germany's airlines and Boeing have been collaborating—and innovating—for decades

Germany remains one of the strongest commercial airplane markets in Europe. It is one of the largest economies in the world and, in Europe, is second to only the United Kingdom in passenger traffic.

Over the next 20 years European airlines are expected to acquire more than 7,000 new jetliners, with Germany likely to be the second-largest market for the purchase of those airplanes.

"The German airlines have been strong business partners and we've had an excellent collaborative working relationship over the years," said Marlin Dailey, vice president of sales, Boeing Commercial Airplanes.

Boeing's commercial airplane fleet—past and present—owes much to its German airline customers.

Lufthansa, based in Frankfurt, has been a valued partner of Boeing since the late 1950s, when it contributed to the design of the 707-420. The airline entered the jet age in March 1960 with delivery of its first 707.

In the 1960s, Lufthansa was the primary launch customer for the Boeing 737 and the Boeing 747-200 Freighter. As launch customer for the new 747-8 Intercontinental, Lufthansa has worked closely with Boeing on its design.

"When you consider how [Lufthansa] has grown and evolved, it's really quite remarkable, and a testament to its focus on quality and leadership," Dailey said.

Air Berlin, based in the German capital, will be one of the first European carriers to operate Boeing's new 787 Dreamliner. Following a need to reduce its initial 787

order due to market conditions, the airline is still scheduled to receive 15 787s, with an option for five more airplanes. Air Berlin also will be one of the launch customers for the Next-Generation 737 Sky Interior.

Since 1991, Air Berlin has grown from two Boeing 737-400s to a fleet of 152 airplanes, including 66 Next-Generation 737s.

"Our relationship with Air Berlin goes way back," Dailey said. "It's a well-run airline that's been able to adapt to the changing marketplace, creating a really nice mix. It's low-cost, but it provides good service."

Both Lufthansa and Air Berlin speak highly of their long-standing business relationships with Boeing.

Wolfgang Mayrhuber, chairman and CEO of Deutsche Lufthansa AG, said the airline and Boeing have enjoyed strong and fruitful business ties for half a century.

Ulf Huttmeier, Air Berlin's chief financial officer, said Boeing has been a valued strategic partner in the development of new aircraft for its fleet.

Another German airline, TUIfly, part of the TUI Group, has been an important Boeing customer since 1973, when it operated as Hapag Lloyd. It played a key role as a launch customer for the Boeing 737-800.

Although the airline industry has been slowed by the economic downturn, Dailey sees brighter days ahead. "Germany is going to lead the economic recovery in Europe. It's all about getting the economy and businesses moving in the right direction. When that happens, I think you'll quickly see them get that spring back in their step."

— Bill Seil

"Boeing is working closely with us on supplying the airplanes of the future with the development of the 787 Dreamliner..."

— Ulf Huttmeier, chief financial officer of Air Berlin

"For many decades, we have shared ideas to enhance aviation and have brought many innovations into service."

— Wolfgang Mayrhuber, chairman and CEO of Deutsche Lufthansa AG, on the airline's long ties with Boeing, which will continue with the 747-8 Intercontinental

Germany's major airlines

Lufthansa

Headquarters: Frankfurt

Fleet: 269 airplanes, including 63 737s, 30 747s and Airbus models. In addition, Lufthansa Cargo has 19 MD-11s

Notable: Lufthansa is the launch customer for the new Boeing 747-8 Intercontinental, with 20 orders

Air Berlin

Headquarters: Berlin

Fleet: 152 airplanes, including 66 737s, and Airbus and Bombardier models

Notable: Air Berlin has orders for 15 Boeing 787 Dreamliners and 71 Next-Generation 737s

TUIfly

Headquarters: Hannover

Fleet: 25 airplanes, all 737s

Notable: The TUI group has firm orders for 13 787 Dreamliners and 30 Next-Generation 737s

AeroLogic

Headquarters: Leipzig

Fleet: 4 777 Freighters

Notable: AeroLogic is a joint venture between DHL Express and Lufthansa Cargo; it has four additional 777 Freighters on order

Other German passenger and cargo airlines include:

Air Cargo Germany, 2 747s; Condor Flugdienst, 13 757s, 9 767s and Airbus aircraft; Germania, six 737s; Germanwings, 27 Airbus airplanes; and Hamburg International, which has an Airbus fleet

PHOTO ILLUSTRATION: BRANDON LUONG/BOEING

Equation for success

Boeing is working with Germany's technology leaders to increase competitiveness—and build business for both countries



“Environmental research is a high priority in Germany, and this could lead to concepts we can use in our commercial airplane programs.”

— Michael Friend, technology director for Germany

PHOTO: ASSOCIATED PRESS

PHOTOS: (Far right, top) Integration and test engineer Wolfgang Egerer assembles the optical head of a satellite component at Boeing supplier Jena-Optronik in Germany. **BOEING** (Far right, bottom) Germany and the German airlines focus strongly on research to make the air transport system more efficient. Shown here is the control tower at Frankfurt Airport. **GETTY IMAGES**

Germany has long had a reputation for technological prowess, particularly in aerospace. Its experiments in flight began with glider pioneers Gustav and Otto Lilienthal in the 1800s and Hermann Oberth's work in rocketry in the early 20th century.

“Germany is a land of innovation, where education, science and research play an important role,” said Lianne Stein, president of Boeing Germany. The country has one of the highest national investments—government and private—in research and development in the world. Germany also is among the top countries in the global patent registration rankings for applied technologies, such as automotive, mechanical, environmental, chemical, power and construction technologies. It has a strong education system; engineering is a highly valued profession.

Boeing Research & Technology's Global Technology organization in 2007 assigned Michael Friend to serve as the company's technology director for Germany. Friend said the company sees Germany as one of the leading countries in the world for cutting-edge technology. “The Germans have engineered solutions to problems in very eloquent ways,” Friend said. “Their engineering really focuses on thinking through problems and coming up with the best solutions for consumers.”

So it makes sense that Germany plays an important role in Boeing's international strategy of working together with technology leaders worldwide to participate in the world's \$1.1 trillion a year investment in technology.

Although Boeing has a long tradition of working together with German research facilities, there is now a focused effort to develop collaborative projects within that country, Friend noted. Recently, that has included work in component manufacturing, propulsion, fuel cells, smart-grid technology, solar energy and environmentally progressive technology.

“A lot of the fundamental research and thinking that started in Germany has contributed to the success of Boeing products over the years,” Friend said. “Now we are increasing the amount of technical interaction that occurs with German companies and institutes to add value to our business units and to our partners in Germany.”

In addition to building relationships within Germany, Friend regularly communi-

cates with technology leaders in programs across the Boeing enterprise. He also gets guidance from the company's Enterprise Technology Strategy team, which aligns research investments with business priorities. Friend coordinates his activities in Germany with Boeing Research & Technology–Europe, which is headquartered in Madrid.

One important accomplishment was the opening of the Direct Manufacturing Research Center (DMRC) at Germany's University of Paderborn in 2009. This collaboration of Boeing and several other companies is designed to further the development of direct manufacturing processes and systems.

“Boeing and the partners in the DMRC can potentially leverage relatively small investments into much bigger technology gains,” Friend said.

The goal of the DMRC is to reduce part production costs and enable the fabrication of more complex and functional component parts.

“One thing that pleases me is our success in finding people here in Germany to help us work on environmental technologies,” Friend said. “Environmental research is a high priority in Germany, and this could lead to concepts we can use in our commercial airplane programs.”

As part of efforts to explore and develop environmentally progressive technologies, Boeing and Rolls-Royce have been engaged in collaborative testing of a wind-tunnel model aimed at helping the companies better understand the interaction between fuel-efficient open-fan engines and commercial airframes. The concept—if proved in testing—has the potential to significantly reduce fuel consumption below levels achieved with current turbofan powerplants, also reducing carbon dioxide emissions.

The project involves testing a large, complex wind-tunnel model with a wingspan of about 11.5 feet (3.5 meters). The model, built by Deharde Maschinenbau of Varel, Germany, is equipped with a pair of hydraulically powered engine simulators, developed and provided by RUAG Aviation, capable of producing up to 240 kilowatts of power to spin counter-rotating propeller blades. Testing takes place at RUAG Aviation's Large Subsonic wind tunnel in Emmen, Switzerland.

Deharde Maschinenbau was recently



among the international winners in the Boeing Supplier of the Year competition.

Boeing also has a number of research projects under way with Boeing supplier Diehl Aerospace, headquartered in Ueberlingen. It is a coordinated research and development effort where a small portion of Diehl's overall research portfolio is directed at projects that are of mutual interest to Boeing and Diehl.

Friend noted that when he first arrived in Germany, many of the companies he contacted were focused on working with Boeing's competitor, Airbus.

“This has changed in the past years, as it is increasingly important for the suppliers to diversify their business base and their customer base,” Friend said.

In addition to Boeing's Global Technology organization, Boeing subsidiary Jeppesen is working with German companies to develop new technologies. Jeppesen's office is in Neu-Isenburg, Germany, near Frankfurt Airport.

One of Jeppesen's projects is exploring future cockpits for the next generation of commercial airplanes, and the types of products that will be used by their flight crews.

“It's imperative that we invest in the future in order to be cutting edge and ahead of the competition,” said Jens Schiefele, Jeppesen's director of Advanced Research and Marine Technologies. “That's how we contribute to the success of Jeppesen and The Boeing Company.”

— Bill Seil

Boeing Company – BA

NYSE: Industrials/Aerospace & Defense

As of 4/23/10

\$75.13

Stock snapshot

52-week range:	
52-week high	\$76.00
52-week low	\$37.72

International competitors

EADS* – EAD.PA	
As of 4/23/10	14.52
52-week range:	
52-week high	16.57
52-week low	10.55

*Prices in euros

U.S. stock indexes

S&P 500	
As of 4/23/10	1,217.28
52-week range:	
52-week high	1,219.54
52-week low	847.12

S&P 500 Aerospace and Defense Index	
As of 4/23/10	397.73
52-week range:	
52-week high	397.73
52-week low	254.09

Dow Jones Industrials	
As of 4/23/10	11,204.28
52-week range:	
52-week high	11,247.20
52-week low	7,898.75

Boeing reports first-quarter results

The Boeing Company last month reported first-quarter net income of \$0.5 billion, or \$0.70 per share, and revenue of \$15.2 billion. Total company backlog at quarter-end was \$315 billion, with backlogs at Commercial Airplanes and Defense, Space & Security largely unchanged.

“We continue to build on the momentum created at the end of 2009,” said Corporate President and Chief Financial Officer James Bell. Employees can read an interview on the Boeing intranet with Bell reviewing first-quarter earnings and what Boeing’s performance and financial position means for employees at: http://boeingnews.web.boeing.com/archive/04_10/042810/100427a_bell_photo.html

The Boeing first-quarter earnings news release is available on the Internet at: <http://boeing.mediaroom.com/index.php?s=43&item=1175>



PHOTO: Corporate President and Chief Financial Officer James Bell. BOB FERGUSON/BOEING

Boeing stock, ShareValue Trust performance

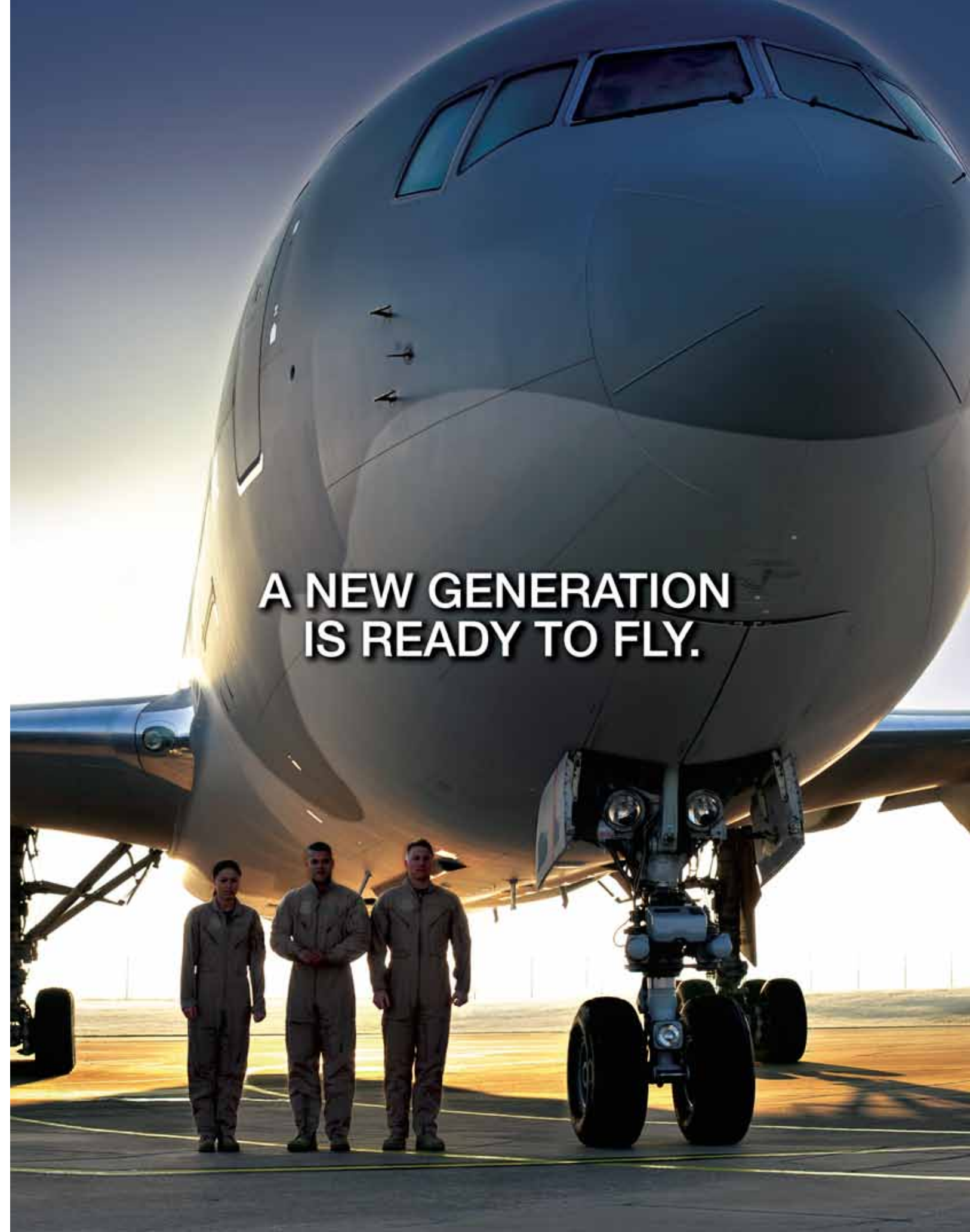
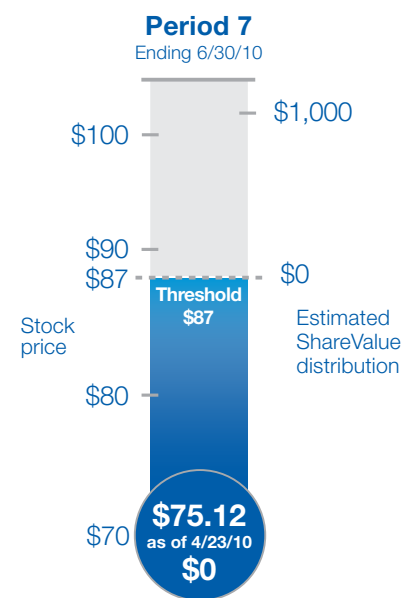
ShareValue Trust, or SVT, is an incentive plan that allows eligible participants to share in the success of their efforts to improve productivity and grow the business.

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

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

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

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



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Stress test

During a key test in March at Boeing's factory in Everett, Wash., the composite wings of the 787 static test airplane were bent upward until they experienced 150 percent of the most extreme forces, or ultimate load, the airplane is ever expected to encounter during service. At the same time, the composite fuselage of the Dreamliner was pressured to 150 percent of its maximum normal operating condition. When this photo was taken, the 787 wing tips were at the maximum point of deflection, about 25 feet (7.6 meters) from normal. A detailed analysis of data collected during the test found the 787 met all requirements and performed as designed. PHOTO: JENNIFER REITZ/BOEING



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 **BOEING**