



Frontiers

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New horizons

Boeing's Vertical Lift business aims to expand internationally with new strategies for success

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

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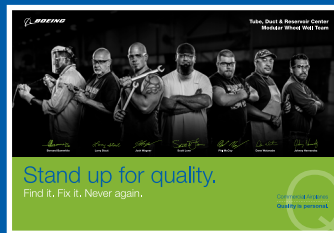
This ad recognizes recent successful tests achieved by the High Energy Laser Mobile Demonstrator, as well as Boeing's commitment to directed energy leadership. The ad is running in trade publications.

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Adapted from a series of posters in support of Boeing's Go for Zero—One Day at a Time workplace safety effort, this ad illustrates new standards that require safety glasses in all operations, production and manufacturing areas, unless in a designated Safety Zone. A gallery of posters, along with other resources, can be found on the Boeing intranet at <http://go4zero.web.boeing.com/index.cfm>.

14-15



This ad is derived from a series of posters highlighting employees who are achieving quality improvements. More than 50 employee engagement teams across Commercial Airplanes posed and created taglines for their posters. A gallery of the posters can be found on the Boeing intranet at http://bcaquality.web.boeing.com/order_posters.shtm.

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Part of Boeing's Middle East "Together" campaign, this ad supports Boeing's history in Qatar and will run in major print publications there. Translated the text reads: "Together we grow. Since 1977, Boeing has been proud to play a role in the development of Qatar's aerospace sector and looks forward to continuing this association into the future. Leading through partnership."

ETHICS QUESTIONS

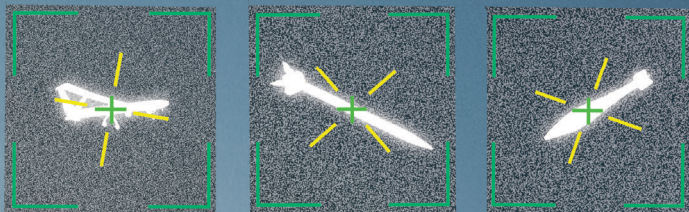
You can reach the Office of Ethics & Business Conduct at 888-970-7171; fax: 888-970-5330; website: ethics.whq.boeing.com.

IAM PROMOTIONS

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

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A DIRECT SUCCESS FOR DIRECTED ENERGY.

Recently, Boeing and the U.S. Army successfully completed a series of tests using the High Energy Laser Mobile Demonstrator (HEL MD). Directed energy systems will provide cost-effective capabilities to counter rocket, artillery and mortar (C-RAM), and threats from unmanned aerial vehicles. The HEL MD is harnessing the power of directed energy to strengthen and protect the warfighter.



A photograph of a worker, Shalamar Miller, inspecting a V-22 Osprey production line. He is wearing safety glasses and a grey t-shirt, holding a yellow flashlight. The background shows the complex machinery and structure of the aircraft's fuselage, with various cables and components visible. The lighting is dramatic, highlighting the worker and the intricate details of the aircraft's interior.

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Apache and Chinook helicopters are being produced for U.S. and international customers by Boeing employees more efficiently than ever before; the V-22 tilt-rotor Osprey is performing missions no other aircraft can do. And now Boeing has added the AH-6i Little Bird attack and reconnaissance helicopter to its rotary wing lineup. The company's Vertical Lift business has the right products at the right time, program leaders say. But expanding the business internationally is key to future success.

COVER: An AH-64E Apache demonstrates its low-level, or "nap of the earth," flight capabilities over the Arizona desert near Mesa, where it is built. **BOB FERGUSON/BOEING**

PHOTO: Shalamar Miller performs an inspection on the V-22 production line at Ridley Township, Pa. **FRED TROILO/BOEING**



28 PARTNERING FOR THE FUTURE

Although small in size, the Middle East nation of Qatar has growing influence around the world—and a growing partnership with Boeing. PHOTO: SHUTTERSTOCK

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Go for Zero—One Day at a Time, the companywide effort that aims to eliminate workplace injuries, is making a difference. PHOTO: GAIL HANUSA/BOEING



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Boeing advancements in directed energy include laser technology that can blast incoming mortar rounds out of the sky. PHOTO: ERIC SHINDELBOWER/BOEING

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The 787 set the bar on flight-deck technology, but Boeing pilots and engineers such as Bob Myers already are working on next steps. PHOTO: MARIAN LOCKHART/BOEING

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For Your Eyes Only.

And everyone's safety. Wear 'em.



One Day at a Time.

LEADERSHIP MESSAGE

Greg Smith

Executive vice president and chief financial officer

Building an even bigger, better Boeing

We all play a key role in driving productivity and profitable growth

We are off to a great start this year. Our first-quarter financial performance reflects the strength of our order backlog and demand for our products and services, and our continued focus on driving productivity and execution through the entire enterprise.

The foundation of this strong performance is an intense focus on execution across the entire business with powerful and effective day-to-day performance metrics such as safety, on-time deliveries, first-time quality and productivity, all of which ultimately drive strong financial results.

We all have a role in influencing

and driving strong performance and it starts with holding ourselves personally accountable to meet our commitments to our customers, driving productivity in all that we do, and embracing a continuous improvement culture. Striving to improve our work each day will build an even stronger Boeing for tomorrow.

This is an exciting and unprecedented time for our company. Our unmatched portfolio of products and services, attractive markets and a strong backlog provide us with a unique opportunity to drive significant value for our customers, employees and investors.

However, seizing that opportunity means that we must meet the demands of the intensely competitive, “more for less” market environment in which we operate.

Our customers are demanding more capabilities at lower costs, and both our traditional and newly emerging competitors are developing innovative products and aggressively improving productivity to build market share and capture the same opportunity that we see.

It is more important than ever for us to compete to win both through innovation, with superior products and services, and through cost-competitive

design and manufacture that delivers the right capability and efficiencies to our customers at the right price.

Winning in the marketplace today and driving strong financial results provides us the resources to continue to invest in our business and is critical to our future.

Expectations from our customers and shareholders are high and reflect the significant opportunities ahead. We must continue to exceed their expectations and deliver strong results.

How can you help? We all play a role in improving productivity and profitability. Let's all take personal accountability and responsibility to meet or exceed our objectives and use tools such as Lean+ and first-time quality to reduce waste, and look for opportunities to be more efficient in everything we do.

We have made great strides on productivity over the years, but day to day, we continue to have some great opportunities to capture more and that's exactly what we must do to win.

Let's work together and maintain that focus, which is essential to building an even bigger, stronger, more competitive Boeing—to benefit the future for all of us and those to follow. ■

PHOTO: BOB FERGUSON/BOEING



SNAPSHOT

Ready to jam

The rollout of the 100th EA-18G Growler last month in St. Louis had special significance as more than 1,000 Boeing employees, political leaders and other stakeholders gathered to recognize the Growler's unique electronic-warfare capability and to support its continued production to help protect U.S. warfighters. The Growler is a modified version of Boeing's F/A-18 Super Hornet and is built on the same production line. PHOTO: RICH RAU/BOEING





QUOTABLES

“The 777 is the difference between making a good profit and a stellar profit.”

—Tim Clark, president, Emirates Airline, which operates the largest fleet of 777-300ERs (Extended Range) of any airline. *Boeing News Now*, April 29

“No bucks, no Buck Rogers.”

—Chris Ferguson, director of Crew and Mission Operations for the CST-100 spacecraft program, on the importance of NASA funding to future space exploration. Ferguson commanded NASA's final space shuttle flight. *Universe Today*, May 9

“It has a mother and a father and there is a hybrid offspring.”

—Mike Carriker, chief pilot of the 777X program, on how the new jet will have flight-deck commonality with both the 777-300ER (Extended Range) and the 787 Dreamliner. *Aviation Week*, May 12 (For more on flight-deck technology see story, Page 40.)



WHAT WE DO

Hire purpose

Meet a Boeing recruiter helping shape Boeing's future—and a diverse and talented workforce

By Marcy Polhemus and photo by Marian Lockhart

La'Tonja Hunter is one of Boeing's professional recruiters in Shared Services Global Staffing. In this *Frontiers* series that profiles employees discussing their jobs, Hunter describes the company's efforts—and hers—to find talent for Boeing's future workforce.

As a diversity recruiter I have an opportunity to help shape the current and future workforce of Boeing, and make an impact on the company's bottom line.

I am one of five diversity recruiters in Global Staffing, responsible for recruiting efforts in the United States specifically targeting female and minority talent. Our work will have a profound impact on Boeing for many years to come. Not everyone at Boeing has that kind of responsibility.

I've been a recruiter for more than 12 years and one of the things I truly enjoy about my job is the outreach component and working one on one with job seekers.

I met a manufacturing engineer at a smaller career fair in Seattle who was on the fence about attending an upcoming National Society of Black Engineers national conference in Nashville, Tenn. I let him know that Boeing would be recruiting at the event and that hiring managers would be there to perform interviews on the spot. Well, he did attend—and he interviewed and received an offer from Boeing. He later emailed me that he wouldn't be in this position without me. It made my day.

I like that we help the hiring managers, too. One manager told me recently after a hiring event that "It is events like these that will truly make a difference in Boeing."

Our outreach efforts with diverse communities have special meaning for me because I'm part of those communities and I know how important those connections to others are. There are job seekers who fly hundreds of miles to Seattle to attend a career fair because Boeing will be there.

This experience is full circle for me. Growing up in the Beacon Hill neighborhood of Seattle, I could look out and see Boeing Field, and I remember being fascinated with the many different airplanes arriving and departing. It's exciting to know I am now working for Boeing, a global company with great influence, and I'm part of an organization that is responsible for attracting and recruiting talented men and women to our company—because they are our future. ■

marcy.polhemus@boeing.com

La'Tonja Hunter

HAS WORKED FOR BOEING:

2 years

ORGANIZATION:

Global Staffing,
Shared Services
Group

HAS BEEN PART OF A TEAM
COMPRISING:

5 diversity
recruiters

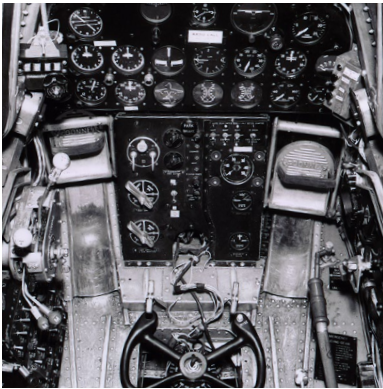
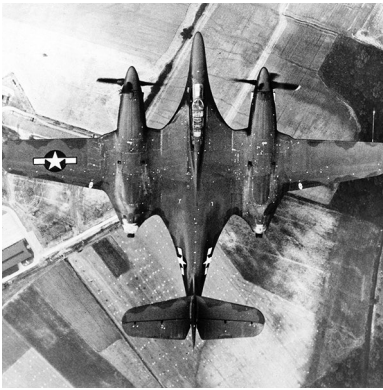
HISTORICAL PERSPECTIVE

'Bat' to the future

The XP-67 helped take McDonnell Aircraft into the airplane manufacturing business

By Henry T. Brownlee Jr.





PHOTOS: (Clockwise from far left) The XP-67 had a futuristic design and curved airfoil; from this view of the XP-67 in flight, it is easy to see why some called it the “Bat”; a view of the cockpit; McDonnell Aircraft chief test pilot E.E. Elliot prior to first flight of the XP-67 in 1944. **BOEING ARCHIVES**

Any aircraft known as “Moonbat” has to be a bit different—and the XP-67 certainly was.

Developed in the early years of World War II under a cloak of secrecy by a just-starting-out McDonnell Aircraft Corp., the XP-67 quickly picked up the monikers “Bat” and “Moonbat” because of its futuristic design and smoothly curved airfoil. But it would not be around long enough to get an official name. Only one prototype was built.

Even so, the work engineers did on the prototype provided the company with a wealth of aircraft design and manufacturing experience, opening the door for McDonnell Aircraft to enter the airplane manufacturing business. It would not be long before the McDonnell name was on some of the world’s top jet fighters.

McDonnell Aircraft, a Boeing heritage company, was an aerospace parts maker when it entered a U.S. Army Air Corps competition in 1940 for a high-speed, high-altitude, long-range interceptor that could shoot down enemy bombers and perform other missions. The military wanted an innovative and radical design that could outperform any fighter of the day.

Only a year before, in July 1939, James S. McDonnell had opened his company in St. Louis. It began primarily as a subcontractor for Boeing and Douglas, making subassemblies for their products. But McDonnell wanted to build and sell aircraft of his own design. That opportunity came with the request for proposal issued by the U.S. Army Air Corps.

The company’s initial offering to win the contract was the Model I, similar in concept to the Vultee XP-54, the Curtiss XP-55, and Northrop’s XP-56, with push propellers behind the cockpit. But the McDonnell entry finished near the bottom of some two dozen proposals from various manufacturers. McDonnell engineers continued to modify their design, and in April 1941 submitted a proposal for what would become the XP-67. A month later, the Army Air Corps awarded McDonnell Aircraft a contract to build two prototypes.

With the curved surfaces of the XP-67, the McDonnell team tried to achieve what’s known as laminar flow—the uninterrupted flow of air over an aircraft’s wings or other

surfaces. The smoother the airflow, the less drag and the more efficient the aircraft.

The prototype was equipped with two turbo-supercharged Continental XI-1430-17/19s engines. It was 44 feet 9 inches (13.6 meters) long, with a 55-foot (16.8-meter) wingspan. It was designed to cruise at 210 mph (340 kilometers per hour) and a maximum speed of 405 mph (650 kilometers per hour). And it would be heavily armed, with six 37 mm cannons.

But the aircraft proved a major engineering challenge. Wind-tunnel testing uncovered problems, including engine-cooling airflow. Engineers also learned that unless manufacturing tolerances were highly controlled to produce an exceptionally smooth skin finish, the benefits of the laminar-flow airfoil would be lost.

But it was the prototype’s engines that doomed it. They were underpowered, and they overheated. During taxi testing leading up to first flight, the engines caught fire.

McDonnell’s chief test pilot E.E. Elliot took the XP-67 on its first flight on Jan. 6, 1944. Although most of the serious stability and aerodynamic problems found during flight testing were eventually resolved, the engine deficiencies were not. During a Sept. 6, 1944, test flight at Lambert Field in St. Louis, the right engine burst into flames. Elliot managed to land the XP-67 safely, but the prototype was lost. McDonnell wanted the Army Air Corps to provide the money to replace the engines with a different kind. Instead, the program was canceled and the second prototype not completed.

The XP-67 was the only piston-engine airplane McDonnell Aircraft ever produced. Jet-powered aircraft were on the way. But the XP-67 had provided the company just what it needed to become a major player in jet-fighter design and manufacturing, starting with the FH-1 Phantom. It was followed by many others, including the F2H Banshee, F3H Demon, F-101 Voodoo and F-4 Phantom. ■

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To learn more and see a video about the XP-67 fighter, visit boeing.com/boeing/history/mdc/xp-67.page



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ality.

Commercial Airplanes
.....
Quality is personal.



BANKING ON IT

U.S. Export-Import Bank crucial link to financing for many airline customers

By Tim Neale

When Kenya Airways took delivery of its first 787 in April, it was a high-profile event—a celebration marking the airline’s acquisition of the fuel-efficient Dreamliner for its growing international business. Less noticed were the months of preparation that preceded the delivery and the airplane’s entry into service, including the carrier’s search for financing.

With the help of the Export-Import Bank of the United States, and the support of Boeing Capital Corp. (BCC), Kenya Airways eventually secured a commercial loan at a competitive rate.

“Financing can be a challenge for some airlines, especially if the company is based in a developing region.”

In 2013, the Export-Import Bank of the U.S. facilitated financing for:



123 Boeing jetliners



\$34.7 billion of U.S. Exports

Source: Export-Import Bank of the U.S.



said Marc Allen, president of Boeing Capital. "That's where BCC comes in. Our mission is to help our customers get workable financing in place ahead of every delivery."

"Ex-Im," as the bank is commonly called, is an 80-year-old federal agency that is small but plays a very large role in U.S. exports, one of the biggest of which is Boeing's commercial airplanes. In 2013, the bank facilitated financing for \$34.7 billion of U.S. exports, including 123 Boeing jetliners, and it returned more than \$1 billion to the U.S. Treasury through the fees it charges for its loan guarantees, according to the bank.

But the bank is under attack in Congress.

"This is a vitally important issue to the future success of our company, our suppliers, and all the people who design, build and support Boeing commercial airplanes," Tim Keating, Boeing's senior vice president for Government Operations, said of the ongoing political debate over the bank.

The bank's authority to operate expires Sept. 30, and while many members of Congress support the bank, according to Keating, a vocal minority wants to abolish it, including

the chairman of the House committee with jurisdiction over the bank.

"That would have a significant negative effect on our business because our competitors all have government export credit programs that support their international sales—three European government programs in the case of Airbus," said John Wojick, senior vice president, Global Sales and Marketing, Commercial Airplanes.

"If Congress shuts down Ex-Im, airlines still will be buying airplanes," he added. "That's not the issue. The issue will be who is making them—Boeing or Airbus—and the answer is likely to be Airbus."

Wojick estimates that hundreds of airplane sales would be in jeopardy over the next few years alone without Ex-Im support for customer financing.

"Already we're hearing from customers who are concerned about the future of Ex-Im, and they're being very candid with us about what may happen if U.S. export credit becomes unavailable," he said.

Given the stakes, Keating said Boeing will need employees to voice support for the bank.

He said U.S. companies in other industries likewise are concerned

HELPING CONNECT AFRICA

The livery of Kenya Airways' first new 787 Dreamliner proclaims it the "Pride of Africa."

Even Kenya President Uhuru Kenyatta was on hand at Jomo Kenyatta International Airport in Nairobi last month to welcome the 787 when it arrived after a delivery flight from Everett, Wash.

"There's a great deal of pride in the airline. It's a pride of all the Kenyans," said Titus Naikuni, the airline's chief executive officer, who is a member of the country's famed Maasai tribe.

Kenya is establishing itself as a growing business hub for east and central Africa. It also serves markets, particularly Europe, with thriving agriculture and horticulture exports.

It makes Kenya Airways an ideal candidate under efforts by the U.S. Export-Import Bank to help emerging nations in Africa succeed with the help of technologies supplied by the United States, said Rob Faye, Commercial Airplanes sales director for the airline.

"Africa's ground infrastructure is challenged in most nations," Faye explained. "The air bridge between developed countries and developing countries like Kenya are vital to the growth of their economy. Without it, the economy stagnates."

Naikuni said his operation has been quick to fill the role with the help of Boeing 737s, 767s, 777s and now the 787.

"What Kenya Airways does is help to connect a lot of business people with Africa, with Kenya and, for a lot of Kenyans, the rest of Africa," Naikuni said. "In terms of the economy, we mean quite a lot to many economies in Africa." ■

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PHOTO: The first of nine 787 Dreamliners set to join the Kenya Airways fleet awaits departure from Everett, Wash., for Nairobi.

COLLEEN PFEILSCHIEFTER/BOEING



about the fate of Ex-Im because all of the world's major exporting nations have their own government export credit programs—60 nations in all.

"If Congress eliminates Ex-Im, the United States will be the only country without this important competitive tool," Keating said. "U.S. exporters will lose billions of dollars of international business annually, and thousands of American jobs will be in jeopardy. Unilateral disarmament is not a winning strategy for our country."

So why are some members of Congress opposed to Ex-Im?

The reasons most often heard are that Ex-Im exists for the benefit of giant corporations that do not need such

assistance; that Ex-Im loan guarantees distort commercial credit markets; that the bank's portfolio of loans represents a risk that taxpayers should not have to bear; and the bank is putting U.S. airlines at a competitive disadvantage against foreign carriers.

Keating addressed those concerns:

→ Almost 90 percent of Ex-Im's transactions last year involved small business, he said. What's more, the thousands of small U.S. businesses that supply parts and services to large exporters such as Boeing, Caterpillar and GE benefit from Ex-Im just as much as the big players.

→ As for allegations of market distortion, the bank's charter specifically mandates that it not compete with commercial lenders but complement private-sector lending, Keating said. "Ex-Im steps in when commercial loans are too costly or in some cases unavailable."

→ The bank's default rate is less than 2 percent over its 80-year history, and last year its default rate was a miniscule one-quarter of 1 percent, according to Keating. "Ex-Im does an excellent job analyzing risk—arguably better than many commercial lenders."

→ There is no evidence that Ex-Im disadvantages U.S. airlines against foreign carriers, Keating said. "The cost of government export credit financing has doubled and is now on par with commercial rates. In addition, U.S.

airlines have been raising money in the U.S. bond market and enjoying some of the lowest financing costs in the world."

Titus Naikuni, chief executive of Kenya Airways, spoke of the importance of Ex-Im and of long-standing relationships when doing large financial transactions. "We've understood them (Ex-Im) and they've understood us. We've been able to have a smooth flow. The way that Ex-Im works is very professional."

Boeing Capital has supported Kenya's transactions with the bank for more than 10 years—transactions that have enabled the airline to secure financing for 737s, 767s, 777s and now the 787.

"It was a win for everyone concerned," Allen, BCC's president, said of the bank financing that allowed Kenya Airways to fly home to Nairobi its first 787 Dreamliner. "The airline got a new, moneymaking asset, Kenya got vital new commercial links to global markets, and Boeing closed a deal with a valued customer. And Ex-Im booked with the U.S. Treasury the significant fees Kenya Airways paid for its loan guarantees." ■

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To learn more about the Export-Import Bank visit www.exim.gov. You also will find a website dedicated to this issue at www.nam.org.

"The way that Ex-Im works is very professional."

—Titus Naikuni, Kenya Airways CEO

PHOTO: GAIL HANUSA/BOEING



90%

Almost 90 percent of Ex-Im's transactions in 2013 involved **SMALL BUSINESSES.**

Source: Export-Import Bank of the U.S.

2%

Over its 80-year history, Ex-Im Bank has had a **DEFAULT RATE** of less than 2 percent.

CUSTOMER PROFILE

HUB OF OPPORTUNITY

Copa Airlines relies on 737s to connect Panama to booming Latin America market

By Jim Proulx



A major factor in business success is being in the right place at the right time. Copa Airlines is a prime example. Copa's Hub of the Americas is based at Tocumen International Airport in Panama City. Seated at the juncture of two vast continents, Copa connects travelers throughout North, Central and South America and the Caribbean.

And it is doing so using Boeing's best-selling Next-Generation 737.

"The Next-Generation 737 has been fundamental to Copa's efforts to create the premier airline in Latin America," said Pedro Heilbron, chief executive officer of Copa Airlines. "A better product means a better travel experience for our passengers, in terms of comfort, performance and reliability. We appreciate how Boeing constantly works with us to give us an even better 737 to meet our operational needs."

The 737 forms the backbone of Copa's 91-airplane fleet. The airliner operates more than 60 737-700s and 737-800s. Heilbron said the 737 is key to Copa's strong on-time performance and reliable schedule—and cost savings.

Copa was the first carrier in Latin America to offer the 737 Boeing Sky Interior, the first in Latin America to operate advanced RNP (required navigation performance) procedures and the first in Latin America to add the Blended Winglet to its 737 fleet. In April, Copa also became first in Latin America to install the new Split Scimitar winglet, developed by Aviation Partners Boeing, on a 737-800.

Founded in 1947 as Compañía Panameña de Aviación, S.A., Copa began service as the national carrier of Panama by operating domestic flights to three cities around the country using Douglas DC-3s.

Today, all Copa's flights from Tocumen are international. The airline serves daily scheduled flights to 69 destinations in 30 countries. Its subsidiary, Copa Colombia, operates domestic flights within Colombia, plus several regional international routes—with more planned for the future.

In 1998, Copa Airlines began a strategic alliance with Continental Airlines, conducting joint marketing and code-sharing arrangements and

frequent-flyer programs. That alliance is reflected in Copa's livery. It is a similar livery to that of United, which merged with Continental in 2010.

Heilbron said Copa will continue to do what it does best—use its growing fleet of 737s to expand service in the fast-growing Latin America market while focusing on low cost and superior service.

In 2013, Copa earned "Best Airline in Central America and the Caribbean" honors from Skytrax.

"Copa Airlines has been a great partner for Boeing for decades," said Van Rex Gallard, vice president, Sales, Latin America, Africa and the Caribbean, Boeing Commercial Airplanes. "Copa has taken the great efficiency, reliability and low-operating cost of the Next-Generation 737 and has used it to build a great product for its passengers, a great asset for the nation of Panama and a great investment for its shareholders." ■

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GRAPHIC: The 737 forms the backbone of the Copa Airlines fleet. Shown is a 737-800 with a new post-production Split Scimitar winglet. **BOEING**

GOING VERTICAL

Vertical Lift is flying high—
and the challenge is to
keep it there

By Hal Klopfer





PHOTOS: (Opposite page) An AH-64 Apache hovers over water during testing. **BOB FERGUSON/BOEING** (This page, clockwise from top) A Chinook for the United Kingdom Royal Air Force is shown in flight. **DAVID ANDREWS/BOEING** The production version of the AH-6 light attack/reconnaissance helicopter made its first flight in May in Mesa; employees Elizabeth Campbell, left, and Charles Powell were part of that flight's engineering test team. **BOB FERGUSON/BOEING** An HMX-1 squadron V-22 is repositioned on the flight ramp at Boeing's Philadelphia site. The aircraft is tasked with presidential support missions. **FRED TROILO/BOEING**



Gazing out across the sprawling cityscape of New Delhi last year, Tom Marcacci could see massive construction projects everywhere, a reminder that India is a country burgeoning with opportunity.

Recently, while in the Middle East on another assignment for Boeing Military Aircraft and its Vertical Lift business, he had a similar feeling as he looked at myriad new office buildings breaking up the waves of white sand and grand palm trees.

In both cases, Marcacci envisioned growth opportunities for the company's Vertical Lift programs, which are being selected to meet defense needs in these growing markets.

"Ultimately—and together—our

customers and partners will be able to experience new technologies that will brighten our mutual futures for decades to come," said Marcacci, who works on international growth for the AH-64 Apache and AH-6i helicopter programs from his Mesa, Ariz., office and makes frequent trips overseas.

More than 30 countries around the world operate at least one of Boeing's Vertical Lift products—the Chinook heavy-lift transport helicopter, the Apache attack helicopter, the V-22 Osprey tilt-rotor, and the Mission Enhanced Little Bird, the predecessor to the new AH-6i light attack/reconnaissance helicopter.

Many of these countries also are among numerous campaigns in the Asia Pacific, Europe, Middle East



and Latin America regions underway with Boeing for more Vertical Lift aircraft, or for upgrades to ones they already operate.

But past and current success does not guarantee future business.

“Although Vertical Lift has been very successful in recent years, we face some very significant challenges over the next decade as our customers around the world confront the realities of shrinking defense budgets,” said David Koopersmith, vice president and general manager of Vertical Lift.

“Our current product platforms are solid and have a lot to offer the United States’ international allies and our strategic partners. But to secure new business in the future, and remain affordable on all of our product lines, we must expand globally through teaming, co-production, shared developments and more.”

Boeing, he added, must continue to have “the right products with the right capabilities at the right time in the right place.

“Our Vertical Lift team is well aligned with the company’s strategic imperative to expand our global advantage,” he said. “We’re charting the course to meet or exceed our goal to grow and sustain our international defense business at 30 percent of overall sales. Over the course of our five-year, long-range business plan, we anticipate that approximately 35 percent of our sales will be from

international customers.”

To that end, Vertical Lift, part of Defense, Space & Security, has been implementing those critical strategies necessary to ensure future success in the U.S. and around the world.

For example:

→ Boeing teams are building aircraft more efficiently and affordably than ever before, helping drive down costs. One example: The new F-model Chinook has a machined airframe that eliminates the need for 400 parts.

→ Vertical Lift is working with customers to improve the Chinooks and Apaches they already have. The Netherlands, for example, was the first international customer of the AH-64D Apache, originally purchasing 30 of these helicopters. Those Apaches are now being upgraded, including an improved communications system. Boeing will modify a total of eight Dutch aircraft at Fort Hood, Texas, and will support the Royal Netherlands Air Force as it upgrades the remainder of the helicopter fleet in the Netherlands.

→ Boeing is producing Apache and Chinook “kits” that are sent overseas for final assembly, integration, flight testing and delivery by licensed manufacturers. Other products, including the V-22 Osprey and the AH-6i, are candidates for co-production.

By working with proven manufacturers such as AgustaWestland in Italy

for the ICH-47 Chinook, Boeing is finding new and formerly inaccessible markets. This type of arrangement means helicopters that may never have been directly built by Boeing are now coming to life with the help of the company’s non-U.S. partners, while sustaining jobs in the U.S., Koopersmith said.

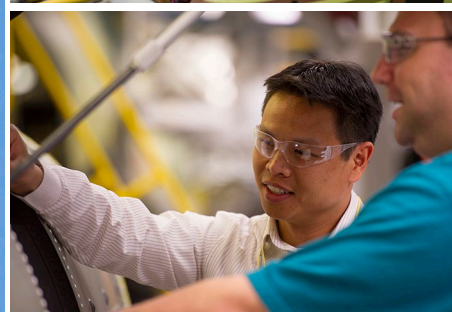
Engaging the local industry not only assists in securing business opportunities in the country but also introduces new skills and talent to Boeing, Koopersmith noted. In the end, both Boeing and its production partners provide and sustain essential ongoing jobs and skills domestically and abroad.

The Vertical Lift team in Philadelphia builds and packages the ICH-47F into kits and then authorizes partner AgustaWestland to build the final

(Continued on Page 26)

PHOTOS: (This page) A CH-47F Chinook waits for fog to lift before starting flight operations at Ridley Township, Pa. **FRED TROILO/BOEING** (Opposite page, clockwise from top right) Two CH-147F Chinooks recently delivered to Canada. **450 SQN, RCAF** Aircraft Assembly Technician Bob Schmeckpeper installs a tip cap for an Apache’s antenna in Mesa, Ariz. **MIKE GOETTINGS/BOEING** Mechanics Charles Lee, left, and Michael Patrone help inspect a Chinook assembly. **FRED TROILO/BOEING** A Boeing AH-64D Apache operated by the Royal Netherlands Air Force rolls inverted and releases flares. **BOEING**





The vertical edge

Boeing's Vertical Lift business has four major production lines in operation at its two facilities in Mesa, Ariz., and Ridley Township, Pa.

In Mesa, the focus is on the AH-64E Apache attack helicopter and the new AH-6i Little Bird attack and reconnaissance helicopter. In Ridley Township, the emphasis is on H-47 Chinook variants, including the CH-47F and Mk6 models, and the V-22 tilt-rotor Osprey.

In 2013, Boeing delivered more than 80 Apaches to defense forces worldwide. The U.S. Army took delivery of 55 AH-64E Apaches, raising the total number of E models to more than 100 as of May 2014.

Last year, Boeing delivered 58 Chinooks to customers. The U.S. Army took delivery of 46 CH-47Fs, raising the total number of F-models delivered to more than 265; seven CH-147Fs went to Canada; and the first three Mk6 Chinooks

were delivered to the United Kingdom, along with the final Chinooks to the Netherlands.

In 2013, new international business for the Chinook program included orders from United Arab Emirates, Turkey and Australia. This year, the Chinook program is pursuing additional international business including opportunities in India, the Middle East and the Netherlands.

Meanwhile, Boeing and the U.S. Army last year signed a contract to provide new AH-64E Apache attack helicopters to the Republic of Korea for the first time. The Republic of Korea Army will be the 14th nation to operate Apache helicopters.

And the V-22 program is looking toward growth internationally. Several countries, including Israel, have expressed interest in the versatile aircraft. ■

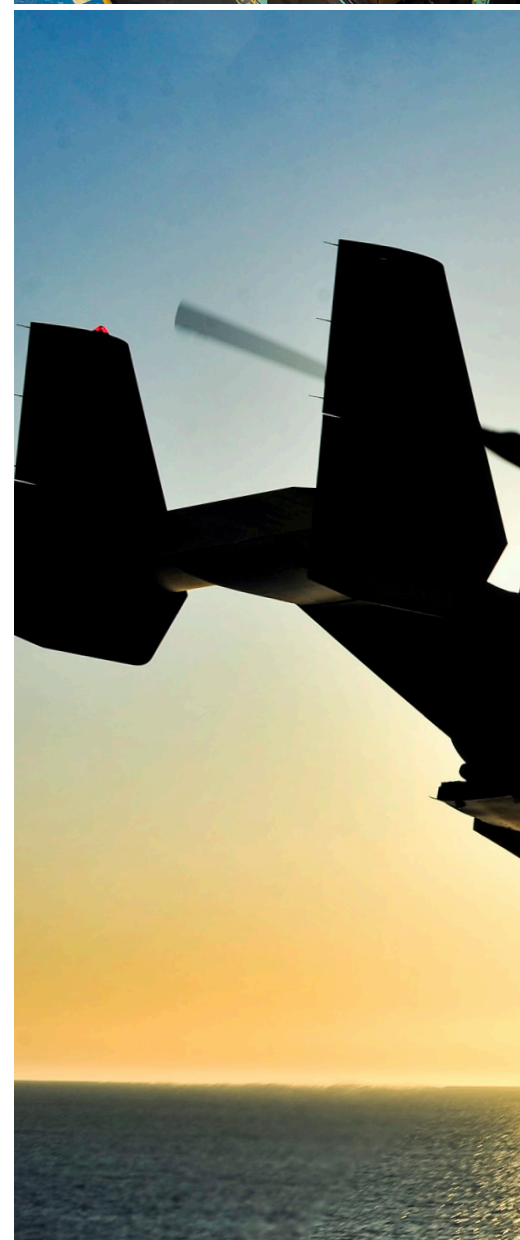
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An AH-64E Apache multi-role attack helicopter maneuvers over saguaro cactuses in the Arizona desert near Boeing's site in Mesa, where the Apache is produced. The E model is known for its ability to seek and eliminate otherwise undetectable threats to ground troops. **BOB FERGUSON/BOEING**

To download this image as a wallpaper for your computer screen, [click here](#).







product. The first of these aircraft is now in flight testing. The program calls for 16 aircraft to be delivered to the Italian Ministry of Defense over the next several years.

John Martire is a Boeing Chinook engineer working at the AgustaWestland site in Verigate, Italy.

For nearly a year, Martire has worked side by side with his AgustaWestland counterparts, building friendships in and out of the workplace. He is of Italian descent, so he feels a special kinship with his host nation and has invested time in learning more about his heritage.

He said trust is one of the keys to Boeing's success on the co-development program.

"Developing a relationship of trust and dependability with our international customers is essential to the success of the CH-47 Chinook as a global enterprise," Martire explained.

The Vertical Lift organization also is working closely with Global Services & Support to bring a new level of production, service and support to customers. The Netherlands is one example. So is the United Kingdom.

In the Netherlands, Ben Indahl's office at Woensdrecht Air Base is only minutes from giant windmills that are stark reminders of the traditional perception of the Netherlands, and how different that is from the country's 21st-century global presence. Indahl, with Boeing's Global Services & Support, is there to help with that country's Apache and Chinook helicopters.

"By having a Boeing representative located with them on their base, on their time zone, we can get real-time feedback, collaboration and support," Indahl said. It also helps Boeing's understanding of any specific issues or problems and fosters open communication and support solutions that will help increase aircraft availability and lower long-term operational and support costs, he said.

"I had a colonel with the Royal Netherlands Air Force tell me that he likes the idea that if he has an issue at 7 a.m. on a Monday morning, he can call me and in 10 minutes I can be in his office to help resolve a problem," Indahl said. "It's part of our vision to view the air force as a partner and not just as a customer."

Meanwhile, in the United Kingdom, Boeing's Neil Bevan travels across the country to various Boeing, customer, supplier and other locations from the picturesque Herefordshire town of Ledbury, located in the shadow of the Malvern Hills.

Bevan, who joined Boeing two years ago after a career in the British nuclear and defense industry, works for Boeing's rotorcraft support program in the U.K., specifically supporting the Chinook's modification and upgrade programs. This includes a digital cockpit and digital automatic flight control system upgrade across the U.K. fleet. His customer's office is in Bristol, with the main Chinook operating base at RAF Odiham.

"The United Kingdom created a

model for how to establish rotorcraft support operations outside the United States,” Bevan said. “Our approach with our United Kingdom customer is to offer a cost-effective balance of both U.K. employees and expertise from throughout the wider Boeing organization.”

That’s an essential part of Boeing’s affordability strategy and customer support that will help drive new business opportunities for Vertical Lift, Bevan and others say.

“We’re not simply looking for new sales,” explained Rich Meanor, a

Vertical Lift international Business Development lead who has been focusing on new business opportunities in parts of Eastern Europe.

“We’re offering comprehensive packages for customers that cover everything from the aircraft to its maintenance and training needs for the life of the product,” he said. “That sets the groundwork for more business—including upgrades and service opportunities—in the future.”

Added Marcacci: “Boeing is demonstrating to our customers that we can be trusted, that we do deliver

on our promises. It’s a slow process in developing these positive relationships, but it is working.” ■

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PHOTOS: (From far left) Jonathan Greer, left, and Tanya Boyer on the Chinook line; V-22 mechanic David Krah assembles an Osprey. **FRED TROILO/BOEING** David Sowersby, aircraft assembly technician, installs upper controls on an Apache while teammate Brooke Hansen works on Crew Station components. **MIKE GOETTINGS/BOEING** An MV-22 Osprey lifts off from the aircraft carrier USS *Carl Vinson*. **U.S. NAVY**



The Qatar

Boeing's growing presence in Qatar is more than just good business

By Eric Fetters-Walp



Qatar is relatively small in both geography and population, but it is growing into a nation with influence, both regionally on the Arabian Peninsula and around the world.

It is the world's largest exporter of liquefied natural gas. The Al Jazeera media network, which now broadcasts to a worldwide audience in multiple languages, is based there. In 2022, Qatar will become the first host country ever in the Middle East for soccer's prestigious FIFA World Cup. The national flag-carrier airline, in just more than 20 years, has become one of the world's

fastest-growing airlines by specializing in globe-spanning international routes. The nation also is investing in diversifying its economy for the future.

Qatar is a growing market for Boeing's military and commercial products, underscoring the importance of a relationship that dates back to the 1970s.

"Qatar performs well above what you would expect of a nation with 2 million people," said Jeff Johnson, president of Boeing Middle East. "Here's an example of a nation that's developed its natural resources—both its oil and gas

reserves and its location. It happens to be an eight-hour flight away from two-thirds of the world's population."

Qatar's emerging role as a global airline hub will be boosted by the recent opening of Hamad International Airport in the capital city of Doha. The state-of-the-art \$15 billion airport is designed to handle at least 50 million passengers annually upon its completion. In late 2010, Boeing opened its first office in Qatar to more directly support Boeing Defense, Space & Security and Commercial Airplanes customers there.

edge



“Opening an office in Doha was a significant demonstration of our long-term interest not only in the market of Qatar but also in partnering with the nation in some of its aspirations for the future,” said Shep Hill, president of Boeing International and senior vice president of Business Development and Strategy. “I think we have been competitively successful there based on our products, based on our services and based on our growing local presence.”

Within a half-dozen years of modern Qatar’s independence from Britain in December 1971, Boeing was delivering

a 707-300 to the nation’s airline. Qatar now represents the 15th-largest market in the world for Commercial Airplanes, Johnson said.

That is due solely to Qatar Airways, which is using new long-range, twin-aisle airplanes, such as the 777 and the 787, that can fly nonstop between Doha and much of the globe. In 2012 Qatar Airways became the first Middle Eastern airline to fly the 787, and it has 30 Dreamliners on order. In addition, Qatar Airways has ordered 44 777 models, including freighters, since the mid-1990s.

“For Qatar Airways, the Boeing 777 is our flagship aircraft. It has been the backbone of the fleet,” Qatar Airways Chief Executive Officer Akbar Al Baker said in a statement at last year’s Dubai Airshow as he signed the airline’s letter of intent to purchase 50 777-9X airplanes. “Operational on many of the routes Qatar Airways flies to, it is well-admired by our crew and passengers alike.”

The airline has developed a

PHOTO: Doha, the capital of Qatar, borders the Arabian Gulf. **GETTY IMAGES**

strong reputation for quality among passengers, winning three honors at the Skytrax 2013 World Airline Awards, including the World's Best Business Class and Best Airline Staff Service in the Middle East awards.

"Boeing and Qatar Airways have enjoyed a strong partnership that began with its first order for 22 777s in 2006," said Marty Bentrott, vice president of Sales for Middle East, Russia and Central Asia, Commercial Airplanes. "Since then, we are proud that Qatar Airways has continued to invest in Boeing airplanes with an order for 787s and a recent commitment for the 777X. With the Middle East commercial aviation sector set to grow rapidly, Qatar Airways has undoubtedly proved itself to be one of the major and key players as it expands its fleet and network across the globe."

While Qatar's airline gains attention among worldwide travelers, the nation also is enlisting Boeing products to update and expand its defense capabilities. In March, the Qatari government announced its intent to contract to buy 24 AH-64E Apache attack helicopters and three Boeing 737 Airborne Early Warning and Control, or AEW&C, aircraft.

"Qatar is one of the most important and strategic customers in the Middle East for Boeing's defense business," said Paul Oliver, vice president of International Business Development for the Middle East and Africa at Boeing Defense, Space & Security. "We're extremely proud of the growing relationship Boeing has with the country."

He pointed out that Qatar was the first Middle East customer for the C-17 airlifter, and within weeks of its delivery it was being used for humanitarian aid missions to Chile, Haiti and elsewhere around the world in the aftermath of devastating earthquakes and other natural disasters. Qatar now has four of the aircraft.

Qatar also is evaluating its jet-fighter options in an ongoing competition, for which Boeing has offered its advanced F-15 and F/A-18E/F Super Hornet candidates. Qatar has indicated it



QATAR AT A GLANCE



AREA:

4,473 square miles
(11,586 square kilometers)
Slightly smaller than the
U.S. state of Connecticut

GROSS DOMESTIC PRODUCT, 2012:

\$185.3 billion (U.S.)
Ranked 59th worldwide; based on
per-capita GDP, Qatar is ranked the
richest nation in the world

POPULATION, 2013:

2.04 million
Ranked 147th in the world

NOTABLE:

No. 1 exporter
of liquefied natural gas

Sources: U.S. government, World Bank, Boeing Middle East

could purchase between 36 and 72 fighters in all, according to Hill. And there are other Boeing military products that may eventually win orders from the country, Hill said.

As Qatar's business with Boeing has grown, so have the company's presence and civic involvement. Boeing Research & Technology, for example, signed an agreement in 2011 with the Qatar Foundation's Qatar Computing Research Institute to perform data analytics for Boeing in the Arabic language. When that project was completed ahead of schedule, Boeing signed a \$1 million agreement with the institute, which will perform advanced analytics work. Data analytics is one of the niche high-tech industries in which Qatar has invested as part of its economic diversification efforts, Johnson said.

Boeing has sponsored opportunities for university students from Qatar, held educational outreach activities for children through the Qatar Foundation

and the Seattle-based Museum of Flight, and organized a series of lectures featuring Boeing leaders and a former U.S. astronaut.

The company also has pursued corporate citizenship programs in Qatar. These include supporting INJAZ/ Junior Achievement, an entrepreneurship training program for university-level students. Additionally, Boeing has supported training for parents, teachers and caregivers that emphasizes the importance of early education from birth to age 5. Through the Arab Youth Venture Foundation, Boeing has launched a teacher training course that uses an applied, problem-based curriculum developed by NASA, the U.S. space agency, to help Qatari teachers make math and science fun and relevant in the classroom.

Such efforts show Qatar and its residents the depth of Boeing's commitment to the country, but they also help Boeing stand out in an area

where competition is growing, Hill said.

"Anytime we're helping an economy diversify or training young people and giving them opportunities, that helps expand the pie globally," he said. "And it's differentiating us from our competitors because we are local, because we have a valued presence, and because we align our business strategy with the national aspirations of the country." ■

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PHOTOS: (Clockwise from far left) Doha's recently opened Hamad International Airport is designed to handle at least 50 million passengers annually upon completion. **GETTY IMAGES** Qatar's first 787 Dreamliner, shown in Qatar Airways livery, was delivered in November 2012; a Boeing C-17 Globemaster III airlifter in Qatar livery; a Boeing AH-64 Apache attack helicopter in flight. **BOEING** Qatar's first Boeing jetliner, a 777-300ER (Extended Range), received a water-cannon salute upon its arrival in Doha in 2007. **QATAR AIRWAYS**



TARGETS DESTROYED —

at the speed of light

Advancements in directed-energy weapons
have turned science fiction into reality

By Queena Jones and photos by Eric Shindelbower





At the White Sands Missile Range in New Mexico, Stephanie Blount, a Boeing electrophysics engineer, was blowing incoming mortar rounds out of the sky—with a weapon that once would have been the stuff of science fiction.

The High Energy Laser Mobile Demonstrator is a solid-state laser system developed for the U.S. Army by Boeing and designed to acquire, track and destroy threats such as mortars and unmanned aerial vehicles.

Blount, who has been with Boeing 20 years and works in Directed Energy & Strategic Systems, was at the controls last November during Army testing when the demonstrator destroyed approximately 70 mortar rounds and one unmanned aerial vehicle in flight.

She likened the experience to playing a video game.

“There’s nothing like seeing flaming wreckage,” Blount said. “People start shooting mortars, and you start shooting them down. It’s cool.”

The High Energy Laser Mobile Demonstrator, developed in Albuquerque, N.M., is but one of

a number of Boeing’s innovative directed-energy capabilities and is part of the Directed Energy & Strategic Systems portfolio.

Starting with precision-guided munitions, or “smart bombs,” that were introduced in the 1970s, lasers are revolutionizing warfare.

A few years ago, Directed Energy Systems modified a 747 with a powerful chemical laser. The Airborne Laser Test Bed successfully destroyed an in-flight ballistic missile—a historic achievement in laser capability. That program was eventually canceled by the U.S. Defense Department for budget reasons, but today Boeing employees are quickly advancing this speed-of-light capability in many new areas as a practical technology, such as the High Energy Laser Mobile Demonstrator.

“Directed energy is maturing rapidly to meet operational requirements, giving the military the right solution at the right time,” said Dave DeYoung, Directed Energy Systems director. “High-energy lasers meet needs in multiple domains, whether that’s a mobile unit for ground forces or

pairing a laser with a naval gun system to destroy small boat threats. The capabilities of high-energy lasers are endless. Directed Energy is a real differentiator for the programs Boeing offers.”

Laser weapons provide effective protection, with the only cost of operation that of powering the electricity, said Blaine Beardsley, program manager for the High Energy Laser Mobile Demonstrator. It takes just a cup and a half of diesel fuel to fire a 100-kilowatt laser for four seconds to destroy a target, he pointed out.

Military leaders have voiced concerns over continuing to use traditional missiles to counter rockets, artillery, mortars and unmanned aerial vehicles.

“I’m not sure we can afford to be firing an \$800,000 missile at an unmanned aerial vehicle, a rocket or a mortar—even an \$80,000 missile,” said

PHOTOS: (Far left) Electrophysics engineer Stephanie Blount works the controls of the High Energy Laser Mobile Demonstrator during testing in Albuquerque, N.M. (Above) The demonstrator in Huntsville, Ala.

Lt. Gen. William N. Phillips, who retired in April. He was principal military deputy to the assistant secretary of the Army (Acquisition, Logistics & Technology). “So investments that we continue to make in high-energy lasers and that capability ... are critically important for the Army of 2025.”

In recent Army testing, the High Energy Laser Mobile Demonstrator used a 10-kilowatt laser. It is designed to handle 50-kilowatt and 100-kilowatt lasers that are under development.

“Testing at 10 kilowatts gives us the opportunity to reduce risks and make improvements prior to installing a higher-power laser,” explained Blount, who has been involved with the system design from the start.

The High Energy Laser Mobile Demonstrator works like this, according to Blount:

From the moment the truck wheels stop until the laser is ready to engage targets takes less than 30 minutes. In that time, the vehicle driver flips the breakers, connects Ethernet cables and starts the on-board generator. The driver then takes care of seemingly minor details outside the truck, such as putting covers on the side mirrors as an extra precaution against reflected beams.

Inside the truck cab, the operator powers up the computer systems that will automate the firing of the laser.

In automated mode, the demonstrator does the work of directing the laser beam.

If the radar detects a ground target or unmanned aerial vehicle—something other than a ballistic target such as

a mortar round—the operator gets a directive to switch to manual mode and to determine whether the object is friend or foe. After verifying the target, the operator uses an Xbox-style controller to take command of the system.

“You see the target, lock on, get clearance to fire the laser, and start firing holes in things,” Blount said.

Imagine, she said, a 20-ounce soda bottle flying through the air miles away at roughly 200 mph (320 kilometers per hour), then directing a dime-size aim point on the bottle.

“The best beam-quality laser is one that produces the smallest spot when focused on a target,” she explained. “The smaller the spot on the target, the quicker you can kill it.”

A 60 mm mortar round is capable of hitting targets from more than three miles away, or about five kilometers. Being able to destroy an incoming mortar round is critical for warfighters, Blount said.

In May, Boeing and the U.S. Army Space & Missile Defense Command tested the High Energy Laser Mobile Demonstrator at Eglin Air Force Base in Florida.

Eglin provided a new environment for testing, with heavy rain, fog and low visibility. Among the test objectives were refining the high-energy laser’s aim point and measuring the laser’s strength over a distance.

“As testing continues, Boeing is bringing more resources and technology to the table,” DeYoung said. “Boeing investments made a huge difference in the Florida testing.”

The Boeing team also is evaluating ways to give the demonstrator a shoot-on-the-move capability.

Meanwhile, Boeing is working with the U.S. Army and the U.S. Navy to incorporate solid-state laser weapon systems on other platforms.

“When we build directed-energy systems, we transfer lessons to other systems to make sure designs that work are replicated,” Blount said.

Boeing has partnered with BAE Systems, for example, to build and test a ship-based 10-kilowatt Tactical Laser System with a machine gun system. The remote-controlled system provides defense against threats such as small boats and unmanned aerial vehicles.

Another derivative weapon system is the Manportable Laser, a lightweight, compact system that’s easily transported or mounted to a vehicle or other platform. It can be operated by an individual.

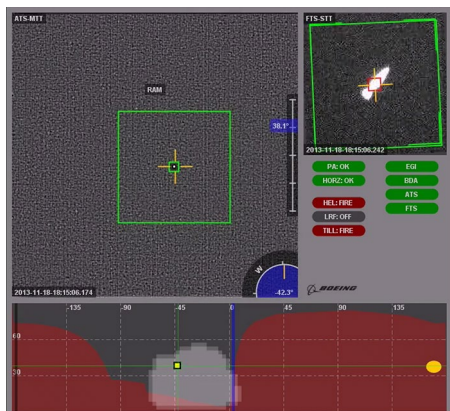
During a demonstration of the Manportable Laser, trainees suggested that Boeing map the controller keys like a popular video game to make operation almost intuitive, Blount said.

“Learning the system comes naturally to most young service members,” Blount said. “After a couple hours of training, they will be shooting down targets.” ■

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PHOTOS: (Below, left) A screen shot shows the high-energy laser locked on target.

BOEING (Below and right) Boeing and the U.S. Army Space & Missile Defense Command tested the demonstrator at Eglin Air Force Base, Fla., in May.



“The capabilities of high-
energy lasers are endless.”

—Dave DeYoung, Directed Energy Systems director





Safety first

Go for Zero is reducing workplace injuries as Boeing builds a robust safety culture

By Patrick Summers

For John Hopp and other mechanics, climbing on the exterior sections of a 747 fuselage in the Everett, Wash., factory is not only easier but safer.

A new lightweight support structure slides along the top of the fuselage and allows mechanics to work safely without the need for ladders and harnesses, which can restrict their freedom of movement, explained Hopp, a mechanic in 747 Wings & Body Structures.

It was designed by tooling engineers and built by mechanics.

“What we did together to create this support structure shows that when it comes to working safely, we watch out for one another, and we have each other’s backs,” Hopp said.

The new 747 fuselage tool is but

one example of workplace safety improvements and changing attitudes about safety across Boeing since last year’s launch of Go for Zero—One Day at a Time. The companywide safety-enhancement effort aims to eliminate workplace injuries. Boeing leaders say the effort helped drive down employee injuries that led to missed work to a record low in 2013.

“We’ve made a solid start on our journey to a zero-injury workplace,” said Ursula English, vice president of Environment, Health & Safety. “There is still a lot of work ahead of us; we can’t let up on our efforts to improve workplace safety.”

Over the past five years, Boeing reduced by 25 percent the injuries that caused employees to miss time

away from work. Now the company is significantly raising the goal and aiming to reduce injuries 25 percent every year.

“We’ve made significant changes that make it safer for employees working around hazards, and we’ve made great progress in implementing tooling and facilities improvements to make our offices and factories safer,” English said. “We’re asking everyone who steps onto a Boeing site, including customers and suppliers, to follow common-sense rules designed to eliminate risks.”

Go for Zero was launched early in 2013 following multiple incidents that resulted in serious injuries and two employee deaths. As part of the effort, all employees are asked to sign a Safety Promise to work safely and speak up if



they have a safety concern. All Boeing managers are required to establish annual business goals around safety and all teams are expected to conduct regular safety-focused conversations.

“The most important part of the Go for Zero launch was company leadership articulating and standing behind the Safety Guiding Principles,” said Dennis O’Donoghue, vice president of Boeing Test & Evaluation. “The principles set the safety expectations and foundation that employees and teams continue to build upon.”

Shelley Lavender, president of Boeing Military Aircraft, added that “educating our workforce” is the first step in creating a culture of safety throughout the enterprise.

“The bottom line is, we don’t want our employees getting injured,” she said. “We care for them, and we watch out for one another.”

Company safety leaders say the changes in attitudes and behavior are hard to miss. For example, the number of safety-related work orders at Boeing facilities quadrupled after the Go for Zero launch, from 1,100 per month early in 2013 to 4,500 per month later in the year, according to Site Services, part of the Shared Services Group. Safety work orders address items such as lighting improvements, and slip hazards from leaking plumbing and standing water.

“The increase in safety work orders represents a very important increase in safety awareness,” said Larry Edwards, vice president of Site Services. “It means employees are now spotting safety risks that might have gone unreported before.”

Go for Zero also is bringing greater safety awareness to situations that could cause a serious injury.

One new tool, High Hazard Assessments, includes checklists that teams can use to identify and mitigate injury risk in activity such as working at heights or in confined spaces. After the fall protection assessment and checklist were introduced early in 2013, fall injuries

PHOTOS: At the Mesa, Ariz., Distribution Center, forklift driver Michael Bowsher (top) and Brandon Rhodes (left) wear safety glasses and high-visibility vests to reduce injury risk and enhance workplace safety. **BOB FERGUSON/BOEING**



Making Boeing safer

Since its launch at the start of 2013, Go for Zero has driven safety deep into nearly every aspect of Boeing's daily activity. Accomplishments include:



Integrating safety at every level of the company, including weekly safety updates to the Boeing CEO



Requiring all managers to establish safety goals



Analyzing every major incident for root causes, and applying corrective action and lessons learned across the enterprise



Completing more than 30,000 safety work orders received by the Shared Services Facilities team and more than 2,600 tooling safety requests



Enacting new processes for working in high-hazard situations including:

- Aircraft towing
- Chemical processes
- Work done at heights
- Confined spaces
- Machining
- Work near overhead cranes
- Work with explosive materials
- Work with hazardous energy
- Parking lots and walkways, for vehicle and pedestrian safety



Establishing consistent companywide standards for the use of safety glasses, high-visibility vests and electronic devices



Conducting regular team safety conversations to recognize successes and identify opportunities to continuously improve workplace safety



“The bottom line is, we don’t want our employees getting injured.”

—Shelley Lavender, president of Boeing Military Aircraft



that caused missed time from work decreased more than 80 percent across the company by year-end.

Employees are driving workplace safety improvements at many sites:

- A Boeing Aerostructures Australia team assembling parts for the 787 Dreamliner reduced its ergonomic injuries 75 percent by collaborating with tooling engineers to design a better jig that holds the aircraft parts.
- When a High Hazard Assessment identified fall protection enhancements on the C-17 Globemaster III assembly line in Long Beach, Calif., engineers, mechanics and safety experts worked together on the design of portable telescoping guardrails that reduce risk and improve safety.
- Teams in El Paso, Texas, are working long-term proactive safety programs that have helped the site substantially reduce lost workday injuries in the past two years. Safety leaders say it’s a significant achievement at a site where manual electronics assembly can present a risk of ergonomics injuries.
- To enhance overall workplace safety, the Distribution Center in Mesa, Ariz., requires employees to wear high-visibility vests and safety shoes. Visitors also must wear vests and add safety shoes if they handle material.
- In Seattle, Boeing Test & Evaluation brought together mechanics and engineers working on a B1-B bomber project to reduce injury risk and design safer work processes upfront.

— At the Commercial Airplanes factory in Frederickson, Wash., a Skin and Spar employee safety team conducts “listening tours” among shop-floor workers to seek input on safety issues and keep the safety dialogue active.

Boeing Test & Evaluation has established a special process that uses an “andon stop,” which has its origins in Lean manufacturing, for employees who have a safety concern to stop a work process or activity.

A stopped work process will not continue until the safety issue is addressed, O’Donoghue said. Managers are expected to lead their teams through the discussion of what caused the andon stop.

“Leaders need to create the environment where people feel safe to stand up and raise a safety issue,” O’Donoghue said. “It’s OK to stop the train and address a concern.”

Lost-work-time injuries at Boeing Test & Evaluation dropped 46 percent in 2013.

The accelerated pace of safety improvements has continued in 2014. New safety standards implemented in 2014 establish companywide requirements for wearing safety glasses and high-visibility vests. They also reduce distractions caused by use of personal devices such as smartphones and digital music players.

The key to creating real and permanent change is for each employee to make safety a personal value “that drives our attitudes and behavior every day,” said Eric Lindblad, 747 program

vice president. “Safety is not somebody else’s job. If we see something unsafe, we need to feel empowered to fix it.”

A lasting and robust safety culture is built upon the many small, personal choices employees make every day, said Atsuo Miyake, safety leader for Environment, Health & Safety. “Have I made the changes I can control? Do I use a handrail? Am I more careful with ladders at home? Do I point out to somebody to stay in a crosswalk?” he said.

And taking the time and caring enough to point out a safety concern is important to Hopp, the 747 Body Structures mechanic.

“Each of us has a role in creating a safer workplace,” Hopp said. “My teammates are watching out for my safety, and I’m doing the same thing for them.” ■

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PHOTOS: (Far left, from top) Aiden Pears, left, and Ryland Robinson build 787 Dreamliner components at Boeing Aerostructures Australia, where smart tooling design helped reduce ergonomics injuries by 75 percent. **ANDREW HENSHAW** Telescoping guardrails are enhancing workplace safety at the C-17 Globemaster III factory in Long Beach, Calif., where Don Livingston Jr., left, and Paul Manley monitor the wing build process. **PAUL PINNER/BOEING** (Above) Boeing Fabrication’s Bobby McDonald (from left), Melanie Faulkner, Tony Hamilton and Jennifer Cameron are part of a team that conducts “listening tours” among shop-floor workers at the Frederickson and Auburn, Wash., factories to gather direct input on safety issues. **MARIAN LOCKHART/BOEING**



A 'node' in the clouds

Real-time connectivity is taking jetliner flight decks into the future

By Kathrine Beck

When Suzanna Darcy-Hennemann began her Boeing career nearly four decades ago, the flight decks of commercial jetliners were filled with a vast array of dials and gauges.

"I started on the 737-200, an airplane that was totally mechanical with a small computer," recalled Darcy-Hennemann, Boeing's first female test pilot and now chief pilot and director of Training and Flight Services at Commercial Airplanes.

Those flight-deck analog systems were eventually replaced by the "glass cockpit." Digital data were displayed on cathode-ray screens

similar to those used in old cube-shaped television sets. Later, in the 1990s, those screens began to be replaced by liquid crystal displays (LCDs), which today provide pilots with all kinds of digital and graphical information, from weather and flight path to how their plane is performing.

But applications to display new and valuable information to flight-deck

PHOTO: Pilot Mike Carriker, at the flight simulator controls, gives input on 777X flight-deck development to engineers Alison Lauderbach (from left), Jim Blohowiak and Jeffrey Goedhard. **MARIAN LOCKHART/BOEING**



crews are in the works.

Using recently developed capabilities for gathering real-time data, Boeing engineers and pilots are working on next-generation applications that, when coupled with satellites, broadband, tablets and Wi-Fi, are taking the commercial airplane flight deck into a future far beyond radar and radio.

“The most significant change in my career is how digital the airplane has become,” said Darcy-Hennemann, who was one of the test pilots for the 777, Boeing’s first commercial jetliner that used fly-by-wire technology, where flight control mechanical inputs are converted to digital signals transmitted by wires.

Now, she said, flight decks have an added dimension—connectivity. Broadband and Wi-Fi are making it possible to exchange information in real time from sources on the ground, in the air and in space. It means turning an

airplane into a “node,” or connection point, on a communications network with global potential.

That opens up exciting possibilities, according to Bob Myers, Commercial Airplanes flight-deck chief engineer.

“We really want to take advantage of the information explosion and make the airplane a node in the clouds,” Myers said.

In April, Boeing completed flight testing of a flight-deck display that will allow pilots to pinpoint the identity and movements of nearby aircraft with far greater accuracy.

Already pilots can use real-time information about wind and weather up ahead—even hours away—to change routing or altitude so they stay on schedule and save fuel, or avoid severe turbulence. In fact, flight decks are expected to play a big part in reaching an industry goal of reducing fuel consumption in commercial airplanes by 15 percent.

“That’s what we’re going after and that is what customers will pay for,” said Mike Carriker, Boeing Test & Evaluation chief pilot for New Airplane Product Development. “And the biggest advancement will be because of communications and Wi-Fi.”

Flight-deck technology—and even how many people are needed in the flight deck to fly the airplane and monitor all the equipment and systems—has come a long way since Carriker learned to fly at age 17 on a grass field in Kansas.

By then, Boeing flight decks had already undergone numerous

(Continued on Page 44)

PHOTOS: (Below) The flight deck of Boeing’s Stratocruiser in 1947 had to accommodate an array of mechanical gauges and a flight engineer to monitor them. **BOEING ARCHIVES** (Right) The advanced flight deck on the 787 Dreamliner features many innovative technologies. **BOEING**





Stacking the deck

Boeing engineers are working on many innovative flight-deck technologies. These include:

COCKPIT DISPLAY OF TRAFFIC INFORMATION.

It lets pilots “see” other aircraft flying nearby and identifies them by airline and flight number. Aircraft can be tracked as they turn, accelerate, climb and descend. Unlike radar it works in air and on ground, and 787 flight testing of the technology was completed in April.

BOEING WIND UPDATES.

This fee-for-service offering from Commercial Aviation Services updates a flight’s weather information with forecast and real-time data sensed by airplanes in flight. The data are integrated with the airplane’s flight path, creating tailored information that is sent to the flight deck from a ground-based customer operations center.

RUNWAY SITUATIONAL AWARENESS TOOLS.

Developed with Brazilian jet manufacturer Embraer and available on some Boeing models, these tools improve situational awareness during landings and prevent runway overruns. A Vertical Situation Display shows pilots a side view of the airplane as well as the terrain during descent. A Landing Distance Calculator, available on an iPad as part of the Boeing Electronic Flight Bag, helps pilots plan approaches and landings whether runway conditions are wet or dry. The Runway Awareness and Advisory System uses a human voice to alert the pilot to how much runway remains. An Overrun Alerting system, under development, repeats “overrun” to warn a pilot to

make a second approach or, if on the ground, to apply all available braking.

SYNTHETIC VISION SYSTEMS.

GPS data and a detailed terrain database are used to build and display a representation of the outside world for pilots on the main displays and potentially on a Head Up Display, which overlays the image over the out-the-window view. It highlights nearby terrain features, obstacles and airports.

ENHANCED VISION SYSTEMS.

This Rockwell Collins–Boeing collaboration for the Boeing Business Jet helps pilots see in the dark, fog and rain. Unlike synthetic vision systems, it uses an infrared sensor to capture real-time video images such

as the runway environment, geographical features or even animals crossing the runway. Images are displayed on the Head Up Display and a flight-deck display.

LARGE DISPLAY SYSTEM.

Another Rockwell Collins–Boeing collaboration, the system is an optional upgrade that puts advanced, 787-style liquid crystal displays on 757s and 767s. The first customer, a cargo carrier, installed three 15-inch displays to replace six cathode-ray tube displays and 10 electromechanical devices such as Mach speed indicators and altimeters. These fuel-saving changes removed 150 pounds (68 kilograms) from the airplane and enable future updates and features. ■ kathrine.k.beck@boeing.com

transformations, including an early innovation that proved unpopular with pilots—enclosing the cockpit; pilots wanted to feel the wind and the rain. Later, the flight-deck area expanded with the addition of navigators, radio operators and flight engineers. Boeing's post-World War II Stratocruiser managed to accommodate 13 people in its flight deck during a test flight.

At the dawn of the jet age, a flight-deck crew of three on commercial jets was standard, two pilots—and a flight engineer who faced sideways and monitored dozens of analog dials and gauges.

Eventually, given the many advances in flight-deck technology, regulators allowed jetliners to be operated with only two crew members on the flight deck—a considerable savings for airlines.

Pilots play a big role in flight-deck development at Boeing. They are represented on teams with authority over design and certification, normal and non-normal procedures, and flight-crew training. Carriker, for example, is helping design the flight-deck displays and flight controls on the 777X, the new twin-aisle jet in development.

"As far as Boeing is concerned," said Darcy-Hennemann, "engineers and pilots are partners." She began

her Boeing career in engineering. Carriker is also an engineer.

Flight-deck innovations are intended to help the aircrew make better decisions to manage their flight, Myers said, but added: "It's also our job to evaluate these applications very carefully so we don't increase the workloads of pilots."

One thing Boeing airline customers don't want to see changed is the overall "look and feel" of flight decks, Carriker said. Maintaining the same configuration from model to model and year to year reduces the cost of pilot retraining.

"Worldwide there are already 90,000 pilots trained to fly the 737," Carriker noted. "Each one probably has \$100,000 invested in their training. Nine billion dollars of invested capital is a major constraint to big changes in the physical flight deck."

The 777X flight deck, Carriker said, will have enough commonality with the 787 Dreamliner to enable pilots to move between models with only five days of training.

Meanwhile, changes in flight-deck technology, such as real-time connectivity, aren't happening all at once.

"We're so used to connectivity on

personal devices in our daily lives, we expect it everywhere," said Tim Anstey, an Associate Technical Fellow with Commercial Airplanes' Cabin and Network Systems. "But in reality, the world's fleet isn't connected all the time everywhere in the world."

Access to reliable, affordable bandwidth around the world isn't yet consistent, and thinly populated areas have insufficient ground infrastructure, Anstey said. Cost to carriers and the regulatory environment are other constraints. But the benefits, he said, are so dramatic that additional connectivity-based changes to the flight deck are inevitable.

Carriker agreed.

"The flight deck of the future will look like a Boeing flight deck today," he said, "but the guts and the information displayed to the flight crew is going to be different by orders of magnitude. We keep improving on a fundamentally fantastic flight deck." ■

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PHOTO: Suzanna Darcy-Hennemann pauses for a photo in the flight deck of the first 777-200LR (Longer Range) in 2005. **MARIAN LOCKHART/BOEING**



MILESTONES



IN FOCUS

In it for the long run

Continuing a remarkable and innovative journey since the first 747 rolled out in September 1968, the 1,500th 747 to be built left Boeing's Everett, Wash., production line in late April. It's a 747-8 Intercontinental for Lufthansa, a long-time 747 operator and launch customer for the Intercontinental. At the rollout celebration was Joe Sutter, who led the Boeing engineering team that designed and developed the "queen of the skies" in the 1960s. "We listened to what the customer wanted," he said. "It's been a very good airplane for the airlines. It's safe, it's comfortable. People like to fly on it. Pilots like to fly it. I'd like to be up here when they roll out the 2,000th."

PHOTO: TIM STAKE/BOEING







معاً، نُحلق عالياً

تفخر بوينج بالدور الحيوي الذي تلعبه لدعم تطوير وتنمية قطاع صناعة الطيران في دولة قطر منذ العام ١٩٧٧، ونتطلع قُدماً لمواصلة هذه الشراكة في المستقبل.

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