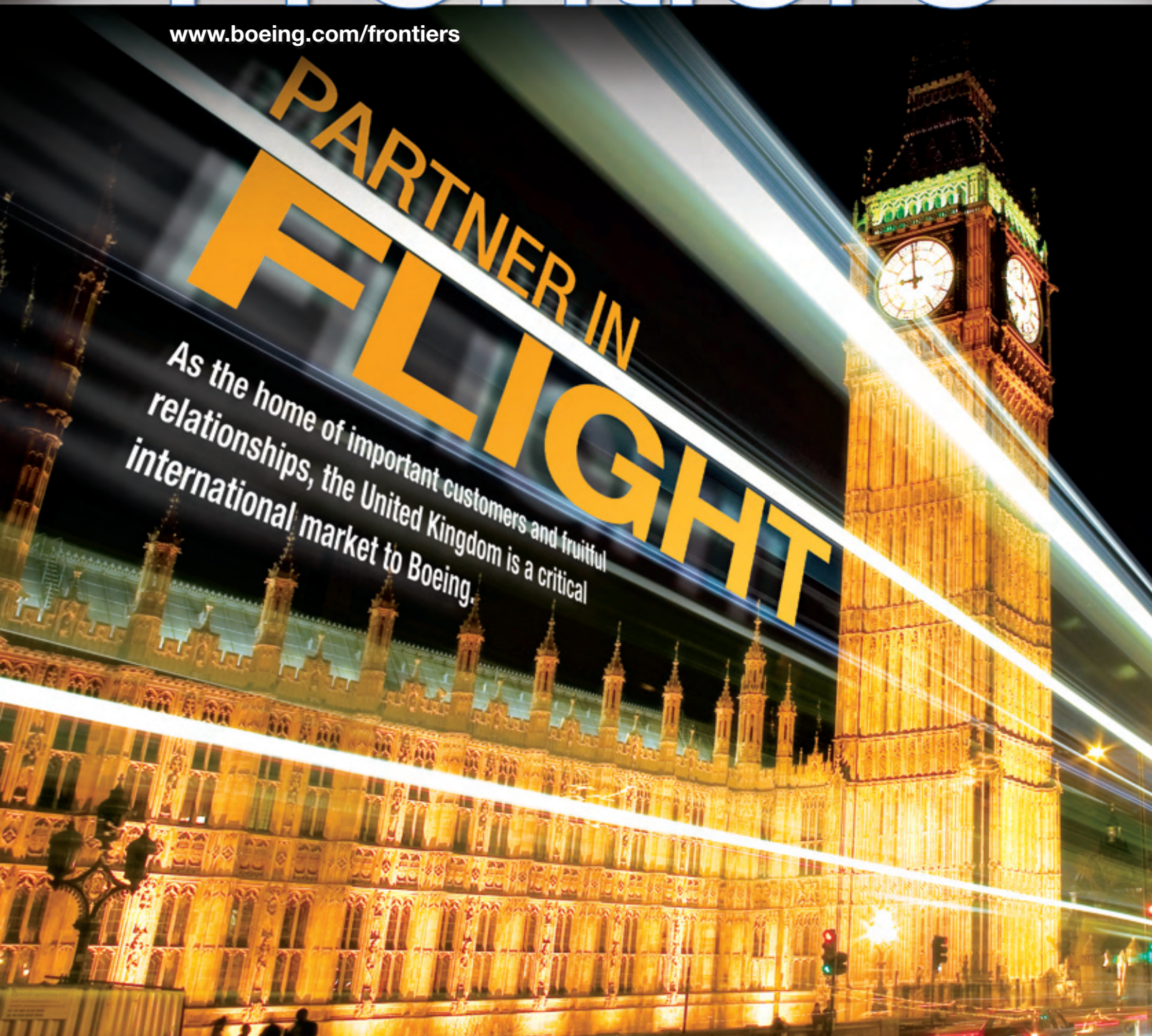


Frontiers

www.boeing.com/frontiers

**PARTNER IN
FLIGHT**

As the home of important customers and fruitful relationships, the United Kingdom is a critical international market to Boeing.



A man with short dark hair, wearing a green flight jacket over a checkered shirt, stands in a dark hangar. Behind him is a large green Chinook helicopter. The lighting is dramatic, highlighting the man and the aircraft.

BOEING AND THE GUARDIANS OF GOSPORT.

With its Through Life Customer Support programme, Boeing is working side-by-side with the Ministry of Defence to ensure the United Kingdom's fleet of CH-47 Chinook helicopters stands ready. This 34-year commitment is just another example of the power of partnership.

 **BOEING**

boeing.co.uk

This is the tenth in a series of new ads created to build awareness of Boeing and its many partnerships in the United Kingdom. Boeing, the largest overseas customer of the UK aerospace industry, currently partners with more than 300 businesses and universities around the country. The advertising campaign has appeared in The Sunday Times, The Economist, The Daily Telegraph and other UK publications, and complements current Boeing business and communications activities in that nation.

ON THE COVER: The London landmark Big Ben. SHUTTERSTOCK.COM PHOTO; COVER DESIGN BY BRANDON LUONG



COVER STORY

BRILLIANT! | 12

Boeing has a wide-ranging presence in the United Kingdom. The company operates The Portal, a decision-support center in Farnborough, with partner QinetiQ. Many British entities contribute to the 787 Dreamliner airplane. And Boeing's partners are helping develop technologies that support Boeing products. Here's a look at why the UK matters to Boeing—and vice versa.

FEATURE STORY

A clean shave | 42

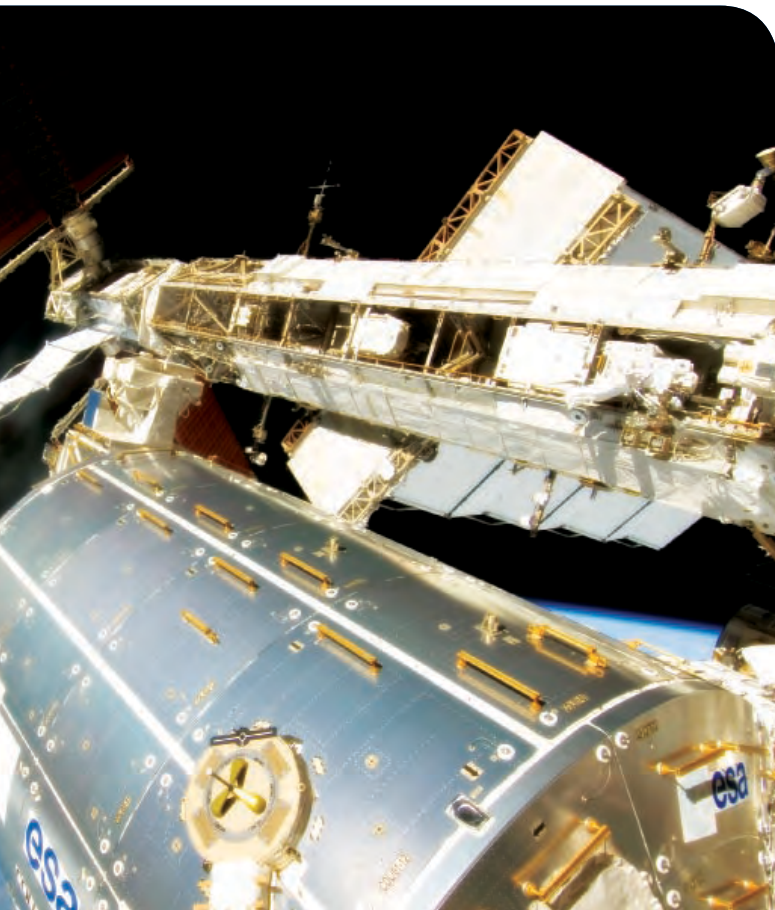
Welcome to the Boeing Portland facility in Oregon, where huge hunks of metal are machined into airplane parts. The rate at which this site strips away metal to form a new part is the baseline on which Boeing measures its performance against the machining industry—and Portland has one of the best metal-removal rates in the world.

Proud bird | 25

With a flawless combat deployment in Iraq that included 1,500 successful sorties and 3,600 flight hours, the Bell Boeing V-22 tiltrotor is proving itself to be what the U.S. Marines have said all along it would be: an aircraft that will transform military operations.

Looking 30 years ahead | 26

Maintaining its technological edge is a matter the Super Hornet program at Boeing takes seriously. The program is following a strategy—the F/A-18E/F Super Hornet “Fight Plan”—that charts the course for improving this aircraft’s combat capability over the next three decades.



Look carefully at the right side of this photo and you’ll see astronaut Ron Garan, STS-124 mission specialist, taking part in a spacewalk last month on the International Space Station. Boeing engineers are focused on keeping the ISS functioning properly. NASA PHOTO

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36 Mechanics Walter Van Wyk (foreground) and Ben Henry, members of a “tiger team” that works freighter issues as they arise, install a floor panel on the 777 Freighter. Teammates worked to ensure the first 777 Freighter adhered to its production schedule. GAIL HANUSA PHOTO

‘Out there’ solutions | 28

With International Space Station assembly nearing completion, Boeing engineers are focused on keeping the vehicle functioning properly to meet mission objectives—and ensuring it’s operating safely and efficiently through its scheduled life and beyond.

On land and in air | 32

The F-22 team last month opened a testing facility that ushers in a new approach to avionics development. The Agile Integration Lab consists of a ground-based facility and the program’s reactivated Boeing 757 flying test bed.

Family affair | 34

Steve Coulter in St. Louis is a father who couldn’t be prouder. His son Matt earned his U.S. Navy “wings of gold,” which qualify him to land aboard an aircraft carrier at sea. The son earned this distinction by flying a T-45 Goshawk—an aircraft the father has assembled at Boeing.

INSIDE

6 Letters
7 Notebook

8 Historical Perspective
10 New and Notable

A world of opportunity | 35

The geographic breakdown of Boeing's airline customers has changed from historical patterns. Through the first quarter of 2008, U.S. airlines account for less than 11 percent of Boeing's record backlog of unfilled orders. Customers in Asia and Australia, meanwhile, make up about 35 percent.

Passing the test | 36

Assembly of the 777 Freighter tested its builders in ways never imagined. But the team worked together to get the first airplane through the factory and onto the flight line—all according to schedule—with minimal impact to other airplanes being built.

In the ballpark | 38

John Mosbacher's day job is serving as a media services specialist at Boeing St. Louis. His other job is game day director of video operations at the St. Louis Cardinals' Busch Stadium. Mosbacher loves his work, loves his Cardinals—and has a World Series ring to prove it.

What a 'releaf'! | 39

As part of its efforts to support communities and the environment, Boeing has supported organizations undertaking reforestation efforts in Southern California and the Puget Sound region of Washington state.

Keep on workin' | 40

For more than 10 years, the Skin & Spar team at the Boeing site in Frederickson, Wash., has been on a continuous-improvement trek with the site's Information Technology systems group. That effort culminated in a technology-based tool-management solution now in use there.

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51 Stock charts

54 Milestones
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38 Boeing video specialist John Mosbacher works in an editing bay in St. Louis (top). Outside of Boeing, he uses his skills as game day director of video operations for the St. Louis Cardinals; above, Mosbacher and his technical director, Louis Neal, watch the boards and the game from their booth at Busch Stadium.

TOP: RON BOOKOUT PHOTO; ABOVE: ST. LOUIS CARDINALS PHOTO BY JIM KELLY

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Editor's note: For this month's letters, Boeing Frontiers offers the answers to some frequently asked questions about the magazine.

Q: What is *Frontiers*?

A: *Boeing Frontiers* is a magazine committed to telling Boeing's global story and relaying news and information about the company. Our charter is to employ the highest journalistic standards to provide news and information—most notably, analysis and context about Boeing's activities—in high-quality print and online formats that comply with standards of fairness, accuracy and objectivity.

Q: When does the magazine come out?

A: The magazine is printed 11 times a year—each month from February through November, along with a December/January edition. In general, it's released on the first Friday of each month and then is posted online on the Boeing external Web site at www.boeing.com/frontiers.

Q: How is *Frontiers* distributed?

A: Distribution varies slightly at each Boeing site, but generally, it is distributed via kiosks or bins located in work areas where there is heavy foot traffic. *Frontiers* is mailed to retirees who have chosen to receive it and to certain other stakeholders who do not work at Boeing. To contain costs, *Frontiers* is not mailed to the homes of individual employees. For detailed information on distribution at your site, please check with your Communications focal.

Q: Why doesn't *Frontiers* list retirees' deaths?

A: Unfortunately, the magazine does not have space to accommodate these numerous requests, nor does it have the resources to track them for accuracy.

Q: How do I submit a story idea or article?

A: *Frontiers* gets a lot of its story ideas from readers and encourages people to send them in by e-mail to boeingfrontiers@boeing.com, or by mail at *Boeing Frontiers*, 100 N. Riverside, MC 5003-0983, Chicago, IL 60606. However, it is best to go through your business unit's Communications focal (see panel at left) with your story ideas. They will take stories through the proper channels and then forward them to the *Frontiers*

editorial staff. This way, the business units can evaluate the editorial content to determine accuracy and newsworthiness. We also encourage letters to the editor as another way to get information into the magazine.

CALENDAR

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

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

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

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

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

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

Sept. 23: Aviation Week Green Aviation forum. Madrid, Spain. See www.aviationweek.com/forums/greenmain.htm

Oct. 1–5: Japan International Aerospace Exhibition 2008. Yokohama, Japan. See www.japanaaero.jp

Oct. 6–8: National Business Aviation Association 61st Annual Meeting & Convention. Orlando, Fla. See www.nbaa.org

Oct. 12–14: Routes. The World Route Development Forum will conduct its 14th annual conference. Kuala Lumpur, Malaysia. See www.routesonline.com

Nov. 19–20: Aviation Week Aerospace & Defense Finance Conference. New York. See www.aviationweek.com/conferences/finmain.htm

Boeing Frontiers assembles the above listings for the convenience of its readers, and they do not constitute an endorsement by The Boeing Company. Times, dates and subject matter are subject to change or cancellation. If you have any items you wish *Frontiers* to consider for the Calendar, please e-mail them to boeingfrontiers@boeing.com, or send them by regular mail to *Boeing Frontiers* magazine, 100 N. Riverside, MC 5003-0983, Chicago, IL 60606-1596.

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

Letters guidelines

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



SNAPSHOT

PRETEND I'M ON THE OTHER SIDE

A U.S. Air Force F-15 Eagle in the “aggressor” paint scheme pitches out for landing last month at Nellis Air Force Base, Nev. This aircraft is part of the 65th Aggressor Squadron, whose mission is to prepare combat air force joint and allied aircrews for future victories through challenging, realistic threat replication, training and feedback.

U.S. AIR FORCE PHOTO BY MASTER SGT. KEVIN J. GRUENWALD

QUOTABLES

“One of the real values and benefits of the airplane is its fuel efficiency.”

— Douglas Steenland, president and CEO of Northwest Airlines, which will be the first U.S. airline to operate the 787, about that airplane, in the June 4 *Seattle Post-Intelligencer*

“This has been a success story ... an excellent example of Navy-contractor teamwork and collaboration.”

— Donald Winter, secretary of the U.S. Navy, at a ceremony commemorating the delivery of the first Boeing-built EA-18G Growler, in the June 4 *Defense Daily*

“There were significant savings in terms of cost and schedule ... by doing this in-line build for all these aircraft and not going to a ‘chop shop.’”

— U.S. Navy Capt. Joe Rixey, P-8 and P-3C program manager, about Boeing’s efficient process of building the P-8A Poseidon aircraft, in the June 10 *Defense Daily*

IAM PROMOTIONS

No promotions listed for periods ending May 30 and June 6, 13 and 20

ETHICS QUESTIONS?

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

Seventh heaven

50 years ago, Boeing and Pan Am revolutionized travel with the 707

By MICHAEL LOMBARDI

This year marks the 50th anniversary of successful scheduled jet travel—made possible with Boeing commercial jets, starting with the pioneering 707.

Boeing, its employees and stakeholders are celebrating this auspicious anniversary with the introduction of the latest member of the “7” family—the revolutionary 787 Dreamliner. The advances in passenger experience that the 787 will introduce are reminiscent of the advances first experienced 50 years ago when Pan American World Airways blazed a trail across the Atlantic Ocean with its brand-new Boeing 707.

On Aug. 15, 1958, Pan Am took delivery of the United States’ first commercial jet airliner, a Boeing 707-120, and began plans for Oct. 26, 1958, when Pan Am and the 707 would make history by inaugurating the first 707 service and the first daily transatlantic jet service from New York to Paris.

Great Britain had been first with jet service in May 1952, flying the DeHavilland Comet I between London and Johannesburg, South Africa. Unfortunately a series of accidents grounded the Comet.

Determined to maintain the lead for Britain and in order to stay ahead of Pan Am and Boeing, British Overseas Airways Corporation inaugurated its own weekly transatlantic service on Oct. 4, 1958, with the new Comet 4.

It was able to perform two Atlantic crossings before Pan Am began service.



Pan American World Airways put the Boeing 707 into transoceanic scheduled revenue service 50 years ago. That start ushered in the age of jet travel.

BOEING ARCHIVES IMAGE

Another airline to introduce jet service, and the first to offer regularly scheduled and sustained passenger jet service, was the Soviet Union's Aeroflot. In September 1956, the carrier started flying from Moscow to Irkutsk with its Tupolev Tu-104 aircraft.

Although they were first, neither Aeroflot nor BOAC captured the public imagination and success of Pan Am and the Boeing 707.

The world had been anticipating the moment when the first 707 would begin scheduled service and open a new era of travel. Boeing had helped build the anticipation with an ad campaign that highlighted the comfort, speed and safety of jet travel. Indeed, one ad proclaimed: "Only seven hours to brush up on your French."

When the day of the first 707 service arrived, there was a great deal of public excitement and media attention. There was also consternation from Pan Am competitors that operated fleets of propeller-powered airliners. These carriers thought they could hold off the jet age by requiring higher fares for passengers who flew jets, but Pan Am kept the fare for the 707 at the same level it was charging for its piston powered planes: \$505 for first class and \$272 for economy.

Among the 12 crew and 111 passengers lucky enough to get tickets for the inaugural flight were Steve Eastman, a Boeing employee, and his wife Hazel. "My father was well aware of the historical significance of the flight, and made reservations two years in advance to be on it," said Louisa Eastman, their daughter and a Boeing employee today. The Eastmans would also fly on Pan Am's inaugural 747 service and even had reservations for the SST inaugural flight before that program was cancelled.

Steve Eastman wrote an article for the former *Boeing News* newspaper describing his experience. First was a ceremony at New York's Idlewild Airport (now John F. Kennedy International Airport) that featured a gala at the Golden Door restaurant. After Juan Trippe, then Pan Am's president, addressed the gathering, passengers were escorted to the plane by Pan Am flight attendants.

The 707, known as "Clipper America," was bathed in flood lights. The passengers crossed the ramp following a path flanked by the U.S. Army's 42nd (Rainbow) Infantry Division band and marked with flags from countries around the world. Actress Greer Garson, also a passenger on the flight, performed the ribbon cutting, and at 7:20 p.m., the sleek 707 climbed into the night sky.



Only seven hours to brush up on your French

Within weeks you'll be able to return the Atlantic and near the United States—in the luxurious Boeing 707 jetliner.

You'll be delighted with the comfort and service you get from flight aboard this new aircraft. It boasts the comfort of take-off, in altitude, pleasantly power lifts the 707 effectively to soaring altitudes. You'll fly smoothly through high, weatherless skies.

In just 10 minutes, you're almost 600 miles out of New York. So quickly you have time to reading and your last French for the duration of three hours.

The 707 is a cabin of peaceful quiet and complete freedom from vibration. There is only the most comfortable, and a sense of exhilaration from the smooth, rapid rise and descent of 707 flight.

Even if you're a veteran airline traveler you'll find flight in the 707 truly exciting—and unique. The 707 is the most thorough, lightest and most versatile in intercontinental service.

How often have you felt in discomfort on previous flights? The 707 is a new era of comfort and service. It's a new era of speed and safety. It's a new era of excitement and adventure. It's a new era of discovery and discovery. It's a new era of discovery and discovery.

BOEING 707 and 720



Boeing helped build anticipation of the era of jet travel with an advertising campaign that focused on the comfort, speed and safety of jet flight. BOEING ARCHIVES IMAGE

In his *Boeing News* account, Eastman described the passengers' excited conversations concerning the lack of noise and vibration. He noted that in a piston-powered airliner, many experienced travelers "normally would have been settled down with ear plugs, blankets and pillows to endure the 12 or more hours of punishment from noise, vibration and buffeting in rough air at lower altitudes."

Knowing from the passenger list that Eastman was a Boeing employee, many of the passengers sought him out. "Their remarks invariably were prefaced by the statement, 'You tell those people at Boeing ...' followed by glowing and in many cases downright emotional comments of the very highest complimentary value," he wrote.

After an unscheduled 71-minute stop in Gander, Newfoundland, due to headwinds, the flight landed at Paris' Le Bourget Airport at 10:01 am, 8 hours and 41 minutes after leaving New York.

Eastman described the crowds in Paris marveling at the airplane and summed up

that "every Boeing employee would and should be extremely proud of the airplane. ... Certainly everyone with whom we have come in contact, whether on board, in service crews, among the many Pan Am people whom we have met, or among the public, is proud to have any connection with the 707."

Although Pan Am and the 707 was not the first airline-jetliner combination, it was the most successful in this era. Two highly respected companies—Boeing and Pan Am, with their reputations and strong brands—helped build confidence and excitement for the future of commercial jet travel.

After the inaugural flight, Pan American began a period of almost unrivaled success in international air travel. For Boeing, it was the beginning of a highly successful business in designing and building the world's finest commercial jet. That story continues, 50 years later, as public anticipation and excitement grow for another new era in air travel that's about to begin with the 787. ■

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Validation!

GAO upholds Boeing's protest of tanker award, recommends rebid

By KIMBERLEE BEERS

The Government Accountability Office on June 18 upheld Boeing's protest of the U.S. Air Force's award of a \$35 billion contract for its KC-X tanker aircraft to a Northrop Grumman/EADS team.

The GAO recommended that the Air Force reopen discussion with the competitors, obtain revised proposals and re-evaluate them, or in essence re-bid the contract.

"This decision comes at the end of a 100-day period during which a team from across Boeing worked tirelessly to ensure that the GAO was provided all the information necessary to fairly evaluate our claim," said Integrated Defense Systems President and CEO Jim Albaugh. "But this is not the end."

"The ruling," said Scott Carson, president and CEO of Boeing Commercial Airplanes, "validates our protest of the award—a step Boeing has rarely taken but did in this case to ensure that the best tanker for the mission is selected and that the American taxpayer receives the best value."

The GAO report listed several reasons for sustaining Boeing's protest, including

- The two offerings were not assessed as outlined in the Request for Proposal.
- Extra credit was given to Northrop for exceeding requirements.
- The Air Force could not show the competitor's aircraft could refuel the required Air Force aircraft.
- Unequal discussions were held with the two competitors.
- An administrative oversight was made with regard to Northrop's ability to achieve a maintenance requirement.



Boeing offered its KC-767 Tanker in the U.S. Air Force's KC-X tanker aircraft competition. BOEING GRAPHIC

- Military construction costs were not correctly calculated.
- Boeing's nonrecurring engineering costs were improperly increased.

It's important to note that the GAO's decision does not indicate that one aircraft is better suited than the other to meet the Air Force's needs. The GAO's opinion means that the agency found enough concerns with the Air Force's decision-making process in this competition to recommend rebidding the contract.

At press time, the GAO had released a redacted version of the entire 67-page GAO decision. Once the Boeing Tanker team fully reviews this document, Tanker leadership will communicate to employees, media and the public.

"We expect the Air Force to outline its plans in response to the GAO report in increasing detail over the next 30 to 60 days," stated Beverly Wyse, 767 Program vice president.

"I know it can be challenging to keep focused when there are so many questions," said Mark McGraw, vice president of Tanker Programs. "But the best thing we can all do is continue to work hard to execute our programs on time and within budget." ■

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787's powerful milestone

Boeing last month reached a major milestone in the development of the 787 Dreamliner airplane by completing the Power On sequence for the first 787. Power On is a series of tasks and tests that bring electrical power onto the airplane and begin to exercise the use of the electrical systems. At left, running tests in the flight deck are (from left) James Townsend, aviation manufacturing technician inspector; Allen Smith, test technician; Jon Stephenson, production test manufacturing engineer; and Riger Vazquez Jr., production test team leader. "The team has made great progress in bringing the bold innovation of the 787 to reality," said Pat Shanahan, vice president and general manager of the 787 program. Program teammates are continuing work on finishing the first 787 and further testing its readiness for operations. First flight is expected in the fourth quarter of this year. MARIAN LOCKHART PHOTO

'An exciting event'

Boeing employees remember 1st delivery of C-17 Globemaster, which occurred 15 years ago in June

BY FELIX SANCHEZ

For Boeing and U.S. Air Force officials who were on hand 15 years ago for the first-ever delivery of a C-17 Globemaster airlifter to a U.S. Air Force base, the memories are crystal clear. It was June 14, 1993, when a new chapter in military airlift history opened with the delivery of the first C-17 to Charleston Air Force Base in South Carolina.

"There was a lot of pressure to make this go well, because it was the first new airplane that Air Mobility Command had brought into the inventory in 16 or 17 years," said Jim Evans, now in Boeing field marketing at Scott Air Force Base, Ill. (At that time he was Col. Jim Evans, integration lead at Charleston for the C-17's arrival.) Indeed, Evans recalled that South Carolina's two U.S. senators at the time, Strom Thurmond and Fritz Hollings, were on hand for the event.

Since that day, the C-17 has grown to be the airlifter of choice in supporting the United States' military objectives around the world. Today, Charleston has 50 C-17 advanced airlifters assigned to the 437th Airlift Wing.

Since the war on terror began in 2003, Charleston crews have moved more resupply cargo to U.S. troops and soldiers than all other airlift bases combined.



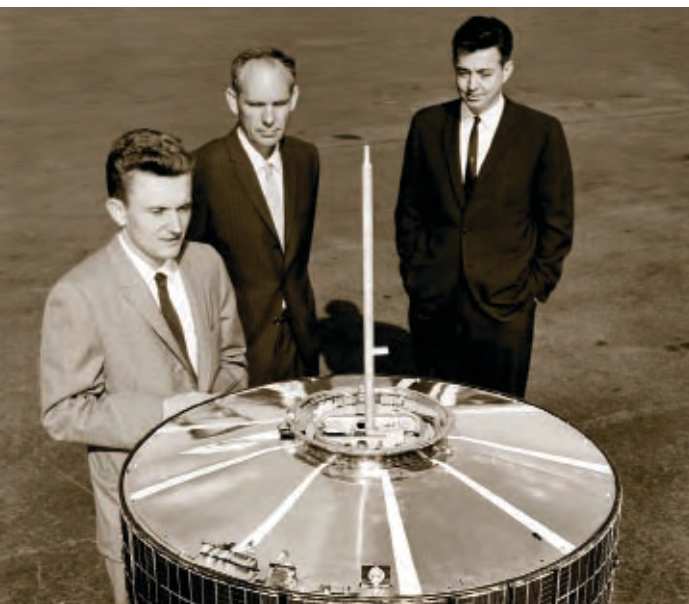
In this 1993 photo, U.S. Air Force Gen. Merrill McPeak and Gen. Ronald Fogelman disembark the "Spirit of Charleston," the first C-17 to be delivered to the Air Force. At the time, McPeak was Chief of Staff of the Air Force and Fogelman was the commander of Air Mobility Command. U.S. AIR FORCE PHOTO BY KEN HACKMAN

In 1995, the 437th deployed C-17s to take part in an airlift operation establishing peacekeeping forces in Bosnia. "The Bosnia missions were the start of the realization that we could use this airplane the way it was designed to be used," Evans said.

In March 2003, C-17s from Charleston, McChord and Altus Air Force Bases conducted the first-ever airdrop of troops into a combat zone from a C-17. And it was out of Charleston that 20 Globemaster IIIs flew in formation in 2006, demonstrating strategic airdrop capability.

"It was an exciting event, that first C-17 delivery," recalled John Cook, who now serves as C-17 Field Services Director for Boeing at Charleston. Now, the excitement is scattered across the country with every new delivery—as well as in the United Kingdom, Canada and Australia, whose defense forces are using the aircraft. ■

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Satellite pioneer Hudspeth dies

Tom Hudspeth—who helped develop Syncom, the world's first geosynchronous commercial communications satellite—died May 27 at age 89. Hudspeth (center) and colleagues Donald Williams (left) and Harold Rosen (right)—shown with Syncom—began work on the first geostationary communications satellite in 1959. In July 1963 Syncom 2 successfully reached orbit over the Atlantic Ocean. Forty-five years later, Boeing marked 2,500 years of cumulative satellite services to customers around the world. "Tom was a pioneer in the truest sense of the word, and our history is deeply rooted in this invention," Craig Cooning, vice president and general manager of Space & Intelligence Systems, told employees. "We would not be here today without the ingenuity and commitment of Tom."

BOEING ARCHIVES PHOTO

Jolly good show!

What makes the United Kingdom, home to this month's Farnborough International Airshow, critical to Boeing? Partnerships, products—and an integrated structure for Boeing's UK operations.

At the Houses of Parliament in London, you'll find Boeing representatives working with stakeholders based in the United Kingdom. Boeing's partnerships with this nation have created benefits for both the country and for Boeing.

SHUTTERSTOCK.COM PHOTO

By NICK WEST AND JUNU KIM

To appreciate just how important an international market the United Kingdom is to Boeing, think about the drive from London's Heathrow Airport to The Portal, a modeling, simulation analysis and experimentation center in the town of Farnborough.

At Heathrow, one of the world's busiest airports, you'll find Boeing airplanes bearing the liveries of carriers from around the globe. These airlines are using long-haul airplanes like the 777 and the 747 to bring people and goods from all reaches of Earth to and from one of the world's great centers of culture and history. From Heathrow, the drive through the British countryside to Farnborough takes about 30 minutes. There you'll find The Portal, which Boeing operates in conjunction with QinetiQ, a British defense and security technology firm. The Portal is a high-power networked decision-support center where programs and customers—primarily the UK Ministry of Defence—can conduct experiments at all levels of armed conflict.

In other words, within a span of a mere 30 miles (48 kilometers), you can see the breadth of the Boeing-UK partnership, from cutting-edge products to customer support to technology for tomorrow's solutions—all for the benefit of the United Kingdom as well as of Boeing, its customers and employees.

The United Kingdom—the setting of this month's Farnborough International Airshow, one of the global aerospace industry's most important gatherings—is a market that exemplifies how Boeing aims to work globally. This nation has not only a rich legacy of Boeing activity and a wide array of Boeing products in use, but it's a market where the company and its partners are helping shape the future of aerospace. By operating as an integrated entity that works for the benefit of the entire company, Boeing has established connections with industry and universities that have helped the British economy—and permit all of Boeing to offer customers in the UK, the United States and rest of the world higher-impact, technology-based solutions. And that means more work for Boeing business programs and their employees.

Indeed, the United Kingdom is home to four carriers—British Airways, TUI (through its purchase of First Choice Airways), Monarch Airlines and Virgin Atlantic Airways—that have acknowledged the revolutionary advances of the 787 Dreamliner by collectively ordering 57 of these airplanes. And it's the home of a defense customer that tapped Boeing to help lead the Future Rapid Effect System (FRES) program, which will provide the British Army with a family of medium-weight, network-enabled, air-deployable armored vehicles that will complement the UK's existing heavy and light forces.

To get deeper insight about why the UK is a critical international market to Boeing and its employees, *Boeing Frontiers* spoke to Sir Roger Bone, president of Boeing UK.

Q: Why is the UK so important to Boeing?

A: Boeing has had a relationship with the UK for more than 70 years, since the UK introduced a fixed-wing military training aircraft called the Harvard. During World War II, the C-47 Dakota and B-17 operated extensively



Sir Roger Bone,
president Boeing UK

Inside

Q&A: Why is the United Kingdom important to Boeing—and vice versa? Sir Roger Bone, president of Boeing UK, explains. **Page 13**

Communities: A look at some of Boeing's activities to improve UK communities. **Page 14**

Partnerships: Boeing best helps its customers meet their needs thanks in part to technologies developed by UK partners. **Page 16**

Environment: Boeing's work in support of the environment and aviation in the UK, as with the rest of the world, reflects how it pioneers technologies that create stakeholder value. **Page 17**

Meet the airlines: The United Kingdom is the home to numerous carriers. Here's a short look at some of them. **Page 18**

History: The Boeing–United Kingdom partnership has lasted for more than 70 years. Here's a look at some of the important points in this relationship. **Page 18**

Farnborough: This town in the United Kingdom may have a population of about only 55,000, but it's an important site of aerospace activity—thanks in part to its biennial air show. **Page 19**

Boeing Defence UK: Why Boeing believes this organization—which puts Boeing's defense activities under one umbrella—positions the company for growth in this market. **Page 20**

with the UK's Armed Forces, and today Boeing has more platform types in service with the UK Ministry of Defence than any other U.S. company. The Chinook for example, has been in service with the Royal Air Force on every overseas operation since it entered service in the early 1980s.

On the commercial side, Boeing's commercial airplane products have made a vast contribution to delivering growth in the UK's air transport capability. This is set to continue with a high concentration of airline customers for the 787, who will in a few years' time operate the airplanes from regional and London airports.

We're honored to support our customers in the UK, but our partnerships here help both sides. The cutting-edge products and services that support our customers in the UK, the United States and around the world feature technologies we have developed with our UK partners. These contributions include new manufacturing technologies, systems and components for the 787, and even the rapid prototyping of the Blended Wing Body research aircraft.

So with our extensive range of customers, as well as industrial and scientific partners, it

is clear that the UK has been and will remain a very important market to the company.

Q: Boeing has had longtime strong links with the Ministry of Defence and British industry. How do you see the business model, and is there any reason to change it?

A: Traditionally the business model has been to sell into the UK from the U.S. The company has invested in technology partnerships, with universities in particular, but we really have felt the need to adjust our strategy.

Essentially, the Defence Industrial Strategy (DIS), published in December 2005, was the catalyst for change. In order to be a long-term partner with the Ministry of Defence, we have to possess the ability to develop intellectual property in the UK. Clear evidence of this is a new Boeing facility in Bristol, which we opened 15 months ago, and The Portal, opened 12 months ago. From there we successfully addressed, with our partner Thales, the bid for the systems-of-systems-integrator role for the FRES program. This should result in Boeing becoming a strategic partner to the Ministry of Defence. We initially employed a couple of dozen people in Bristol and 10 in Farnborough, and as time goes by we expect

this to increase significantly. So this is a concrete example of how we have responded to the DIS, built a capability onshore and won a contract.

Q: How is Boeing viewed as a company in the UK?

A: We have links and relationships with up to 250 British supply companies, and our story has been very much one of adding value to the economy in terms of being a customer to the aerospace industry and a supplier to the air transport industry. This all plays into the bigger approach of Boeing operating as a global company and being much more than an American company selling products globally. Boeing has tremendous brand equity and our stakeholder contacts and profile are much higher than they were four years ago.

We make a major contribution to the sustainable aviation debate with the positioning of the fuel-efficient 787 in particular, but also through contributing knowledge and expertise in biofuels, air traffic management and airport operations. In early May the company jointly hosted a Parliamentary debate and reception in conjunction with British Airways. This event was specifically aimed at working with one of



Boeing supports The Green Corridor's Tree Buddies Project, which raises environmental awareness and helps children new to the United Kingdom.

PHOTO COURTESY OF THE GREEN CORRIDOR

A community partner

Boeing is committed to being an active, engaged corporate citizen of the communities in which it does business, and the United Kingdom is no exception. Community partners Boeing has worked with in the UK over the past several years include

Prince's Trust xl clubs: To address issues such as high truancy rates, incidents of social exclusion and student underachievement, the Prince's Trust in-school xl clubs promote skills development for at-risk 14- to 16-year-olds. Boeing UK is a long-standing supporter of the Prince's Trust xl clubs. In the city of Sheffield, where Boeing co-founded the Advanced Manufacturing Research Centre, the company has supported a local xl club for the last four years.

Green Corridor: The Green Corridor is based in West London, where some of the busiest transport networks converge. It's also an area in much need of social, economic and physical regeneration. Boeing specifically supports the group's Tree Buddies Project, a program aimed at 11- and 12-year-olds that has two core objectives: to help children new to the UK integrate into their schools and communities, and to raise environmental awareness. The young people are paired with "buddies" in their classes to learn about their local environment, specifically trees.

Groundwork UK: Boeing UK has given its support to two important social-improvement projects being run this year in London by Groundwork UK, an environmental development nonprofit. Under Groundwork's "Designing Out Crime" program, the entryway to the Belmont Recreation Ground, neglected and a haven for troublemakers, will be redesigned thanks to a Boeing grant. Also, Groundwork's "Past on your Doorstep, Future in your Hands" program is helping young people at risk of exclusion from school or those who may have already been excluded, to reconnect with their educational goals and their local communities.

our most important customers to illustrate the environmental performance endeavors of the industry.

We've been also an active supporter of the need for a third runway at Heathrow. There is a strong feeling in industry as a whole that it is necessary, and we are working both behind the scenes and in the public domain to support the case. So with all of these proof points as well as some reputation research, I think Boeing is well regarded and valued by our stakeholders.

Q: How is Boeing viewed as a corporate citizen?

A: To demonstrate Boeing's commitment to corporate citizenship, the company has built successful partnerships with several nonprofit organizations such as the Prince's Trust, the Green Corridor and Groundwork, to address key community priorities including education, social inclusion and the environment (see story on Page 14). In addition, Boeing UK has relationships with universities and also is involved with numerous industry groups and trade organizations. The company is a member of national-level organizations such as the Confederation of British Industry, the Royal Aeronautical Society and the Air League. It's also actively involved in regional issues with the UK's Regional Development Agencies and trade associations such as the Farnborough Aerospace Consortium, Northern Defence Industries, and the West of England Aerospace Forum.

There are less than 1,000 Boeing employees in the UK. That's far fewer than in the United States. But we know that the quality of the relationships we build with community partners, educational institutions and trade and industry groups is integral to being perceived as a responsible corporate citizen among our neighbors here.

Q: What are the opportunities for Boeing employees to work in the UK?

A: We have a small corporate team based in London. Elsewhere around the UK we have offices stretching geographically from Perth in Scotland to Gosport on the south coast. BCA has a team of around 40 people in Heathrow, where the European, Russian and Central Asian Sales operation is headquartered. The Alteon, Jeppesen and Continental Datagraphics subsidiaries add another 300-plus to the number of employees.

On the defense side of the business, our organic growth has seen a number of

local and expatriate positions created on the Chinook Through Life Customer Support program (a comprehensive program for support of UK Chinooks) and FRES in particular. With the long-term intent to generate intellectual property in the UK, we expect much greater growth in full-time local positions.

Q: How is the company configuring itself for growth in the UK?

A: IDS has created Boeing Defence UK, an organization for its activities here. This IDS integration effort is designed to position Boeing for growth and improve the company's defense capabilities in the UK (see story on Page 20). The essence of the IDS reorganization has been in line with the DIS and will increase Boeing's presence in the long term, establishing a cost structure that positions us to offer better value for money, more jobs, and development of on-shore industrial participation.

Providing an integrated support infrastructure will have benefits for all of our existing

programs. Equally, the creation of new functional heads such as Supplier Management & Procurement, Quality Assurance and Engineering, for example, from existing personnel will aid the integration process, leading to shared learning, common processes and career growth opportunities.

But we're also involved in activities that support all of Boeing. BDUK already has held several supplier industry days in partnership with Boeing Commercial Airplanes in a "one Boeing" approach to doing business globally. Bringing together suppliers from both our defense and commercial businesses allows us to deliver the depth and breadth of Boeing to our local industry partners. And that "one Boeing" presence also enables sharing of best practices—and contributes to our journey toward seamless organization within the company and throughout the supply chain. ■

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United Kingdom at a glance

Official name: United Kingdom of Great Britain and Northern Ireland (Great Britain includes England, Scotland and Wales)

Location: Western Europe; islands including the northern one-sixth of the island of Ireland between the North Atlantic Ocean and the North Sea, northwest of France

Area: 244,820 square kilometers (94,525 square miles)—slightly smaller than the U.S. state of Oregon

Population: 61 million

Estimated gross domestic product, 2007: \$2.771 trillion

Estimated GDP real growth rate, 2007: 2.8 percent

Defense budget, 2007-2008: £32.6 billion (about \$65 billion)

Military spending as part of GDP, 2006: 2.5 percent

Sources: Economist Intelligence Unit; UK Ministry of Defence

Engine of growth

A look at some of Boeing's many technology-based UK partnerships

Perhaps it's fitting that the nation that gave birth to the Industrial Revolution is a major technology partner with Boeing.

The United Kingdom is a strategic center of research for Boeing. Although the nation has just 1 percent of the world's population, it undertakes around 5 percent of global research. And it's not standing still: The British government has set a target to raise national investment in research and development to 2.5 percent of gross domestic product by 2014.

The aerospace business also is important to the UK. At a recent Parliamentary forum, Ian Godden, chief executive of the Society of British Aerospace Companies, said aviation represents more than 1.5 percent of the overall economy in the United Kingdom. The sector employs 280,000 people, with an additional 500,000 people working in the supply chain, Godden added.

Accordingly, Boeing is keen to ensure it can continue and grow its relationship with the UK, where there are up to 250 suppliers and partners. "We are taking a cross-enterprise approach in our engagement with British industry, building on the depth and breadth of suppliers that Integrated Defense Systems' Industrial Participation program has traditionally given us. When combined with the technology sourcing of Phantom Works and the UK's industrial input on the 787 program, we see a long-term, mutually beneficial relationship that will grow even stronger over time," said Brian Moran, UK Industrial Participation lead.

Boeing has forged enduring links with UK industry and universities. Much of Boeing's relationship with British industry stems from the Industrial Participation program, which works actively with economic development agencies across the regions. The program also evaluates new research opportunities, most notably in collaboration with Phantom Works.

Among the partnerships that deliver cutting-edge capabilities to Boeing:

- QinetiQ, the UK's largest single research and development company, signed an overarching agreement with Boeing in 2004. The company works with Boeing in a cross-enterprise way. A leasing agreement, for example, gives Boeing Commercial Airplanes and IDS unfettered access QinetiQ's 5-meter wind tunnel, a world-class testing facility.

Strategic partnering with QinetiQ has established a powerful team to support UK Ministry of Defence and other UK and European business opportunities. The win of the Mission Training Through Distributed Simulation Capability Concept Demonstrator program marked a major success and has been followed by the establishment of The Portal, a state-of-the-art decision-support center at QinetiQ's Farnborough facility.

- Boeing has established multiyear collaborative R&D partnerships with



At the University of Sheffield's Advanced Manufacturing Research Centre, W.S. Tham inspects a part recently completed on the Shape Metal Deposition Cell at the facility. The cell uses titanium wire to literally grow parts up from CAD models. Boeing is the lead member and co-founder of this site, which has helped develop, validate and transition new manufacturing technologies. AMRC PHOTO

Sheffield, Cambridge and Cranfield universities to work on a variety of advanced information, aeronautics and manufacturing technologies.

As the lead member and co-founder of the University of Sheffield's Advanced Manufacturing Research Centre since 2001, Boeing has been instrumental in helping develop, validate and transition new manufacturing technologies. The AMRC originally was set up in support of the UK C-17 IP program and has grown to become a £60 million (about \$120 million) collaboration of more than 20 international partners. The AMRC played a vital role in Messier-Dowty's win of the 787 landing gear contract.

A new collaborative centre for Integrated Vehicle Health Monitoring, which will emulate the success of the AMRC, recently was established at Cranfield University. The center will focus on developing integrated health management systems, standards and software for a host of industries. Boeing and Cranfield are supported in this initiative by the East of England regional development agency and industrial partners such as BAE Systems, Meggitt PLC and Rolls-Royce. In addition, Cranfield, Britain's leading postgraduate research-intensive university, has undertaken numerous research projects with Boeing in recent years. The most visible example is the rapid prototyping of the Blended Wing Body research aircraft, which made its first flight last year.

- Boeing's importance to the United Kingdom, and value to the British economy, is typified by the 787 Dreamliner program. Among the many UK aerospace entities that play a part in the 787 are GE Aviation (formerly Smiths Aerospace), Rolls-Royce, Messier-Dowty, Cobham, GKN, Ultra Electronics, Eaton Aerospace, Claverham, QinetiQ and the AMRC.

In addition, Boeing subsidiary Alteon will provide training for all European 787 pilots, cabin crews and maintenance personnel at its new European training facility near London's Gatwick Airport. Simulators used in the training will be built at Thales UK, which is a short walk from Alteon.

A climate of change

The UK cares greatly about aviation's role in the environment. And so does Boeing

Although public concern over global warming has grown immensely as of late, the issue of climate change and the environment has been high on the public agenda in the United Kingdom for several years.

The UK's discussion on this topic has touched on aviation's role. Although the United Nations' International Panel on Climate Change said airlines contribute only 2 percent of global man-made carbon dioxide emissions, Boeing is taking a leadership role to help the global industry limit its share of emissions. The work Boeing performs in support of the environment and aviation in the UK, as with the rest of the world, reflects how Boeing pioneers new technologies that create value to its stakeholders.

"Boeing takes its environmental responsibilities very seriously. We have a good story to tell about our products and we try to play a constructive part in public debate about how to achieve reductions in fuel use—and carbon dioxide emissions," said Marlin Dailey, Boeing Commercial Airplanes vice president of Sales for Europe, Russia and Central Asia.

The strongest evidence of how Boeing is helping UK-based airlines cut fuel consumption and greenhouse gas emissions is that four of the nation's carriers collectively have ordered 57 787 Dreamliners. Thanks to the advanced technologies employed in this new, midsize airplane, the 787 will use 20 percent less fuel for comparable missions than today's similarly sized jetliners, with an equivalent reduction in carbon dioxide emissions. The 787's technologies also mean quieter takeoffs and landings, as well as a noise footprint that's more than 60 percent smaller than today's similarly sized airplanes.

Boeing is active in numerous efforts to make air travel more environmentally friendly. Here's a quick look at some of these many activities.



In February, Boeing, Virgin Atlantic, Imperium Renewables and GE Aviation partnered to conduct the first commercial aviation flight using a sustainable biomass-to-liquid fuel mixed with traditional kerosene-based jet fuel. Commemorating this flight are (from left) Geoff Adreasen, Virgin Atlantic chief Boeing pilot; John Plaza, Imperium Renewables CEO; Sir Richard Branson, president of Virgin Atlantic; Marlin Dailey, Commercial Airplanes vice president of Sales, Europe, Russia and Central Asia; and Tim Held, GE Aviation's manager of advanced combustion engineering. BOEING PHOTO

- Boeing is a member of a broad coalition, called Flying Matters, that highlights the positive impact of the air transport industry on economies and society. Boeing's approach is that it can contribute the most to the aviation and environment debate in the technical arena. "This is where we can directly support our customers, helping them in turn to assure their stakeholders that the industry is making the advances needed," Dailey said.

- For several years Boeing has been engaged in the Community Awareness program that has helped UK customers such as First Choice, Virgin and British Airways engage with community, business and commerce groups around airports. Many of the company's UK-based 787 partners have helped the company in this process. Rolls-Royce and GE Aviation (formerly Smiths Aerospace) have been actively engaged in the dialogue.

- In February, a Virgin Atlantic 747-400 made the first commercial aviation flight using a sustainable biomass-to-liquid fuel mixed with traditional kerosene-based jet fuel. This flight, for which Boeing partnered with GE Aviation, Imperium Renewables and Virgin Atlantic,

marked the first step in a broader industry-wide technology initiative to commercialize alternative fuel sources for aviation. On this London-to-Amsterdam trip, one engine used a kerosene/biofuel blend including babassu oil and coconut oil provided by Seattle-based Imperium Renewables.

Who's who among UK airlines



TUI

Type: Charter airline
 Approximate number of jetliners*: 75
 Key jetliners in fleet: Boeing 737-300, -500, -800, 757-200, 767-200, -300,

-300ER; Airbus A320, A321
 Key jetliners on order: Boeing 787-8

TUI Travel was formed by last September's merger of TUI AG's Tourism business and First Choice Airways, the European launch customer for the 787. The UK airline operation includes both First Choice and Thomsonfly, the largest charter airline in the world.



Ryanair

Type: Low-cost airline
 Approximate number of jetliners*: 173
 Key jetliners in fleet: Boeing 737-800

Key jetliners on order: Boeing 737-800

Since its founding in 1985, Ryanair has grown into one of Europe's largest carriers. Although Ryanair is based in Ireland, it's launched 12 new UK routes this year. Ryanair operates only Boeing 737-800 airplanes and has firm orders for more than 100 new aircraft to be delivered over the next five years.

70 years and counting...

June 9, 1938: The North American Harvard, based on the T-6 Texan, is sold to the British government for aerial reconnaissance and training.

March 20, 1941: The British government purchases three Boeing 314A aircraft and allots them to the British Overseas Airways Corporation for use as transport aircraft.

Feb. 16, 1948: U.S. Air Force bomb groups equipped with the Boeing B-29 Superfortress participate in air defense exercises with Royal Air Force Fighter Command for the first time.

April 25, 1971: BOAC operates its first Boeing 747 flight between London and New York.

1930s

1940s

1950s

1960s

1970s

June 24, 1939: Pan American inaugurates the first northern transatlantic mail service to Southampton, UK, in a Boeing 314 Yankee Clipper. Four days later, the first passenger air service commences from New York to Southampton.

June 6, 1944: More than 1,000 military Douglas DC-3s and C-47s airlift more than 20,000 paratroopers across the English Channel during the first hours of the D-Day invasion of occupied Europe.

May 27, 1960: BOAC introduces the Boeing 707-436 aircraft on its London to New York service.



EasyJet

Type: Low-cost airline
 Approximate number of jetliners: 137
 Key jetliners in fleet: Airbus 319, Boeing 737

Key jetliners on order: Airbus 319

EasyJet, founded by entrepreneur Stelios Haji-Ioannou, started operations in 1995 with two leased Boeing 737 Classics. In a growing market, the airline quickly expanded its fleet with Next-Generation aircraft. In 2002, the airline placed an order for 120 A319 aircraft with Airbus. It's currently phasing out its Next-Generation 737s.

* UK operation only. Excludes regional jets



Monarch Airlines

Type: Low-cost scheduled airline; integrated tour operator
 Approximate number of jetliners: 31
 Key jetliners in fleet: Boeing 757-200, 767-300; Airbus A330-200, A300-600, A320, A321

Key jetliners on order: Boeing 787

The Monarch Group of companies includes scheduled, charter, engineering, technical, leasing and cargo operations. In its 40th year of existence, the company counts itself among the leading low-cost and charter airlines in the UK, flying six million people to around 100 destinations annually. In 2006, Monarch joined the 787 customer base with an order for six 787 jetliners.



British Airways

Type: Full-service airline, national flag carrier

Approximate number of jetliners*: 235

Key jetliners in fleet: Boeing 747-400, 777-200

and -200ER, 767-300ER, 757-200, 737-300, -400 and -500; Airbus A319, A320, A321

Key jetliners on order: Boeing 787-8 and -9, 777-200ER; Airbus A380, A320

British Airways is UK's largest international scheduled airline and today serves more than 550 destinations. It's also the largest operator of Boeing 747s. In response to the recent agreement that liberalizes air travel between the United States and the European Union, British Airways just launched its new subsidiary OpenSkies. This carrier will use Boeing 757s configured to carry about 80 passengers to connect New York with cities on the European continent.



Virgin Atlantic

Type: Full-service airline

Approximate number of jetliners*: 38

Key jetliners in fleet: Boeing 747-400; Airbus A340-600, A340-300

Key jetliners on order: Boeing 787-9

On June 22, 1984 Virgin Atlantic, owned by Sir Richard Branson, operated its inaugural scheduled air service between London Gatwick and Newark, N.J., using a single, leased Boeing 747-200. Today the carrier serves 30 destinations worldwide. In 2006 (the most recent figures available), Virgin carried 5.14 million passengers, up 14.7 percent from the previous year. In February, Virgin flew one of its Boeing 747 aircraft from London to Amsterdam with 20 percent of power for one engine being provided by a plant-based biofuel.

April 16, 1988: First flight of the T-45 Goshawk, a highly modified version of the BAE Hawk land-based training jet. Developed by McDonnell Douglas and British Aerospace, the T-45 is used by the U.S. Navy as an aircraft carrier-capable jet trainer.

May 24, 1982: British Airways operates its last flight using the Boeing 707, which has been in service with British Airways and BOAC, one of its predecessor carriers, for 22 years.

Oct. 27, 1988: Air United Kingdom becomes the first airline based outside the United States to operate the Boeing 737-400 airliner.

Nov. 10, 2005: The Boeing 777-200LR Worldliner jet lands at London's Heathrow Airport, breaking the record for the longest nonstop passenger airline flight, after a 12,500-mile trip from Hong Kong.

May 23, 2001: The Boeing C-17 Globemaster III is formally accepted into Royal Air Force service, with No. 99 Squadron.

Sept. 28, 1998: AgustaWestland, under license from Boeing, delivers the first of 67 UK Apaches.

July 18, 2007: A Boeing Chinook Exhibition is officially opened by Baroness Thatcher at the Royal Air Force Museum in Hendon.

Nov. 9, 1978: The AV-8B Harrier prototype for the U.S. Marine Corps makes its first flight. Based on the British-designed Hawker Siddeley P.1127 Kestrel/Harrier aircraft series, the AV-8B Harrier II was developed by a team representing McDonnell Douglas (now Boeing), British Aerospace (now BAE Systems) and Rolls-Royce.

1980s

Sept. 14, 2004: Boeing announces plans to invest £7 million (about \$14 million) to build a new Alteon training centre at London's Gatwick Airport. Alteon is a wholly owned subsidiary of Boeing.

May 22, 2006: Boeing formally commences work on the 34-year Through Life Contractor Support program for the Royal Air Force's fleet of Chinook helicopters.

April 17, 2007: Boeing officially opens its new defense Systems Engineering and Integration facility in Bristol.

July 11, 2007: Boeing and QinetiQ, a British defense and security research firm, open The Portal, a new decision-support capability center in Farnborough.

1990s

Nov. 3, 1998: British Airways takes delivery of its 50th Boeing 747-400.

2000s

2010s

Feb. 24, 2008: A Virgin Atlantic Boeing 747-400 conducts the world's first flight utilizing biofuel for power.




An overhead view of Boeing's facilities at the 2006 Farnborough International Airshow. Boeing will participate in this year's version of the biennial aerospace industry gathering.

FARNBOROUGH INTERNATIONAL AIRSHOW PHOTO

Farnborough:
A key UK aerospace center

One hundred years ago, Samuel Cody, an American, made the first powered flight in the United Kingdom on board British Army Aeroplane No 1A. Cody's flight took place in the town of Farnborough—which has since become one of this nation's most important aerospace centers. Today, the town is known for the Farnborough International Airshow, one of the aerospace industry's biggest events. In 2008 the show, which takes place every other year, celebrates its 60th anniversary. Boeing will be at the event with a range of products on static display. ■



Among the Boeing aircraft serving the UK Ministry of Defence is the Apache helicopter.

Unity in the UK

Boeing's UK defense operations realign for growth and customer support

BY MARIBETH BRUNO AND MADONNA WALSH

A special relationship”—British Prime Minister Winston Churchill coined that term to describe his country's history of military and economic cooperation with the United States. He said the countries' close ties required not only “growing friendship and mutual understanding” but also “common study of potential dangers,” similar weapons and joint use of military bases.

Since Churchill's time, the United States and United Kingdom have continued to maintain their “special relationship” as the world's No. 1 and No. 2 defense markets. Boeing has been active in the United Kingdom for just as long, from the country's purchase of North America's Harvard trainer aircraft in 1938 to this year's reorganization of Boeing's UK defense businesses under the umbrella of Boeing Defence UK. Boeing will formally introduce BDUK this month at the Farnborough International Airshow, which takes place in the United Kingdom—a nation where Integrated Defense Systems sees up to \$7 billion in business opportunities over the next decade.

“Boeing sees the United Kingdom as a source of highly skilled suppliers and partners as well as a valued customer,” said BDUK Managing Director Mike Kurth. “Bringing together IDS businesses as part of a single UK entity positions us for growth by streamlining our infrastructure, building a cohesive, local strategy and demonstrating our continued commitment to UK stakeholders. BDUK is also the foundation of our response to the Ministry of Defence's Defence Industrial Strategy.”

Boeing employees already have noticed how this streamlining is

making a difference. “[BDUK] has been very effective in opening up communication between the various IDS groups in the UK,” said Roland Perez, who manages the U.S. T-45 Supplier Program under which BAE Systems manufactures about 80 percent of the T-45 trainer's bill of material. “It comes in handy knowing about other Boeing resources throughout the country.”

The Defence Industrial Strategy (DIS), launched in 2005, calls for retaining certain industrial capabilities within the United Kingdom to protect national security, develop intellectual property, and create jobs across a wide range of skills. It asks suppliers to make commitments in areas including through-life support, systems engineering, and innovation/research and development, and to “create value, employment, technology or intellectual assets in the UK and thus become part of the UK defence industry.” Lt. Gen. Andrew Figgures, Ministry of Defence Deputy Chief of Defence Staff (Equipment Capability), put it in even plainer terms: “To me, it means commitment. It means you are investing in our future.”

That's just what BDUK is doing across the country, with a variety of products and services.

FRES: A Foothold for Expansion

One of several milestones on the way to a single BDUK was the opening of a new facility in Bristol in April 2007 in support of IDS Combat Systems' contribution to the Future Rapid Effect System program. In October, the Ministry of Defence awarded Boeing and partner Thales UK the program's initial System-of-Systems Integrator contract. FRES will provide

the British Army with a family of medium-weight, network-enabled, air-deployable armored vehicles to meet up to 16 roles.

“Establishing a base, setting up a long-term partnership and developing intellectual property onshore were key factors in the FRES win,” said Jonathan Bailey, deputy director, BDUK Bristol.

Combat Systems UK Director Jim Freeman added that Boeing’s actions fall into an essential category of the Ministry of Defence’s evaluation: behavior. “We need to understand, act like and actually be a UK company that understands how the Ministry of Defence and industry do business, and bring the best of Boeing together for our customer,” he said.

“Successfully executing this program will position us to expand our capability in the UK and European defense markets,” Bailey concluded.

THE PORTAL: A GLOBAL RESOURCE

The Portal, a Farnborough-based joint effort between Boeing and UK defense technology firm QinetiQ, officially reaches its first anniversary this month. But it was providing programs with modeling and simulation services for months before its opening ceremony. In fact, the Portal team directly contributed to the FRES contract win by using its simulation environments to help explore battlefield scenarios.

“The Portal is a central resource for all BDUK and IDS activities in the UK,” said Boeing Technical Fellow and Portal Facility Director Shane Arnott. “Any program can request support, from a simple presentation to a large experiment that links facilities across the UK, the United States and Australia.

“The DIS is very specific about the need for industry and the Ministry of Defence to engage earlier in the systems-development process,” Arnott continued, “and its companion document, the Defence Technology Strategy, makes dozens of references to the need for simulation and synthetic environments to aid decision making. The Portal is the answer to those calls from the customer.”

Arnott, who is Australian and set up a similar capability for Boeing Australia Limited, is pleased that when he moves to a new assignment in August, he will be succeeded by a “local”—Portal operations analyst John Winskill, a former British Army officer. “Another way we can build our presence here is by placing highly qualified UK citizens in leadership positions,” Arnott said.

SUPPORT—AND IMPROVEMENT

BDUK’s activities in the United Kingdom involve not just product development but also support for existing assets.

- IDS Support Systems Integrated Logistics, partnering with major subcontractor Vector Aerospace (formerly the Defence Aviation and Repair Agency), has committed to keeping 27 of the 40 UK Chinooks available to the front lines at all times. Just two years into the 34-year Chinook Through Life Customer Support program, the team is exceeding performance indicators for both availability and mission capability.

Program Director James O’Loughlin credits widespread sharing of best practices in Lean and Employee Involvement with the program’s cycle-time reductions. “We work with our customer, with Vector and with the Boeing Rotorcraft team in Philadelphia to make improvements that will return Chinooks to service as quickly as possible, while reducing overall maintenance costs,” O’Loughlin said.

- Boeing delivered the Royal Air Force’s sixth C-17 Globemaster III on June 11. The new airlifter was a welcome addition to a hardworking fleet that supplies the “air bridge” to Afghanistan and Iraq. Since the first

RAF C-17’s operational debut in 2001, the aircraft have been used at about 120 percent of their originally planned flight hours per year.

Supporting that punishing schedule is the job of the C-17 Globemaster Sustainment Partnership (GSP)—a contract between Boeing and the U.S. Air Force that the United Kingdom takes part in through a Foreign Military Sales agreement. Boeing field service representatives work on-site at RAF base Brize Norton.

“Our engineers’ postproduction product review authority means repairs can take place right on-site, which saves time and keeps C-17s in the air,” said Boeing C-17 Field Services Manager Trevor Kirby.

- The Boeing team in Yeovil, England, and Mesa, Ariz.—working as a contractor to Britain’s AgustaWestland—provides a full range of support services for the British Army’s fleet of 67 Apache helicopters. British Army Air Corps Apaches are forward-deployed from Wattisham Air Field in the UK in support of NATO-led operations in Afghanistan. Aviation Training International Limited, a joint venture between Boeing and AgustaWestland, provides crew training services.

“The Boeing technical staff and management team are located in the same building as



Through the Chinook Through Life Customer Support program, Boeing is maintaining the United Kingdom’s fleet of Chinook helicopters. NICK WEST PHOTO

the Ministry of Defence, AgustaWestland and other industry-alliance partners,” said Technical Support Services and Yeovil Site Manager Don Brubaker. “So the lines of communication are excellent—we understand our customers’ needs, and they see us as listening and responding appropriately.”

Program Manager and Capture Team Leader John Wilson said his team is working on a Future Support Arrangement that will transition the program into a long-term, Performance Based Logistics solution similar to Chinook TLCs. “We’re also working closely with BDUK and others to share lessons learned and exploit economies of scale,” Wilson added.

- The BDUK support team for the RAF’s fleet

of seven E-3D Airborne Warning and Control System (AWACS) surveillance/command-and-control aircraft also is located close to its customer, on base at RAF Waddington. Boeing completed the seven deliveries in 1992, but its support began with predelivery preparations and continues today with postdesign services. The team has completed an upgrade of the fleet’s radar capability and installation of the Global Positioning System/Inertial Navigation System.

The Ministry of Defence continues to review potential enhancements to maintain interoperability with AWACS fleets in the United States, NATO, France and Saudi Arabia. BDUK stands ready to provide whatever support

is required. “Clearly, we’re in it for the long haul,” said Boeing Field Support Manager Brad White.

BDUK’s efforts such as the ones listed above are already attracting notice, said Air Vice-Marshal Stuart Butler, Capability Manager (Information Superiority). “You’ve now got an increased presence in the country and you’re very much becoming part of the UK infrastructure,” he said. “We’re delighted to see that particular buildup is increasing.

“We’re in this game to win,” Butler added, “and we can only do that by working together.” ■

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The Portal, a joint effort between Boeing and QinetiQ, is a high-tech decision-support facility that provides modeling and simulation services.

The same language: *Creating BDUK*

The task was clear: Bring together the dispersed operations and employees working on Integrated Defense Systems projects in the United Kingdom to present a single Boeing Defence United Kingdom face to stakeholders. As it happened, this transformation is occurring at a time when Shared Services Group, Information Technology, Human Resources and Finance are working to enhance their international operations.

The administrative transition is progressing on schedule, with all affected operations and employees expected to move officially into the new organization early this month. IDS’ nearly 170 UK-based employees stay informed via a new intranet site and a monthly all-hands teleconference and webcast.

“We want to be sure that when we align everyone into Boeing Defence UK there are no disruptions to the level of service employees receive and expect,” said BDUK Managing Director Mike Kurth. “The alignment also simplifies compliance and other legal concerns—reducing the number of audits, for example. We’re working closely with the SSG team to streamline the infrastructure services that support our operations.”

“SSG’s goal is to help BDUK run its business without having to worry about the infrastructure,” said Russell Geen, business manager of the Boeing St. James London office, where BDUK is headquartered. “Our efforts are aligned to support the Internal Services Productivity initiative. Everything we do is intended to create a more effective operation.”

Across the *pond*

Who's working for Boeing Defence UK? Here are a couple of the many teammates.



Marie Perry Systems engineer, Future Rapid Effect System (FRES), Bristol, England

What I do: Currently, I'm looking at Interfacing Programs and Systems (IP&S) for FRES. FRES is a System of Systems program, and as such we are trying to achieve effective integration across multiple dimensions. Just part of this is achieved by looking at IP&S.

What I hope will come of the creation of BDUK: I hope it will become a stepping-stone for Boeing to grow as a business in Europe. We have the potential to become a several hundred- or thousand-person organization of UK personnel, able to operate independently and to reach back into the rest of Boeing for assistance when needed.

What I like about working for Boeing in the UK: It's an exciting place to work and we have a strong feeling of camaraderie. Having the chance to shape something new is a great opportunity and outweighs any initial "growing pains." Having support from Boeing in the United States also provides us with opportunities to develop our careers.



Stu Duncan Site manager, UK Chinook Through Life Customer Support program, Perth, Scotland

What I do: I'm responsible for oversight and provision of Boeing Technical Services and Support to facilitate the overhaul and repair of the Royal Air Force CH-47 Chinook helicopter's major and flight-critical components. We have an extremely close relationship with our RAF customer.

What I hope will come of the creation of BDUK: For the first time, we are recognized as "one Boeing" rather than a series of satellite program offices. Our ability to capitalize on lessons learned and move forward together will lay solid foundations on which we can build even stronger bonds with our customer base.

What I like about working for Boeing in the UK: It's great to be part of an organization that values its people and continually pushes the boundaries of the possible. We're able to draw on the expertise of the entire Boeing community in the development of agile, proactive support solutions.

Industrial Participation: Why it matters

Industrial Participation (IP) is an essential element of many of Boeing's proposals for contracts outside the United States, whether it's contractually required or—as in the case of the United Kingdom—strongly encouraged by the customer country. Boeing's IP agreements include placement of direct work, orders for supplies, opportunities to bid on supply contracts, transfer of technology, or other forms of assistance to the customer country. In some cases, commitments are satisfied with help from Boeing's current vendors. Since Boeing does not formally commit to IP agreements unless a contract for sale of its products or services is signed, offering a substantive IP proposal increases Boeing's chances of winning international competitions. To be considered as a beneficiary, the potential supplier must have sufficient capability and capacity and be competitive in cost, quality and schedule.

Some of Boeing's U.S. employees are concerned about the company's placement of work outside the United States. Integrated Defense Systems President and CEO Jim Albaugh said that while he understands their

concerns, "many countries require [IP]. It's a fact of life. ... I think another way to look at it is, if we didn't satisfy those requirements it would generate no additional work in the United States. Winning programs that have offset requirements creates jobs not only in the customer country but also for the rest of Boeing and our suppliers."

Brian Moran, IDS lead for UK Industrial Participation, said IP increases Boeing's access to goods, services and intellectual property while strengthening alliances with key stakeholders—all of which positions the company for growth. "The UK government via its Defence Industrial Strategy acts in support of onshore technology creation and aerospace employment, and IP is one of the ways in which Boeing demonstrates strong awareness of and compliance with this policy," said Moran. "The advocacy we receive from our UK customers, the world-class supply of UK products and services, and the country's high level of technical innovation make our products more capable, desirable and competitive worldwide."

Practice makes perfect

Here's the view from the pilot's seat in an F-15C simulator at the Boeing-delivered and -operated Mission Training Center at Langley Air Force Base, Va. A team co-led by Boeing recently conducted an exercise that allowed pilots from different nations, flying various types of aircraft, to train simultaneously and virtually in a realistic fighting environment.

BOB FERGUSON PHOTO

Boeing helps fighter pilots worldwide train practically 'side by side'

By STACEY RITTER HOLLOWAY

This is the first time ever I was able to interact with fighters from a different country; and I am really, really impressed!"

Those words, spoken by a Royal Air Force Tornado GR4 pilot, summed up his participation in Avenging Eagle, the first ever link-up between the U.S. Distributed Mission Operations Network aircrew training system and another nation's simulation facilities. The exercise, which took place in March, was delivered through the UK Mission Training Through Distributed Simulation Capability Concept Demonstration program (MTDS CCD).

Since 1999, Boeing has been considered an industry expert in providing training in a Distributed Mission Operations environment. This capability allows U.S. Air Force pilots the means to train as they operate—in teams from around the globe, without requiring pilots to leave their home base. Today, that expertise includes providing distributed training capability to U.S. coalition teammates in the United Kingdom.

Delivered by Team ACTIVE—a team led by Boeing and British defense and security technology firm QinetiQ in partnership with the Royal Air Force, U.S. Air Force and subcontractors—Avenging Eagle provided a new capability for simulators and training centers to be networked together on the Distributed Mission Operations Network. During the exercise, pilots in five different locations across the UK, United States and Europe flew aircraft simulators linked to allow them to cohesively plan, execute and debrief the mission—all within a virtual environment.

"The more aircraft we can link, the better the opportunity to improve both British and U.S. capabilities," said Capt. Richard Ward, 390th Fighter Squadron, Mountain Home Air Force Base, Idaho.

Simulators for European-built Tornado and Typhoon fighter/attack jets, Boeing E-3 Airborne Warning and Control System (AWACS) aircraft, and Forward Air Control at Royal Air Force Base Waddington, UK, were linked to simulators for the Fairchild A-10 ground attack aircraft in Spandahlem, Germany; Lockheed F-16 fighter at the Air Force Research Laboratory in Mesa, Ariz.; Boeing F-15 fighter at Langley Air Force Base, Va.; and AWACS at Tinker Air Force Base, Okla.

"The MTDS program has exceeded everyone's expectations by defining and delivering training capabilities never before imagined," said Tony Jones, vice president, Boeing Training Systems and Services, a division of the Support Systems business of Integrated Defense Systems.

Within the networked simulation environment, pilots are able to fly, communicate and execute their mission just as they would in an actual aircraft, but without the weather, cost and flight-safety constraints experienced in live practice. Instructors generate realistic threats that the pilots engage and fight—all via computers.

Avenging Eagle was the last exercise under the MTDS program. Over the past 30 months, the program staged nine events, of varying complexities, that drew from a wide range of air assets and operational scenarios.

What's next for joint and coalition training? George German, Boeing manager of the MTDS CCD program, said: "We want to continue expanding the global capabilities of the network so that in addition to the UK, the air forces of multiple countries can train in one virtual environment." ■

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Bird of a different feather



An MV-22 Osprey belonging to Marine Medium Tiltrotor Squadron 263 waits for members of the 7th Iraqi Infantry Division and Marines with Military in Transition Team 0720 to load up after an operation. U.S. MARINE CORPS PHOTO

Marines praise how Osprey aircraft performed in combat in Iraq

By JACK SATTERFIELD

The Bell Boeing V-22 tiltrotor aircraft—with its speed, maneuverability and multimission capability—has come into its own as the tactical transport of choice in Iraq. With a flawless combat deployment under its belt and a second tour of duty performing at comparable levels, the Osprey is proving in the heat of battle what the U.S. Marines have argued all along: This aircraft will transform U.S. military operations.

That's good news for Boeing and its Osprey partner, Bell Helicopter Textron in Fort Worth, Texas. In fact, following 25 years of development and years of controversy surrounding the aircraft's performance, their vision and investment paid off in March with a five-year procurement program for 167 Ospreys.

The first V-22 fleet operations began in 2006 when Squadron VMM-263, nicknamed the Thunder Chickens, was the first to convert from CH-46 Sea Knight helicopters to the V-22. The Marines certified the squadron operationally ready in 2007; squadron members boarded an amphibious assault ship last September with 10 aircraft, and combat flying commenced in October.

VMM-263's Ospreys supported Marines throughout Al Anbar Province, covering most of western Iraq. Two additional Ospreys were added midway through the tour with continued smooth operations, underscoring the V-22's safety, reliability and mission suitability.

The Osprey proved that in combat it's definitely a bird of a different feather. V-22s take off, land and hover like helicopters, but fly most missions as speedy turboprop aircraft. In other words, once airborne, its engine nacelles can be rotated forward to convert the aircraft to a turboprop airplane capable of high-speed, high-altitude flight. The V-22 can cruise at about 275 miles per hour (440 kilometers per hour) in airplane mode.

During its Iraq deployment VMM-263 completed nearly 1,500 combat sorties, many involving several aircraft, logging almost 3,600 flight

Osprey's score points

Here are some of the capabilities of the V-22 Osprey tiltrotor aircraft:

- Increased speed: It's twice as fast as a helicopter
- Much longer range, resulting in greater mission versatility than a helicopter
- Multimission capability:
 - Amphibious assault
 - Transport
 - Combat support
 - Search-and-rescue
 - Long-range special-operations infiltration and exfiltration
 - Medevac

hours. It had a 69 percent mission-capable rate (a measure of aircraft availability for flights). In fact, the squadron completed every mission assigned without delay. Not a single squadron member or aircraft suffered a scratch in the six-month deployment. Insurgents targeted Ospreys twice, but crews flew quickly out of harm's way.

"I'm proud of the aircraft's performance," said Lt. Col. Paul Rock, VMM-263's first commanding officer. "This aircraft can scream across the ground. There's nothing in the [helicopter] inventory that can keep up with the Osprey. I'm very satisfied at how well it performed."

"The commandant [Marine Gen. James T. Conway] clearly made the right decision to send this airplane into combat so that our warriors forward could have the best assault support aircraft ever made for war-fighting purposes," said Lt. Gen. George Trautman, deputy commandant for Aviation. "But, I don't want anybody to think that this is the end of a journey. We're going to continue to learn lessons, improve, and work hard to exploit the capabilities of this airplane. I anticipate in the coming years and decades, as Air Force Special Operations Command and others see the utility of this aircraft, it's just going to become more and more valuable across the board."

In April, with the completion of their deployment, VMM-263 turned over its combat assignment and its Ospreys to VMM-162 (known as the Golden Eagles). The 200 men and women of VMM-263 continue to laud the aircraft, as they have from the start. But now, following a successful deployment, they can also boast: "The Eagles have landed, but we Chickens were there first!" ■

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Their 'Flight Plan'

5 ways the Super Hornet team works to ensure combat superiority—for today and the next three decades

By PHILIP CARDER

It's one thing to create a technologically advanced product. But what's the plan to maintain that edge?

Companies in all industries must address that question, and it's a matter that the Super Hornet program at Boeing takes seriously. As the program continues to deliver F/A-18E/F aircraft to the U.S. Navy customer, it's following a strategy—the F/A-18E/F Super Hornet “Flight Plan”—that charts the course for this multirole strike fighter's combat capability over the next three decades.

“When I look at what the Super Hornet offers our warfighting commanders today, I really feel we are unmatched at what we bring to the fight,” said Bob Gower, Boeing's F/A-18 and EA-18 vice president.

Thanks to a total system engineering effort, coupled with Lean+ business practices, the program has delivered more than 360 aircraft to the Navy—each on time and under budget—and is positioned for air dominance well into the future.

“The Flight Plan is our advanced capability insertion road map that partners Boeing with the U.S. Navy to ensure the Super Hornet and its electronic attack variant, the EA-18G Growler, remain in front of developing threats over the next three decades,” said Mike Gibbons, F/A-18E/F and EA-18G Flight Plan manager.

Here's a look at five ways the Flight Plan adds continuous capability upgrades to the Block II Super Hornet.

- **Improved situational awareness.** The second phase of Block II enhancements upgraded the APG-73 radar, a mechanically scanning radar, with the APG-79 Active Electronically Scanned Array (AESA) radar as the heart of the system. Additionally, the Advanced Targeting Forward Looking Infrared (ATFLIR) pod and Shared Reconnaissance Pod provide upgraded sensor capability.

“You need all of the right sensors on the platform, and you need to integrate what those sensors are telling you. That is where we stand out,” Gibbons explained. “The Super Hornet pilot knows where all of the threats are and can then decide to either avoid or engage and eliminate the threat.”

- **Accuracy and lethality.** The powerful AESA radar and the ATFLIR—part of the Super Hornet's network for multisource integration—can pinpoint targets with devastating accuracy. “We can correlate data between the AESA and ATFLIR via multisource integration, and then algorithms integrate that data, enabling the deletion of any targeting error,” said Shelley Lavender, F/A-18 program manager.

Another destination on the Flight Plan map is the addition of an In-



The Flight Plan is a technology insertion road map for the F/A-18 Super Hornet that partners Boeing with the U.S. Navy to ensure the aircraft remains in front of developing threats over the next three decades. BOEING PHOTO

“There just aren’t any other platforms out there that can match what we bring to the fight.”

– Bob Gower, Boeing F/A-18 and EA-18 vice president

frared Search and Track (IRST) system that will enable the F/A-18E/F to operate in a completely passive mode while scanning the battlespace for heat emitters, or enemy aircraft.

“IRST will allow the Super Hornet to detect and track targets based on heat,” said Gower. “Even stealth has a hard time hiding heat. This is part of our balanced approach to lethality.”

• **Network-centric-operations support.**

Lavender said another hallmark of the day/night all-weather strike fighter is its versatility when connecting into the warfighting network commonly known as net-centric operations. For example, when forward air controllers on the ground employ the Remotely Operated Video Enhanced Receiver (ROVER) system, the F/A-18E/F sends video to the ROVER. The system confirms in a matter of seconds that the pilot is engaging the correct target by evaluating the real-time air-to-ground video captured by the Super Hornet’s sensors.

• **User-friendly interface.**

The Super Hornet’s Multifunctional Information Distribution System/Link 16 can instantly pass targeting information between aircraft with the push of a single button. “It is a machine-to-machine interface,” Lavender said, “that used to take 27 keystrokes before the

targeting data could be transferred and the weapon could be employed. Obviously, this goes a long way toward reducing pilot workload.”

• **Versatility.** “We can perform simultaneous air-to-air and air-to-ground combat with the addition of the APG-79 radar,” Gibbons said. “That hasn’t historically been available. To date, it has been an either air-to-air or air-to-ground mode. Now, the Super Hornet is smashing that paradigm. With the F/A-18E/F it’s same-time air and ground missions. That’s tough to match.”

Yet the Super Hornet can do more than that. Because of its 11 weapons stations, it can fight its way into target areas, launch weapons, and fight its way out. The Super Hornet is “the pre-eminent multirole platform in the world today,” Gower said. The F/A-18E/F’s unlimited angle of attack flying capability coupled with its ability to execute air-to-air, fighter escort, air-to-ground, close air support, maritime attack/tactical maritime operations and reconnaissance missions, and even serve as a tactical air refueler, make it a true force multiplier. “There just aren’t any other platforms out there that can match what we bring to the fight,” Gower said.

Gower said the Navy will operate the Super

Hornet until 2035 or 2040, because it is the only platform that offers such unique, combat-proven capabilities. But, Gower said, the Super Hornet team must continue following the Flight Plan and enhance and upgrade the F/A-18E/F to remain ahead of threats that continue to emerge.

“And we’ve only tapped the surface of what the APG-79 radar can do,” he said. “You will continue to see capability leaps as we go forward.” ■

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Internationally attractive

Thanks to its track record of reliability, affordability and availability, the Super Hornet is an attractive option for international customers. Australia recently became the first international Super Hornet customer—with its acquisition of 24 F/A-18 dual-seat F models. Additionally, the Super Hornet is a competitor in India’s Medium Multi-Role Combat Aircraft competition. Other nations are eyeing this aircraft to meet their air combat needs.



Among the Super Hornet’s many advantages is its versatility. It can execute air-to-air, fighter escort, air-to-ground, close air support, maritime attack/tactical maritime operations and reconnaissance missions, and even serve as a tactical air refueler.

BOEING PHOTO

Out-of-this-world engineering

Astronaut Ron Garan, STS-124 mission specialist, conducts a spacewalk outside the International Space Station during last month's mission. Behind him are the blackness of space and Earth's atmosphere. With ISS assembly nearing completion, Boeing engineers are focused on keeping the station functioning properly.

NASA PHOTO

Boeing employees in Houston provide solutions implemented 200 miles above Earth

By ADAM MORGAN

The largest, most complex engineering feat in history is the International Space Station. Its astronaut crews rely daily on Boeing, the prime contractor for this massive undertaking, to keep it operating flawlessly and to keep them safe in the challenging space environment.

In addition to designing and building the major U.S. components for ISS, engineers from Boeing's Space Exploration division are responsible for integrating the work of an international network of 15 participating countries and hundreds of contractors. Now, with ISS assembly nearing completion, Boeing engineers are focused on keeping the vehicle functioning properly to meet mission objectives.

"We helped develop and now sustain the many systems that operate the ISS. Our engineers integrated these subsystems into a vehicle that has performed exceptionally well on orbit," said Mark Mulqueen, ISS Vehicle director, Boeing Space Exploration. Boeing's role on the ISS includes command and control, communication and tracking, data handling, software development, electric power generation, thermal heating and cooling systems, environmental control systems, and maintaining the structural and mechanical backbone of the ISS to sustain life on orbit.

ISS sustaining engineering teams are intimately aware of the design of the station and stay closely connected to daily vehicle performance, which includes sitting side-by-side with NASA in Mission Evaluation Rooms. MERs are the engineering rooms that analyze data from systems on orbit to identify anomalies. Indeed, last September Boeing engineers in

the MER were the first to spot a problem with a giant rotating joint for the solar arrays.

Boeing analyzes more than 400,000 signals such as pressure, temperature and valve positions necessary to operate the ISS. The engineers receive these signals as part of approximately 1.5 million lines of flight software code running on 44 computers communicating via 100 data networks—all designed and produced by Boeing.

Another task is assisting the NASA customer with extravehicular activities, or spacewalks, as well as intravehicular activities, which happen inside the station's pressurized modules.

Boeing engineers ensure the activities go smoothly and help NASA operations understand the intricacies of the system's hardware and software.

"Our engineers take into consideration the human elements involved with many of the tasks," said Terri Puckett, manager, Extravehicular Activity & Crew Systems Integration for Space Exploration. "Our intimate knowledge of the design of the U.S. elements and interfaces with the international elements helps us ensure proper positions for the astronaut performing the work—bolts are reachable, handrails accessible, visible worksites, etc."

There are also times when the team is called on for their expertise on very short notice.

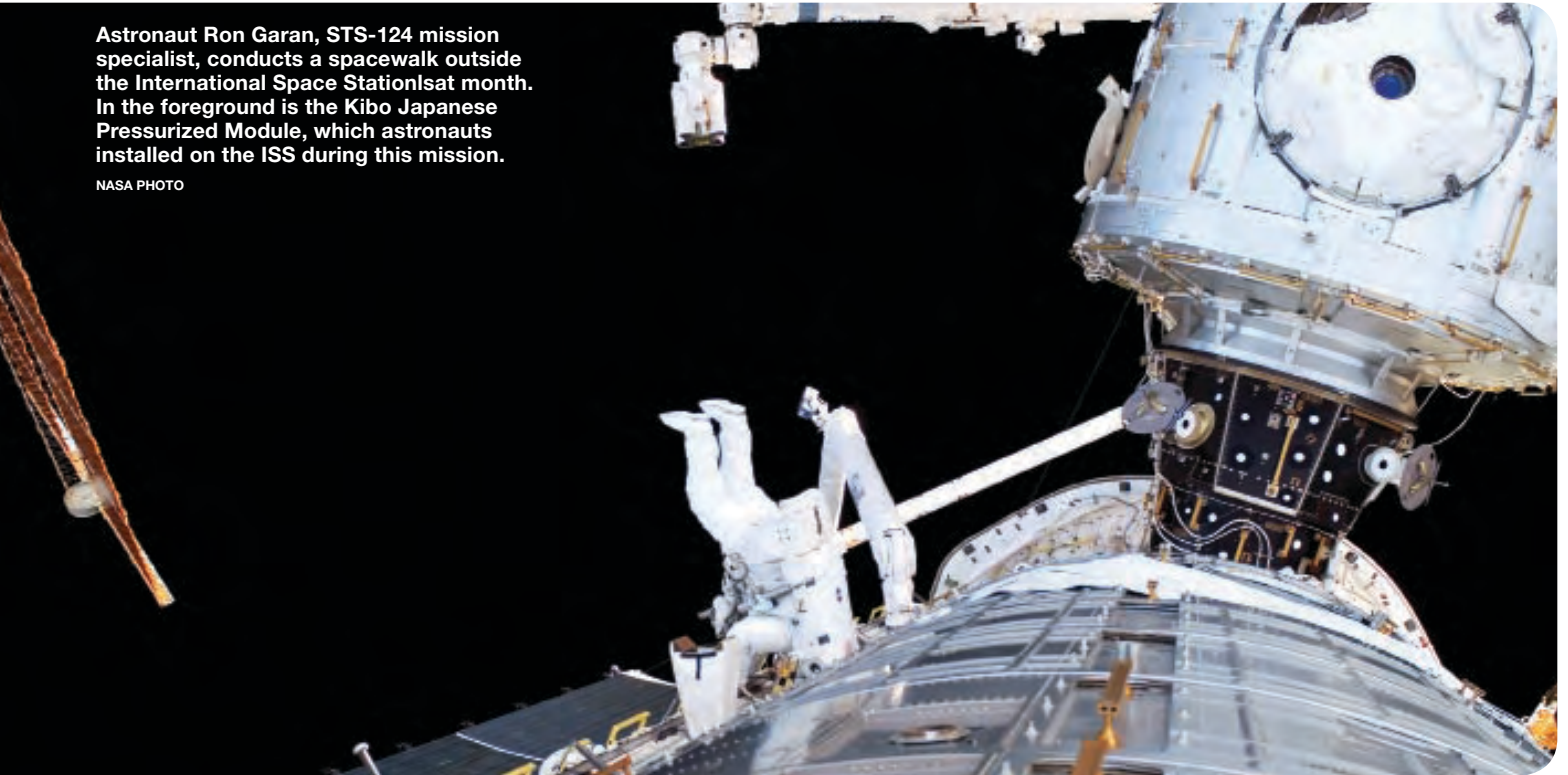
"Things will inevitably break, and we don't always have a space mission scheduled in the near term to take a new part or component up to

“When you’re performing tasks 220 miles above Earth, you have limited time to complete the tasks, so every minute counts. We have the inherent knowledge and the skills to provide safe, effective solutions very quickly.”

– Patricia Schmidt, Systems engineer, Extravehicular Activity & Crew Systems Integration

Astronaut Ron Garan, STS-124 mission specialist, conducts a spacewalk outside the International Space Station at month. In the foreground is the Kibo Japanese Pressurized Module, which astronauts installed on the ISS during this mission.

NASA PHOTO



the station,” said Patricia Schmidt, Systems engineer, Extravehicular Activity & Crew Systems Integration. “There are interesting engineering challenges to figuring out what already exists on orbit and how to make that work to solve the problem. It can be really exciting.”

For example, what if an astronaut is trying to drive a bolt, and that bolt doesn’t turn at the recommended torque settings? “It’s our job to work with all the engineering groups to resolve that issue,” Schmidt said. “When you’re performing tasks 220 miles above Earth, you have limited time to complete the tasks, so every minute counts. We have the inherent knowledge and the skills to provide safe, effective solutions very quickly.”

The Boeing teams also work with the customers on various mission operation procedures that help maintain the station at its full operating capacity. Some of these procedures involve ensuring that new systems being added are not harming the vehicle or the crew members.

The team helps establish requirements for things such as handrail clearance (crewmembers have enough clearance to grab the handrail), working volume (astronauts have enough working area so they don’t become entrapped) and pinch points (areas that could cut a crewmember’s glove).

The teams use graphical analysis, mock-ups and visits to NASA’s Neutral Buoyancy Laboratory, the giant pool where astronauts train for upcoming missions in simulated weightless conditions, to work with astronauts on procedures for performing tasks. Some Boeing engineers are certified divers and assist crew members in the 40-foot-deep pool to provide “hands-on” training.

The Boeing team always is looking for opportunities to leverage advances in technology to update station components. Because Boeing has intimate knowledge of the current ISS configuration, and how that configuration is integrated, it is in a good position to analyze where and what kinds of improvements will add the most benefit.

“There is nothing more expensive than launch-to-orbit costs. If we can use technology to extend the life of our parts or subsystems and reduce the need to replace them, or replace larger components with smaller ones, then that’s a great benefit to our customer, because it reduces their launch costs,” Mulqueen said. “We are in a good position to extend the life of the subsystems because we know how they operate and how to control, repair and improve them.” Mulqueen added that the engineering knowledge learned from ISS can also be applied to future spacecraft.

The ISS is scheduled to be in service until 2016 and likely will be extended by NASA to 2020 or beyond. Boeing’s thorough knowledge of the station, its rich history in space, and the company’s ability to use knowledge from around the enterprise will keep the ISS in step with advances in technology. That will ensure it’s operating safely and efficiently throughout its scheduled life and beyond. ■

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Goin' Agile



The F-22 Agile Integration Lab interlinks the 757 Flying Test Bed (shown here) with a sophisticated ground-based test and evaluation facility via a multicable “umbilical” cord. This provides the capability to test several avionics software versions dynamically during a single six-hour flight, land the aircraft, reconnect the umbilical and certify the upgrades against systems that don’t need to be tested in an airborne environment.

MARIAN LOCKHART PHOTO

F-22 team accelerates avionics modernization with new approach

By DOUG CANTWELL

The Seattle-based F-22 team cut the ribbon last month on a new approach to avionics development as well as a new facility.

The Agile Integration Lab consists of a ground-based facility interlinked by way of a supersized “umbilical” with the program’s re-activated Boeing 757 flying test bed. The AIL adds a dynamic test and evaluation capability that will fast-track the integration of new radar capabilities under Increment 3.1 of the Raptor avionics modernization program.

“As far as we know, this hasn’t been done before,” said Brian Harden, program manager for the AIL, referring to the concept of yoking a ground-based lab with an easily detachable dynamic test bed asset. “We operated at a plodding monthly tempo during the engineering/manufacturing/development phase, using a ‘fly-fix-fly’ approach. We can’t afford this in Increment 3.1.”

Increment 3.1 will endow the Raptor with exponential enhancements, such as synthetic aperture radar that will improve the pilot’s ground attack; mission systems that enable delivery of the Boeing-built, precision-guided Small Diameter Bomb; electronic attack capabilities to foil enemy air defenses; and dynamic retargeting that allows last-minute mission adjustments.

Boeing provides the wings, aft fuselage, avionics integration and training programs and part of the sustainment for the F-22.

FAILURE NOT AN OPTION

If you load a new version of avionics software on board an actual F-22 aircraft in order to flight-test it, you run into all kinds of bottlenecks, Harden explained. For one, you have to get the new software certified for “man-rated” systems—where there’s a test pilot’s safety at stake—that can eat up weeks of your schedule.

With the AIL, he said, “it’s not a stretch to say we can accomplish in a day what used to take a month.” His team can upload multiple software versions into the flying test bed’s workstations, test them during a single six-hour flight, land and park the airplane in its stall beside the ground-based lab, reconnect the umbilical, and certify the software updates in concert with F-22 systems that don’t need to fly on the test bed: weapons, engines and flight controls, for example.

The team faced a narrow window for standing up the AIL. If they didn’t meet their June 6 deadline for going operational, it would throw everything off cycle for flight tests at Edwards Air Force Base, Calif., scheduled to start in late 2009—thus delaying final certification and delivery of the new capability to the warfighter. “Our theme became, ‘What’s the value of a day?’” Harden said. “There was simply no time for procrastination or bureaucratic roadblocks.”

While his engineering team came up with the breakthrough concept of a combined airborne/ground-based test and evaluation facility, Harden was quick to mention they couldn’t have achieved it without a lot of timely help from sources across the enterprise.

“Boeing really came together as a company to support us,” he said. “We couldn’t have done it all ourselves—and we didn’t have to.” The Derivative Airplane Programs team in Seattle pitched in, as did the stress engineering support team in Wichita, Kan.

“We all know you can get myopic in your approach and totally overlook something that can hurt your program. So we depended on these guys to find the chinks in our armor.”

— Brian Harden, program manager for the AIL

EXECUTE ‘BETTER THAN PLAN’

Harden and his team came to rely heavily on INARs, or independent nonadvocate reviews, to give them an outsider’s impartial assessment of their plans and progress. For the INARs, they recruited St. Louis colleagues from the F-15 and F/A-18 programs who had dealt with similar test and evaluation challenges.

“We all know you can get myopic in your approach and totally overlook something that can hurt your program,” Harden observed. “So we depended on these guys to find the chinks in our armor.” Harden’s team would ask the INAR reviewers two basic questions: Do we have an executable plan? If so, are we executing it?

The team also established key progress metrics early in the schedule, and worked to the watchwords: “execute better than plan.”

It wasn’t just enterprisewide support that covered their backs, Harden recalled. The open communication his team enjoyed with the U.S. Air Force customer and team partner Lockheed Martin made a huge difference. “We established an atmosphere of trust early on,” he said.

Brig. Gen. C.D. Moore, the F-22 program manager and a former Raptor test pilot, started things off with an unorthodox staffing decision. He assigned the member of his team who’d voiced the most skepticism regarding the AIL team’s success to oversee the project.

By picking this liaison, Moore figured he was less likely to hear sugar-coated progress reports or get blindsided by surprises. He asked for a weekly briefing that covered only the areas of concern and avoided routine information. “Gen. Moore knew we didn’t have time to spend working issues that weren’t issues,” Harden said.

The Lockheed Martin Raptor group initially was skeptical about the interlinked airborne/ground-based AIL solution. However, once the Seattle team convinced them it could be done—and would reduce cost and schedule risk—they jumped on board with both feet, Harden said.

THE FUTURE OF TESTING?

From its inception, this was a think-outside-the-box project. “What does your lab of the future need to look like?” was a question Harden would ask. In an era of ever-tightening defense budgets, the AIL team has found a way to use existing assets—and eliminate some of them—to provide more robust test and evaluation

capability at lower cost. But the new lab is not just about cutting costs or staying on schedule. The ultimate goal is to get new capabilities into the hands of pilots sooner—both to maximize their effectiveness and ensure their safe return from the mission. Perhaps the lab of the future has arrived. ■

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Both the 757 Flying Test Bed and the Agile Integration Lab house a full-scale F-22 cockpit. Here Brian Harden, AIL program manager (center), and Kelly Haynes, cockpit communications engineer (left), work with the FTB cockpit located in the 757’s cabin, which allows evaluation of the man-machine avionics interface under actual flight conditions.

MARIAN LOCKHART PHOTO

All in the family

St. Louis F-15 assembly mechanic Steve Coulter (right) and wife Pat traveled to Texas in late May to be on hand for son Matt's winging ceremony as a U.S. Navy aviator. Matt had spent 13 months at Naval Air Station Kingsville, Texas, training in the Boeing T-45 Goshawk (shown here), an aircraft his dad had assembled during his first decade at Boeing.

U.S. NAVY PHOTO BY MARYANN SHRAMKO



A St. Louis assembly mechanic recalls working on T-45 Goshawk jet trainers—the same aircraft that his son flew to earn his U.S. Navy wings

BY DOUG CANTWELL

Steve Coulter, an F-15 assembly mechanic in St. Louis, got pretty choked up recently as he watched his son Matt cross the stage aboard the USS *Lexington* in Corpus Christi, Texas, to receive his “wings of gold” as a U.S. Navy aviator. “I expected it to get a little emotional, but I wasn’t ready for this,” he said.

That’s because Steve took pride in the training vehicle as well as in the young man wearing the dress whites.

Coulter spent his first decade at Boeing assembling the T-45 Goshawk, the two-seat jet in which son Matt earned his “wings of gold” and qualified to land aboard an aircraft carrier at sea. Steve had even gone out to Long Beach, Calif., in 1990 as one of the crew that packed the program in semitrailer trucks and moved it to St. Louis, where the 210th Goshawk recently rolled off the line.

Matt had taken a while to find traction in his career pursuits. He first accepted an athletic scholarship at University of Arkansas at Little Rock, where he spent two years working toward an engineering degree, playing soccer and feeling uncertain about both. He then enlisted in the Navy, where things started to click for him.

He’d heard about the Navy’s “Seaman to Admiral 21” program and decided to apply. STA-21 gives enlisted personnel who demonstrate outstanding motivation a chance to earn a commission and become an officer. Admiral Mike Boorda championed the program during the 1990s after rising from the enlisted ranks to become Chief of Naval Operations. Boorda believed that “people should have the opportunity to excel, even if they don’t get a perfect or traditional start.”

As a newly commissioned lieutenant, Matt headed to Naval Air Station

Pensacola, Fla., where he toughed it out through six weeks of preflight indoctrination. He then moved on to nearby Whiting Field, where he first retracted landing gear in propeller-driven T-34 trainers. Arriving at NAS Kingsville in Texas, he underwent three months of intensive classroom and simulator preparation to fly jets.

Matt found the 13 months of training at Kingsville grueling. “It was like taking an exam every day,” he recalled. “If you weren’t prepared, you screwed up and had to do it over again.”

His most unforgettable training moment? “Definitely my first cat shot on the carrier,” he said, referring to the ship’s steam-powered catapult launch. “It’s like nothing you’ve ever felt before, accelerating from zero to 120 knots in two seconds.”

Matt recalled moving up to the T-45C’s all-digital, flat-panel “glass cockpit” with its head-up display (HUD). “There’s a huge difference in precision with the digital and a lot less to keep track of in your head,” he said. “When you make your [carrier landing] approach, it’s much easier to stay on the right glide slope using the HUD.”

Matt also appreciates the system’s velocity-vectoring function, which appears as a symbol on the HUD indicating the aircraft’s true trajectory. “When you’re out in poor visibility or strong crosswinds, the velocity vector helps you distinguish your real direction of travel from what your senses may be telling you.”

Where to from here? “As one of the new guys out in the fleet, I’ll be getting my share of the nuggets,” by which he means the night flights and other duties avoided by the pilots with seniority. “But I love to fly,” he said, “and I’m happy to pay my dues.” ■

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Doing business globally

Why there's a connection between production stability and BCA's worldwide base of airline customers

Where are our customers based? "Largely outside of the United States," is how Boeing Commercial Airplanes answers that question.

Historically, about one-third of Boeing's airline customers were based in the United States, one-third in Europe and one-third in the Asia-Pacific region. But that has changed.

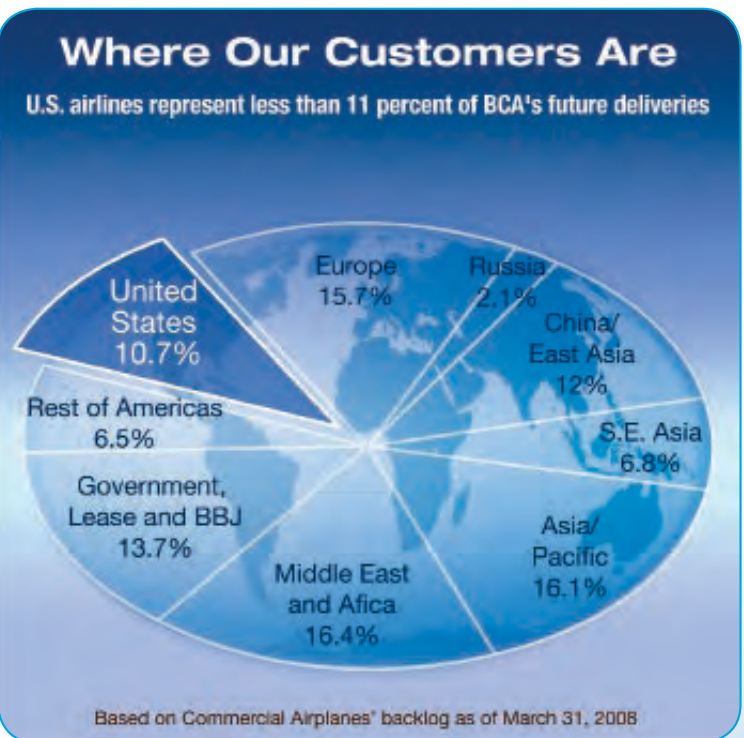
Through the first quarter of this year, U.S. airlines account for less than 11 percent of Boeing's record backlog of unfilled orders. Airlines in Europe and Russia combine for less than 18 percent, and customers in Asia and Australia comprise about 35 percent.

Middle Eastern and African airlines account for a little more than 16 percent of Commercial Airplane orders. Customers in Canada, Latin America and South America combine for 6.5 percent of the order book.

Leasing companies make up a substantial portion of Boeing's backlog of commercial airplane orders. Like Commercial Airplanes, leasing companies place these airplanes with customers around the globe.

"The geographic diversity in our order base is one of the reasons we believe the latest market cycle is fundamentally different than previous business cycles," said Ray Conner, Commercial Airplanes vice president of Sales. "We're less susceptible to an economic downturn in one country or one region of the world. That'll help us be more stable in producing through the cycles."

To maintain market access and sell airplanes around the world, Commercial Airplanes works with some 3,700 suppliers in more than 90 countries around the globe.



"In a global business like ours, it's in our best interest to work with international partners," Conner said. "International sales keep our factories and engineering areas busy."

"Our suppliers are selected based on performance and value—they have to be able to deliver on their commitments," he added. "If they can deliver on commitments and they're based in a country where we have active sales campaigns, that's an added bonus." ■



First 767-300 Boeing Converted Freighter redelivered

The first 767-300 Boeing Converted Freighter (BCF) was redelivered to ANA June 16 at a celebration in Paya Lebar, Singapore—in the hangar of ST Aviation Services Co (SASCO). SASCO, Boeing's partner in the MD-11 and 767-300 BCF programs and the 757-200 Special Freighter program, was a Boeing Supplier of the Year in 2005.

"Our Boeing team is thrilled to deliver the first 767-300BCF, on-time and on-budget," said Lou Mancini, vice president and general manager for Boeing Commercial Aviation Services. "Boeing employees and SASCO worked as partners to complete this well-designed and expertly managed conversion."

One of the most versatile converted freighters, the 767-300BCF can fly 3,100 nautical miles (5,741 kilometers) with a full payload and offers cross-fleet compatibility with other 767s. Boeing has 17 firm orders for this airplane.

Degree of difficulty



Doug Loisel makes adjustments to the 777 Freighter's 10-foot-by-12-foot (3.04-meter-by-3.65-meter) main-deck cargo door. GAIL HANUSA PHOTO

Employees key to successful introduction of 777 Freighter into new manufacturing system used to assemble 777 family

By DAN IVANIS

While all airplane derivative programs come with their share of challenges, the 777 Freighter set a new standard for degree of difficulty. Just ask the mechanics, engineers or anyone else involved in getting the first one through the Everett, Wash., factory and onto the flight line.

Partly because of its freighter-unique features and partly because it was introduced into the factory at the same time the 777 program was transitioning to its new Boeing Production System—which includes a moving manufacturing line—the 777 Freighter tested its builders in ways never imagined.

Despite these challenges, the first 777 Freighter made its way on time through the factory and onto the flight line with minimal impact to the passenger airplanes being built all around it.

“One thing I’ve really enjoyed about this first freighter is that it has been a ‘we’ situation,” said Wes Williams, a 36-year Boeing employee and lead for the team that installed the freighter’s mammoth main-deck cargo door. “It was refreshing that everyone met the challenges—but also shared in the pain and wealth of working through the challenges.”

Although it’s the sixth model in the 777 family and the third introduced in the past five years, the freighter was the most demanding of the 777 siblings—and not only because of the manufacturing system changes. Designed to fly farther and provide more capacity than any

other twin-engine cargo plane, the 777 Freighter’s cargo-driven differences pushed the envelope.

Three major differences that separated the freighter from its passenger-carrying family members included installation of a 10-foot-by-12-foot (3.04-meter-by-3.65-meter) main-deck cargo door, a rigid cargo barrier near the front of the plane on the main deck, and a new floor system designed to support and restrain main-deck cargo loads. Each presented its own set of unique challenges.

MAIN-DECK CARGO DOOR

The main-deck cargo door, which is located on the left side of the airplane on the aft section of the fuselage, just behind the wing, is the most striking and visible of the 777 Freighter’s features. Its sheer size allows the 777 to integrate with 747 freighter fleets, which comprise about half the world’s freighter capacity. Cargo operators will easily be able to transfer 10-foot-high pallets between the two models through the new door.

While the large opening is sure to be a customer favorite, it presented mechanics with a new experience.

“On the 777 moving line, the airplane is carried on a cradle as it moves along,” Williams said. “The engineers did a great job of predicting how things would work around this large opening, but it was still new for all of us and something we’ll have to get used to.”

“It was refreshing that everyone met the challenges—but also shared in the pain and wealth of working through the challenges.”

– Wes Williams, Boeing employee

“We’re still learning the door, so from that perspective it has been a challenge,” said Doug Loisel, a member of the main-deck cargo door team. “I’ve been working on lower-deck cargo doors for 10 or 11 years, so working on this one is a lot the same but on a much larger scale.”

The door itself was installed with few issues and has been performing well.

RIGID CARGO BARRIER

The rigid cargo barrier (RCB) presented challenges because of its size, heft and inflexibility. Semicircular in shape, the one-ton monolith must fit snugly in place in the forward section of the airplane, aft of the flight deck.

“The RCB is loaded into a special tool and then a crane lifts the tool and RCB onto the deck,” said Jon Rogers, a mechanic involved in the process. “The tool was designed to help us move the RCB through the fuselage and into position. Then it has to be lined up and tilted into place. There’s less than a quarter inch of clearance in some places, so there’s very little wiggle room.”

NEW FLOORING SYSTEM

Because the bulk of the freighter’s potential payload of 226,700 pounds (102,829 kilograms) will be carried on the main deck, a new flooring system was designed to accommodate the much heavier load. A monolithic aluminum superstructure is covered by floor panels that are more complex in their design and pattern than those on passenger planes.

“There are about 30 percent more fasteners involved in the freighter’s floor, because each panel has container tie-down fittings. In all, I’m responsible for 16,500 holes,” said Joe Daher, a 13-year Boeing employee and lead for the group that installs the floors.

Complicating the floor mechanics’ plight is that once the RCB is in place, only one door (the main-deck cargo door) provides access to their work area.

“It is quite a dance to work around everyone else on the airplane in that situation,” Daher said.

The transition to the Boeing Production System (BPS) and moving line has been a major change for the 777 program. The transformation began more than two years ago when a 777 was moved from its traditional slant manufacturing position and placed nose-to-door in the Everett factory. Since then, forward and aft fuselage sections have been moved onto moving crawler tools for systems installation work. Final body join was the last position to transition to “crawlers”; this happened earlier this year. This summer, the full U-shaped moving line for 777 assembly is expected to be complete and moving at a rate of 1.6 inches (4.06 centimeters) per minute.

Successfully moving the 777 Freighter through the new production system required close coordination among groups such as Manufacturing, Engineering, Supplier Management, Tooling and Planning. The program

established 10 around-the-clock, rapid-action teams to work with Manufacturing to rapidly support any issues that arose during the build.

“Building this freighter in the cycle we are on while trying to transition to BPS has been extremely challenging,” said Williams. “But people have given the hours and attention it took to get us where we are.”

The 777 Freighter is scheduled to be delivered to launch customer Air France in the fourth quarter. With 78 orders from 11 customers, the 777 Freighter accounts for more than 20 percent of the current 777 backlog. ■

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Adjusting the 777 Freighter’s main-deck cargo door are (from left) Doug Loisel, David DePuy, Michael Mortenson and Wes Williams. GAIL HANUSA PHOTO

Play ball!

St. Louis employee loves his job— and his *Cardinals*

By KATHY COOK

St. Louis is a baseball town. And when 40,000 baseball fans pack Busch Stadium to see their St. Louis Cardinals play, they receive up-to-the-second scores, stats—and a little entertainment—from Boeing employee John Mosbacher.

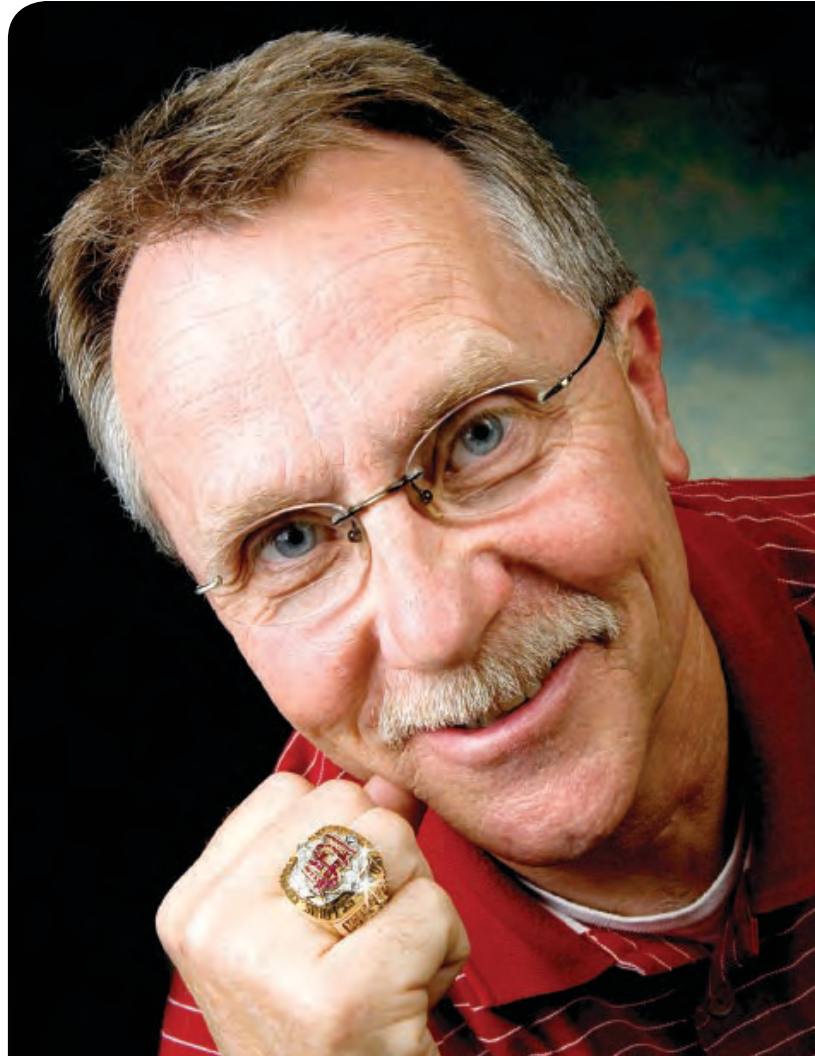
Mosbacher—a media services specialist for Boeing since 1979 and a Cardinals fanatic forever—is the team's game day director of video operations at the stadium. His Boeing experience makes him a perfect fit for his responsibilities behind the computers that operate Busch Stadium's video boards. He understands exactly what's needed on the technical side to keep fans instantaneously informed on scores, hits, errors and speeds of pitches thrown, and provides instant replays (when allowed) as well as player facts and trivia.

His "job" at Busch Stadium started in 1983 when he was a newlywed looking to earn a little extra money. He began editing highlights from the games, a job similar to the type of video editing he was doing at Boeing predecessor company McDonnell Douglas. Later, when the Cards wanted to do more creative things with a state-of-the-art video board, Mosbacher knew exactly what was needed to make it work. He's kept at it every season since, enhancing his skills along the way. The job brings him to the stadium 80 times a year—more when the Cardinals make the playoffs.

As with any job, there are ups and downs. For instance, Mosbacher's promotion to game day director came with a painful learning curve. "There are rules set down by Major League Baseball regarding what can and cannot be shown on the video board, including replays," he said. "The one thing you can't do in baseball is show up (discredit) an umpire. There was this bang-bang sort of play, and I flashed a replay of it on the screen. I soon received a call from a veteran umpire that was unpleasant, to say the least. Since then if I have to think about whether or not to run something, I don't run it."

Mosbacher began working for the Cardinals in 1983, one season after they won a World Series championship. Yet despite several playoff appearances, the team didn't recapture baseball's biggest honor until 2006. "The guys in the broadcast booth were starting to blame it on the 'Mosbacher curse,'" he quipped. "I was one of the happiest people in the stadium when we won it again in '06!"

When the Cardinals moved from the old Busch Stadium to their new home in 2006, Mosbacher inherited a much more sophisticated system. "We've got amazing capability with the new system and we can provide so much more information," he said. "We can provide data on anything related to baseball to satisfy anyone—from the casual observer to the die-hard baseball fanatic."



John Mosbacher, a media services specialist for Boeing, is the game day director of video operations for the St. Louis Cardinals. The team won the World Series in 2006—and presented Mosbacher with a World Series ring. RON BOOKOUT PHOTO

Mosbacher can entertain fans with interesting facts and trivia and practically any stat—even a player's updated batting average based on his last at-bat. From the video board, fans might learn fan favorite Albert Pujols' first name is not Albert. It's Jose. Or, they could learn a batter's hitting average against right-handed pitchers, or with runners on base. "It really is a fun and interesting job," Mosbacher said.

As much fun as he has with the Cardinals, Mosbacher's also loved the job he's held at Boeing. "Here I get to do the entire gamut of video—shooting, editing, producing—and I get to do it around the really terrific aircraft we produce. All in all, I'm a pretty lucky guy," he said as he glanced at the ring on his finger—the same World Series ring won by his Cardinals in 2006. ■

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The tree's the thing

Boeing backs natural conservation efforts in Southern Calif., Pacific NW

By SUSAN BIRKHOLTZ

Forests provide quality of life by protecting water supplies, minimizing flood risks and abating pollution by absorbing carbon dioxide. And there are few places in the United States that the benefits of thriving forests are more critical than in Southern California, where car-choked highways and masses of buildings stand in contrast to the beauty of nature. Each year, wildfires plague the region with devastating consequences for forests and wildlife.

That's why Boeing was quick to respond when last year's wildfires destroyed thousands of acres of forests and parklands in Southern California, an area home to nearly 28,000 Boeing employees. Company-matched donations of Boeing employees and retirees to the American Red Cross for immediate relief activities totaled more than \$702,000, which included a large grant from the Employees Community Fund of Southern California.

At that time, Boeing pledged to make a \$1 million contribution toward rebuilding—or in this case “releafing”—efforts in the region. The company fulfilled that pledge with a \$1 million grant to Los Angeles-based nonprofit TreePeople to launch its California Wildfire Restoration Initiative. Rick Stephens, senior vice president, Human Resources and Administration, announced the grant at an early June press event at the nonprofit's Coldwater Canyon Park headquarters in Los Angeles County.

The comprehensive initiative will help mobilize and train urban volunteers to restore and protect the ecosystem in the damaged forest areas of Southern California. This effort, along with similar actions across the world, aligns with Boeing's Environment community-investment focus area objective to promote the conservation, improvement and restoration of critical natural assets and to train citizens to protect and conserve the environment.

Key to the success of TreePeople's initiative are its plans to engage in strategic partnerships with local, state and federal agencies that manage public lands in Southern California, including the Santa Monica Mountains, the City of Los Angeles Department of Recreation and Parks, and the four national forests that serve the counties of Los Angeles, San Bernardino, Ventura and San Diego.

“TreePeople's mission is a noble one: to ‘help nature to heal our cities,’” Stephens said. “But after last year's devastating wildfires, TreePeople knew that healing nature would become a pressing priority and began working with people throughout the region to restore these critical areas. Boeing is proud to support TreePeople in this effort.”



Children from a local school participate in a TreePeople Eco-Tour by planting tree seedlings with (from left) Nicole Beaty, a Boeing summer intern; Rick Stephens, senior vice president, Human Resources and Administration; Anne Roosevelt, vice president, Global Corporate Citizenship; John Garamendi, lieutenant governor of California; and Andy Lipkis, TreePeople president. TONY ROMERO PHOTO

Boeing had established a relationship with TreePeople long before this grant, however. In fact, the Employees Community Fund of Boeing California has been a TreePeople proponent for more than 25 out of the nonprofit's 35 years of existence.

Among the innovative TreePeople programs funded by the California ECF are the Elementary Education Eco-Tour Program, which brings city schoolchildren to Coldwater Park Canyon to learn about forests and the importance of their protection and conservation, and the Campus Forestry Program, which funded the distribution of the TreePeople Citizen Forestry Books to school libraries throughout Los Angeles, Orange, Riverside and San Bernardino counties. TreePeople also has been a recipient of more than \$600,000 in corporate contributions throughout the years.

Meanwhile, in the Puget Sound region, Boeing recently awarded the Cascade Land Conservancy a \$750,000 grant to support the conservation work of The Cascade Agenda in forests, along creeks and streams and in the restoration of forested parks in the northwest United States.

The grant comes as the conservancy moves into the public phase of a \$20 million Cascade Agenda Campaign. The Cascade Agenda, launched in 2005, is a 100-year regional program aimed at conserving 1.3 million acres of working forests and farmlands as well as revitalizing cities and towns throughout the region.

“This grant reflects the far-reaching promise of The Cascade Agenda and the proven track record of the Cascade Land Conservancy,” said Mary Armstrong, vice president of Environment, Health and Safety and a Puget Sound area resident. “Boeing is proud to continue its long-standing support for the environment because it helps us maintain the Puget Sound region as an attractive, vibrant and competitive place for our employees to live and work.” ■

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Cutting cost with cutting tools

How Boeing Information Technology worked with a cross-functional team to trim aluminum—and expense—from airplane parts

By RON GLOWEN AND ROBIN McBRIDE

Boeing Information Technology is helping save time and production cost in the shop-floor fabrication of wing parts for Commercial Airplanes.

At manufacturing facilities in Frederickson and Auburn, Wash., arrays of computer-controlled cutting and drilling tools the size of coffee cans are loaded into customized machines. They are used to remove excess metal from thick aluminum slabs to shape the panels, spars, stringers and other components for airplane wing structures.

This automated choreography at Boeing Fabrication Skin & Spar is a state-of-the-art process for creating precision wing parts that can be up to 100 feet (30.5 meters) in length. Yet everything depends on the high-performance cutter assembly tools performing the right task in the right place to exacting tolerances.

In the mid 1990s, the Auburn Skin & Spar team asked the factory's Information Technology (IT) systems group to find a way to reduce machine setup time and ensure the correct cutters were being used. Thus began a continuous improvement process culminating in a technology-based tool management solution now in use on 13 spar mills and seven skin mills in the Frederickson fabrication building.

The Boeing-designed Tool ID (short for Tool Identification) system is yielding significant savings in several areas. Tool ID combines software

and the latest radio frequency identification (RFID) technology with computer numerically controlled (CNC) machining to manage cutting tools.

“Our IT team went out to the shop floor to observe and talk to the machine operators and tool-crib operators, looking for process improvement opportunities,” said Rick Morrow, IT Manufacturing & Quality Systems manager for factory automation. “We also talked to vendors for the RFID device, and CNC technology needed to develop the tools and processes. Our job was to bring it all together as a standard user interface with standard processes that can be replicated at each milling machine.”

The skin and spar mills are CNC machines with two cutting heads, each with a spindle turning at high speed. Cutting assemblies are inserted into these spindles. The motion of the heads and the left or right rotation of the spindles perform the milling operations.

As a milling job progresses, the computer-based part program prompts the machine operator to manually replace and load the cutters with the appropriate tool for the part feature being milled, a step known as a tool-change operation. Before the use of Tool ID, this step could result in the operator inserting either the wrong tool or selecting the incorrect tool orientation, resulting in a scrapped part or costly rework.

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“These teams have demonstrated a strong commitment to technical excellence by using Lean+ thinking, and have achieved tremendous success in attaining greater factory productivity, higher quality and lower operating cost.”

— Nancy Bailey, vice president Boeing IT Product Systems

With Tool ID, each cutter is embedded with an RFID chip—a component about the size of a fingernail—to eliminate the possibility of a tool being placed incorrectly during tool change operation. Tool ID prompts the user to scan data from this chip using a hand-held sensor or wand. The system compares the data from the chip to what is required by the part program. The tool change process is inhibited unless the correct tool is scanned by the hand-held wand.

Eliminating tool mismatch has resulted in significantly increased machine utilization, keeping pace with higher airplane production rates and reducing rework. The Tool ID system also collects and maintains information on how long a cutter has been in use. This gives tool-crib personnel data to better estimate cutter life, monitor tool wear and manage inventory.

Key to developing a standard solution was creating workable interfaces with different CNC programs, machines and software vendors. A cross-functional team of equipment engineers, manufacturing engineers, industrial engineers, computing specialists, numerical control programmers, CNC machine control

vendors, maintenance and tool-crib operators developed the retrofit specifications. In a Material and Process Technology lab, M&PT and IT teams developed productivity and process improvements for interoperability between the Auburn and Fredrickson Skin & Spar shops.

“The implementation of the Tool ID system is the culmination of many years of hard work by the IT, M&PT and factory teams to reduce production costs, including material, transportation, machine wear and manual work due to mismatch,” said John Donohue, Extrusion shop manager. Philip Leith, senior manager in Skin & Spar, said, “This will be installed on many new milling machines and is becoming a company standard process.”

“These teams have demonstrated a strong commitment to technical excellence by using Lean+ thinking and have achieved tremendous success in attaining greater factory productivity, higher quality and lower operating cost,” said Nancy Bailey, vice president of Boeing IT Product Systems. ■

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Photos:

Left: Mike Kegley (from left) and Raam Mahadevan are shown inside the operator console with Ray Hervey, Frederickson Skin & Spar machine operator. Kegley, Mahadevan and Tom Grant (not shown) developed the Tool ID computing interfaces that match cutter selections with computer-controlled part-milling programs.

Right: Al Reeves Jr. (left) and Ralph Warren Jr. calibrate the precise tool parameters needed for milling operations at the Tool Presetting and Measuring station. Automating this process means each tool is preset with the same settings to perform a specific task.

DANIEL M. THOMPSON PHOTOS

Life on the cutting edge

Boeing Portland touts world-class fabrication and metal-removal rates

Machinist Dennis Higgs operates a Cramic milling machine at Boeing Portland. The airplane part is a flap track for the new 747-8. ED TURNER PHOTO



By BRENDA PITTSLEY

Uncut titanium may look like one of the large silvery pieces of driftwood that regularly wash up on Oregon's beaches. But on the Boeing Portland factory floor, the metal is hardly a piece of floating debris in terms of value. A 5,400-pound (2,449-kilogram) hunk of titanium is valued at six figures.

From the lumpy form of the metal will emerge a side-of-body chord, a part that attaches a wing to an airplane body. A finished part—destined for Boeing's airplane production facilities in Washington state—weighs 250 pounds (113 kilograms) and looks nothing like weathered wood. Giant tools carve the hard metal with geometric exactitude, whittle sharp edges and exquisitely polish rough surfaces.

The rate at which metal is stripped away to form a new part is the baseline on which Boeing measures its performance against the machining industry. And the Boeing Portland factory has one of the best metal-removal rates in the world. "It's fair to say our [metal-removal] rates are several times greater than most in the world," said Portland

nium 5553, Inconel (a nickel-based alloy) and Carpenter 465 (a type of stainless steel).

Boeing Portland's unassuming character is even reflected in its main lobby. There, a wall is covered with shelves full of plaques and framed documents. But the display has nothing to do with the site's industry or professional accomplishments. They are testimonials from school children, senior citizens and community organizations that have benefited from employees' volunteer efforts over the decades.

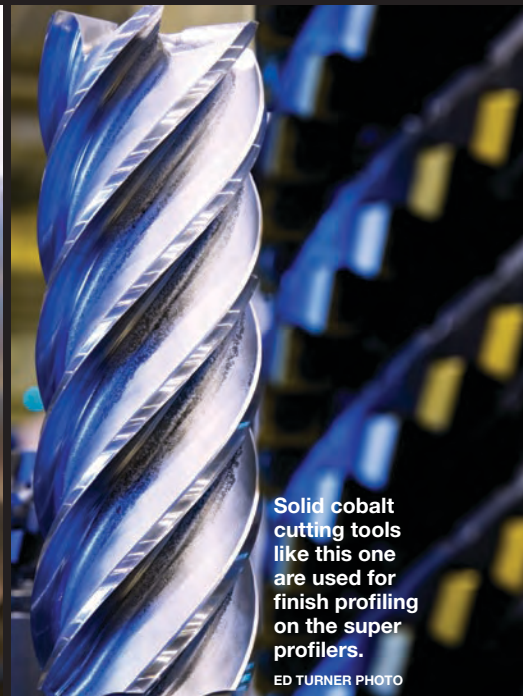
Not on display is the U.S. Federal Aviation Administration Aviation Safety Inspectors Recognition Award. This was presented to the site in May 2008 following an audit that one inspector said was his first in 20 years without a single write-up.

Also absent from the wall is the ISO 14001 certification from the International Organization for Standardization, recognizing the site's environmental policy, plans and actions. Portland is one of four Boeing sites with the certification (see Page 20 of the March 2008 *Boeing Frontiers*).

Nonetheless, Portland is attracting attention. The site's continuous improvement success has drawn the interest of manufacturing industry



Machinist Tony Truong loads a partially machined 737 landing-gear beam onto a hard-metal milling machine. ED TURNER PHOTO



Solid cobalt cutting tools like this one are used for finish profiling on the super profilers.

ED TURNER PHOTO

General Manager Jenette Ramos, who has visited the "titans of machine shops" in North America, Europe and Russia.

Located about 200 miles (320 kilometers) south of Seattle, Boeing Portland has a relatively low profile—but the factory is considered a center of excellence for complex machining.

"We're pretty self-contained here," said Mike Hallgrimson, project manager. "We're in a unique situation in that we have right here virtually everything we need to do business."

The Portland facility is the largest machining business unit in Boeing Commercial Airplanes. With around 1,600 employees at its 87-acre site, it isn't one of the state's largest employers, but it is one of the largest profile milling facilities in the world. It produces some 400 end-items from extremely hard, corrosion-resistant metals such as tita-

representatives from around the world. Since 2006, the site has hosted some 16,000 visitors from companies such as Nike, Toyota and Mitsubishi, who come to learn best practices. Even 30 members of the Oregon Air National Guard visited for a Lean learning event. "Once last year we had six countries represented in one day," Ramos said.

The visitors see things such as a state-of-the-art slotter machine that strips metal from a base form at a rate 13 times faster than the industry average. They also see 40-year-old workhorse metal-cutting machines that can mill Carpenter 465—a notoriously tough metal to cut—at a rate 290 percent above the industry average.

These metrics are "pretty significant accomplishments," said Ur-maze Naterwalla, tooling engineer and applications and testing specialist on the factory floor. "It puts us on the map for metal cutting."

“We’re pretty self-contained here. “We’re in a unique situation in that we have right here virtually everything we need to do business.”

– Mike Hallgrimson, project manager

A coolant waterfall flows in the cutting zone of a super profiler.

ED TURNER PHOTO

The site is also on the map for safety. “Considering what we do with hard metal and the complexity of what we do, the Boeing Portland site is really safe,” explains Ron Breunig, a factory consumables handler in the grind shop where cutting tools are sharpened. “We are consistently one of the best performers in terms of safety.”

So, what’s behind Portland’s success? Ramos said it’s placing a premium on each employee’s value and focusing on a one-team, one-plan approach. “The underlying belief of our culture here is that every person has something important to do, and every person is vital,” she said.

Manufacturing Director Mike Starr said there are no silos in the Portland work environment, no isolated work groups that focus on narrow objectives rather than the big picture. This was reinforced when every employee received the 2008 Portland Site Expectations document, which aligns every person and function to company and site goals.

Other innovations introduced in the last three years at Portland include “line-of-sight teams,” an Employee Involvement (EI) program, flow lines and numerically controlled testing.

The line-of-sight teams place representatives from strategic work groups—managers, Lean leaders, industrial engineers, manufacturing engineers, supply chain analysts, quality assurance personnel and other support functions—together in one office directly on the factory floor to facilitate coordination and communication.

The EI program started in early 2007 with four teams and by June 2008 had grown to 45 teams with 410 people. These teams draw on worker expertise for on-floor decision making. “The benefit of EI is that it allows the work crews to self-manage their own areas, within their business boundaries. It allows them to shape the environment they work in,” Starr said.

Program manager Dennis Watson admitted EI had early skeptics but said it’s now going really well. He cautions the program is not a quick fix. “It takes years to grow mature teams, but the resulting knowledge transfer helps ensure the Portland site continues to expand its capacity, retain its work force, remain competitive—and keep those metal removal rates the highest in the industry.” ■

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A finished bull gear for a 737 horizontal stabilizer actuation unit. ED TURNER PHOTO



Shawn Tolman, a gear-line machinist, studies work performed on a 737 horizontal-stabilizer actuation unit bull gear. ED TURNER PHOTO

Made in Portland

Boeing Portland is all about metal parts. Parts fabricated in the site's metal shops are integral to the entire airplane—from the flight deck to the tail. Used in all Boeing commercial airplanes, some are considered lifeline parts, meaning the assembly line stops if they're not delivered. Those parts include

Complex Machining

- Flap tracks
- Flap supports and linkages
- Flap carriages
- Landing-gear beams
- Engine mounts
- Terminal fittings
- Stub beams
- Spar fittings
- Splice assemblies
- Flaperons
- Trunnions
- Drag braces
- Mini-cantilevers
- Main landing-gear attach fittings
- Side-of-body chords
- Torque tubes

Gear Systems

- Gear boxes
- Power-drive units
- Jack screws
- Auto throttles

Pilot Controls

- Control columns
- Aisle stands
- Speed brakes

Big skills, big hearts

The 1,600 employees at the Boeing Portland facility in Oregon are proud of their highly recognized expertise in metal cutting. They're also proud of their community, as evidenced by volunteer activities. Here are some of the ways Portland employees reach out to their neighbors:

- Employees gave \$235,000 to the Boeing Portland Employees Community Fund last year.
- Volunteers routinely support the Start Making a Reader Today reading program and the Portland Rescue Mission. They also

provide food and gifts to 30 families in need during the winter holidays.

- A group of employees and retirees builds wooden doll cradles and toy trains for children of fallen soldiers, local children's hospitals and other local nonprofits. Last year, they built 44 cradles and 44 trains.
- The Portland site made a land grant of approximately 14 acres to the City of Gresham to build a new wetland complex for storm-water treatment in 2005.

Keeping a sharp edge

There's a clear path for career advancement in metal cutting at the Boeing Portland site. International Association of Machinists/Boeing Joint Programs training resources include more than 65 courses, a fully equipped machining training lab and a mentoring program with the most experienced machinists on the shop floor. The goal is to maintain a highly skilled workforce to carry on Boeing Portland's tradition of metal-cutting excellence.

Apprenticeships: Machinist apprentices who successfully complete a four-year program of classes and hands-on training become state-

certified journeyman machinists. Electrical apprentices who successfully complete a five-year program (or 10,000 hours) of on-the-job training and off-hour classes become state-certified journeyman electricians.

Internships: A Boeing-sponsored partnership with local school districts and community colleges places 12 interns per year in a three-year program to promote exposure to the manufacturing environment and provide opportunities for basic education and skill development.



Apprentice Kristen Brown (left) and Darwin Utter, a Joint Programs and Apprenticeship Lab Instructor, work on a manual lathe in the skill lab. ED TURNER PHOTO



Lean focal Dave Judd, Industrial Engineers Luong Hua and Ethan Milton and Quality Assurance Investigator Denise Schwartz work an issue in Boeing-Portland's line-of-site office. ED TURNER PHOTO

Closing on a century of progress

The history of Boeing Portland began when T.H. "Harry" Banefield and C.J. Parker went into the construction business together in 1909. In 1923 the partners purchased the Portland Wire and Iron Works in Portland, Ore., a business that later became the Iron Fireman Company. By the late 1920s, the company was the world's largest manufacturer of automatic coal stokers. In tough economic times, the company also built rototillers and Christmas lights, much as Boeing built furniture and speed boats in its formative years. By the late

'30s, the Iron Fireman Company was producing precision machined parts and assemblies for the Boeing B-17. In 1963, the Iron Fireman Company built a new plant and moved to Gresham, Ore., just east of Portland. There it manufactured 747 main landing-gear beams and trailing-edge products into the early '70s. In 1974, Boeing purchased the Gresham plant, where expanded operations continue today at the site now known as Boeing Portland.



Urmaze Naterwalla examines an end mill used on the 747-8 main landing-gear beam and machined on a super profiler. ED TURNER PHOTO

Is there a doctor in the house?

Portland employee describes 'best place in the world for metal cutting'

Urmaze Naterwalla isn't really a doctor. But his prescription for testing and collecting numerical data on the system associated with cutting and delivering finished metal parts has been so revitalizing at the Boeing Portland site, the leadership team there awarded him an honorary doctorate degree in metal cutting.

"The focus on technology has increased exponentially during Naterwalla's three years at the Portland site," said General Manager Jenette Ramos. "Performance improvements are definitely sharpening the site's competitive edge."

"It's hard to describe the cool things we're doing with hard metals in Portland," said Operations manager Ted McCrow. "We're learning and teaching the industry to cut metals."

Naterwalla said success at Boeing Portland is not an individual effort, but that of a great team comprised of cutting tool specialists, engineers, developers, procurement, machine operators and shop leads—all driven by strong management support. The team's No. 1 priority, Naterwalla said, is to deliver predictable and repeatable performance. "What we've really gotten good at in the past few years is making data-driven decisions," he said.

Naterwalla may not have a PhD, but he does have advanced degrees in mechanical and industrial systems engineering from Purdue University and Ohio State University. He also performed machining research at Ohio's Engineering Research Center for Net-Shape Manufacturing.

Long before academics, Naterwalla was learning to cut metal in his uncle's machine shop in Mumbai (formerly Bombay), India. At age 10,

he was cleaning, filing and drilling vintage British motorcycles. He showed an aptitude for the work and gained an appreciation for that generation of machines—classic Norton, Triumph, and BSA motorcycles from the '30s to the mid-'70s—which he still collects and restores. "I admire the old bikes for the technology that doesn't exist in modern bikes," he said. "It's what we might call the artistic flair, a blend of engineering with the art of motorcycles."

Naterwalla said working in machine shops paid his way through college. During those years he worked at a lab in Indiana that made machines for testing other machines to American Society for Testing and Materials standards. There, he teamed with World War II pilots and mechanics. "They taught me most of what I know," he said. His hands-on experience continued with a job at Ingersoll, a top manufacturer of high-velocity metalwork machines and services.

Then, three years ago, he visited Boeing Portland. "I left drooling!" he said. "The capacity and expertise here are unique. Anyone in the metal-cutting world would be impressed."

Indeed, Boeing Portland has a long history of machining large parts in hard metals. "The employees here have vital, tribal knowledge and abilities to machine a fully hardened part, such as the 20-foot (6-meter) main landing-gear beam for the 747-8.

"And, we're doing this," he added, "at faster and faster rates."

So, with a lifetime of metal-cutting experience, it's obvious Naterwalla loves what he does. And he's doing it at what he said is "the best place in the world for metal cutting—the Boeing Portland facility!"

— Brenda Pittsley



Jim Edens (left), a quality inspector, looks at an airplane on the Everett, Wash., flight line. In St. Charles, Mo., Otis Stith (right) packages a completed Joint Direct Attack Munition tailkit. Thanks to the work of Edens, Stith and Boeing teammates around the enterprise, the ShareValue Trust plan will provide an award distribution. LEFT: GAIL HANUSA PHOTO; RIGHT: RICHARD RAU PHOTO

ShareValue Trust delivers

Employees' work in driving growth, boosting productivity, fulfilling promises leads to award distribution, thanks to this incentive program

ShareValue Trust, a Boeing employee incentive plan, is about to pay out for the third straight time.

The trust's Period 6 ended June 30 with the price of Boeing stock above the \$54-a-share mark, which triggered an award distribution to an estimated 195,000 eligible current and former employees.

The award is based on appreciation of Boeing's stock price from when the payout threshold was set four years ago.

"Boeing has performed well over the last four years, thanks in large part to the hard work and long hours that employees devote to improving productivity, driving growth and meeting our commitments to our customers," said Boeing Chairman, President and Chief Executive Officer Jim McNerney. "ShareValue Trust is one way that Boeing rewards employees for the success they help create in returning value to shareholders. And in the process, it adds employees to the ranks of shareholders."

Employees and former employees who were on a U.S.-based payroll during the period (July 1, 2004, to June 30, 2008) will receive the award distribution in Boeing stock, with fractional shares paid in cash. After they receive their stock, they may manage it in any way they choose (including selling the stock upon its receipt). Beneficiaries of deceased eligible employees and eligible employees who are paid through a non-U.S.-dollar-based payroll will receive cash.

The trust, established in 1996, was designed to give employees the

opportunity to become Boeing shareholders, have an ownership stake in the company and benefit from future growth in the value of their Boeing stock. Shareholders may vote on company matters, receive dividends, give their stock as a gift or charitable contribution, sell their stock or choose to participate in the Boeing Dividend and Reinvestment and Stock Purchase Plan.

The stock price of Boeing and other companies can be driven by a number of factors, including general economic and market conditions, the degree to which a company has been successful in delivering on its commitments to its customers, operational and financial performance, and investors' expectations of how it will perform in the future.

McNerney reflected on what's needed to drive toward the \$87-a-share payout threshold for the trust's seventh and final period, which will end June 30, 2010: "While the forces behind today's economy are much larger than Boeing, we can be even more competitive within that economy if we continue to focus on our customers and improve our innovation, execution and productivity—areas where many Boeing employees have already established a very good track record but where we all can improve. These actions will, in turn, help make our customers more competitive. We believe that satisfied customers and more efficient operations can, over the long term, help lead us to business growth, better profitability, appreciating stock value, sustained employment, and further rewards for the employees who make it all happen."

WHAT IS SHAREVALUE TRUST?

ShareValue Trust is a Boeing employee-incentive program that allows eligible employees to share in the success of their efforts to improve productivity and grow the business. The company has invested a total of \$1.7 billion worth of Boeing stock in the trust. By doing that, Boeing has demonstrated its commitment to share with employees the success they help create. That success, for SVT purposes, is measured by the increased value of Boeing stock held in the trust.

Over the 14-year life of the program (1996 to 2010), there are seven individual, overlapping investment periods (see table on Page 50). At the beginning of each period an award distribution target is determined by the price of Boeing stock on the final day of the previous period. After the end of each period, the value of the trust above the award threshold target is distributed to employees.

Beginning near the end of July, eligible U.S.-based employees will receive their award distribution in Boeing common stock. Eligible employees on non-U.S.-based payrolls will receive a cash award distribution through normal payroll processes in August and September.

Despite the recent volatility of the U.S. stock market, Wall Street has generally recognized and rewarded Boeing's strong financial performance over the 48 months of Period 6. However, it was the average stock price on June 30 that triggered an award distribution for the third straight time.

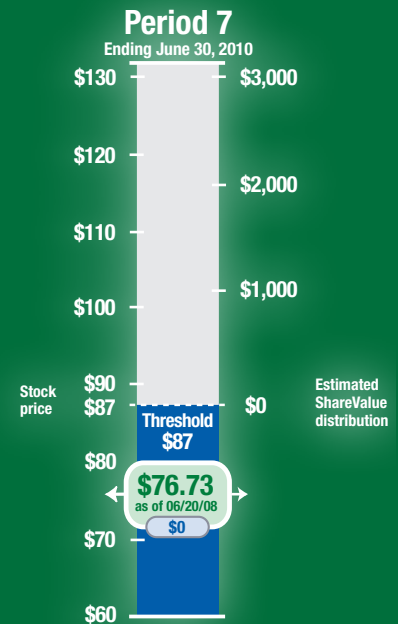
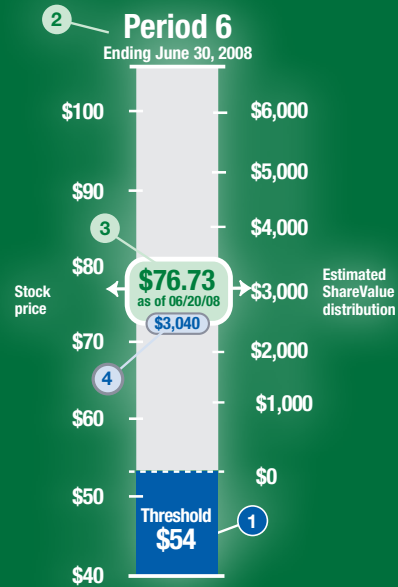
Still unsure what ShareValue Trust means for you? Knowing five concepts can help you better understand ShareValue Trust. (Refer to the Period 6 "thermometer" chart at right to find references to points 1 through 4 below.)

- 1 Threshold:** This is value the fund needs to reach at the end of an investment period for participants to receive a distribution. The value of the fund that exceeds the threshold is distributed in the form of stock in the United States (international locally hired employees receive cash). For Period 6 to pay out, the stock price needed to be at least \$54 when this period ended.
- 2 Investment period:** Each period is four years long (except for the first period, which ended in 1998 and was two years long). There are seven overlapping periods, which begin and end every two years. Period 6 ended June 30; Period 7 is in progress and ends June 30, 2010.
- 3 Stock price:** The share price shown is the average of the day's high and low price for Boeing stock, which is traded on the New York Stock Exchange.
- 4 Distribution size:** The size of the distribution is determined by how much the fund has grown above the threshold value by the end of an investment period. The total distribution is divided among all eligible current and former employees, based on their months of eligible employment.
- 5 Fund value:** In 1996, Boeing established a 14-year trust with more than \$1 billion invested in Boeing stock. An additional \$700 million was added to account for people joining the company as a result of business acquisitions. The value of the trust changes when share prices change or when the company reinvests dividends.

So how much will you get? See Page 50 for an example that involves two hypothetical employees—one who's eligible for all 48 months of Period 6, and one who's eligible for only 15 months.

ShareValue Trust performance

ShareValue Trust currently is in Period 7 of its seven overlapping investment periods; Period 6 ended June 30. Below are press-time estimates of potential award distributions for Periods 6 and 7. For more on this employee incentive plan—and for explanations of the terms referred to by the circled numbers in the Period 6 chart—see the story at left.



The above graphs show an estimate of what a "full 4-year participant" ShareValue Trust distribution (pretax) would be for Periods 6 and 7 if the end-of-period average share prices were the same as the recent price shown. The share price shown is the average of the day's high and low New York Stock Exchange prices. Updates to participant/employment data will be made periodically. For more information on the ShareValue Trust, visit <http://www.boeing.com/share>.

(Continued on Page 50)

DETERMINING YOUR AWARD DISTRIBUTION

The amount of your ShareValue Trust distribution is based on the Boeing stock price at the end of a period, the total number of months you have been employed at Boeing during the period, the number of eligible participants, and the number of shares in the trust.

Not good with word problems? Let's look at two scenarios. Here are the factors that are the same for both employee A and employee B:

The stock price at the end of the period is \$70 and the period threshold is \$1.028 billion, which equates to a stock price of \$54. There are 19.3 million shares in the fund and 6.9 million participant months. The difference is that Employee A has been eligible for the entire 48 months of the period, while Employee B has been eligible for only 15 months. Remember, these are just to give you an idea of how the trust works and are not a guarantee of a specific award distribution.

Participated for Full 48 months*

$$\left\{ \begin{array}{l} \$70 \\ \text{End of period} \\ \text{Stock price} \end{array} \right\} \times \left\{ \begin{array}{l} 19.1\text{M} \\ \text{\# of shares} \\ \text{at end of period} \end{array} \right\} - \$1,028\text{M} \text{ Threshold}$$

$$\times \frac{6.9\text{M} \text{ \# of participant months}}{48 \text{ Individual participant months}} = \sim \$2,150 \text{ Share Value Trust pretax award distribution}$$

Participated for 15 months*

$$\left\{ \begin{array}{l} \$70 \\ \text{End of period} \\ \text{Stock price} \end{array} \right\} \times \left\{ \begin{array}{l} 19.1\text{M} \\ \text{\# of shares} \\ \text{at end of period} \end{array} \right\} - \$1,028\text{M} \text{ Threshold}$$

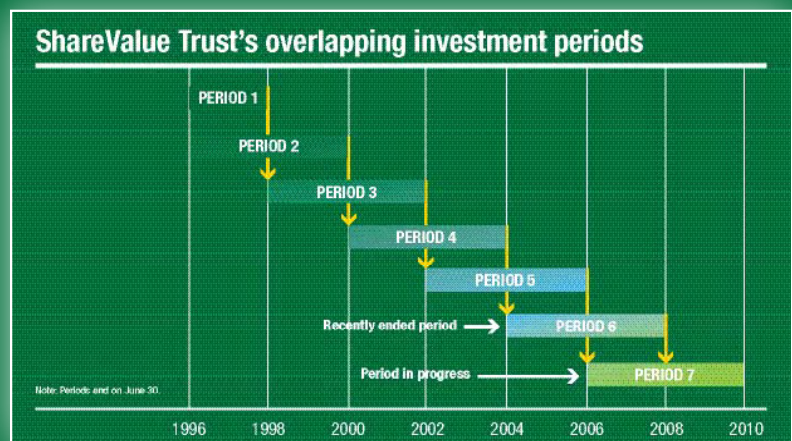
$$\times \frac{6.9\text{M} \text{ \# of participant months}}{15 \text{ Individual participant months}} = \sim \$671 \text{ Share Value Trust pretax award distribution}$$

M = millions
* = Examples are for illustrative purposes only

YOUR STOCK, YOUR CHOICE

Whether you hold or sell, there are some important things to keep in mind when you receive a stock distribution from ShareValue Trust.

- **SVT, taxes and you:** A ShareValue Trust award distribution is considered earnings and is therefore subject to all applicable state and federal taxes at the time of the award distribution. There may be additional taxes if you then sell the stock at a gain. You are responsible for reporting any capital gains or losses to tax officials in your year-end tax filing. For more information, consult a tax professional.
- **Watching your shares:** You can track Boeing stock in Boeing News Now, the company news site on the Boeing intranet (<http://boeingnews.web.boeing.com>). You can also find track it through most daily newspapers, television or the Internet. The company's trading symbol is BA.
- **Becoming a Boeing stockholder:** Boeing shareholders participate in its growth through stock-price appreciation and income from dividends. As a shareholder of a public company, you may vote on company matters, receive dividends, use your stock as a gift or for a charitable contribution, sell your stock, or choose to participate in the Boeing Dividend and Reinvestment and Stock Purchase Plan.

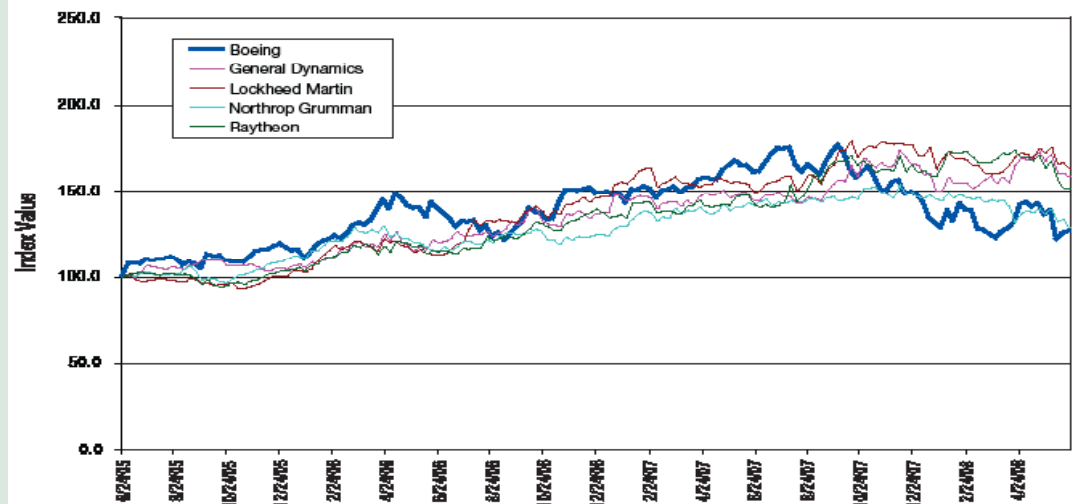


Boeing offers a Dividend Reinvestment and Optional Cash Purchase Plan administered by Computershare (Boeing's transfer agent) for shareholders of record holding 50 or more shares. For more information, visit www.boeing.com/companyoffices/financial/reinvestment.html.

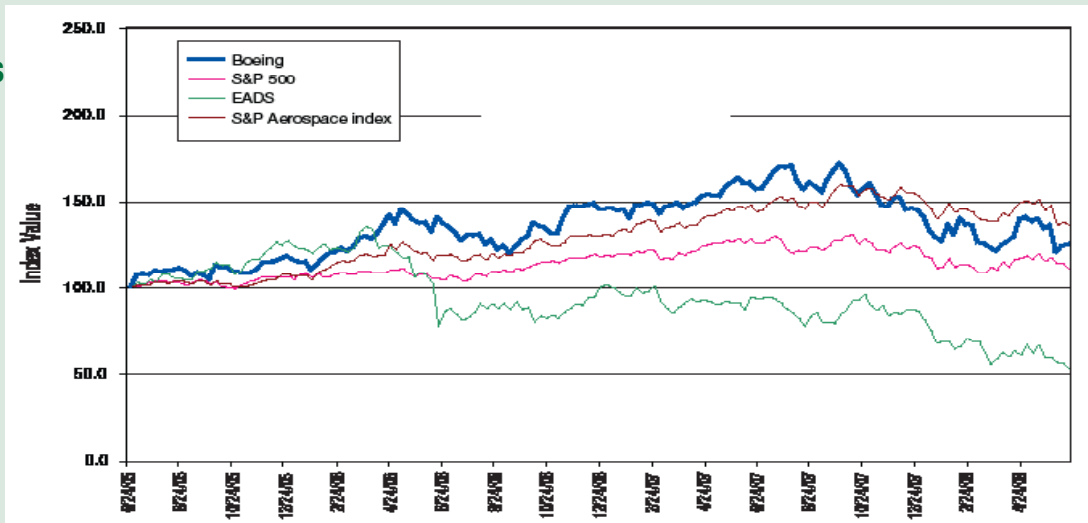
STOCK WATCH

The chart below shows the stock price of Boeing compared to other aerospace companies, the S&P 500 index and the S&P 500 Aerospace and Defense index. Prices/values are plotted as an index number. The base date for these prices/values is June 24, 2005, which generates three years of data. The prices/values on that date equal 100. In other words, an index of 120 represents a 20 percent improvement over the price/value on the base date. Each data point represents the end of a trading week.

Boeing vs. U.S.-based competitors



Boeing vs. stock indexes and international competitors



• **Selling your SVT-awarded stock:** If you sell your SVT-awarded stock, you will receive the market price at the date and time your sales transaction is executed—which in all likelihood will be different than the June 30 closing price at which your award is valued. You will also receive a federal form 1099-B with your check. Keep this form safe; you must file it with your 2008 taxes. ■

Comparisons: 4-week, 52-week

	Price/value as of 6/20/08	Four-week comparison		52-week comparison	
		Price/value as of 5/23/08	Percent change	Price/value as of 5/25/07	Percent change
BOEING	75.83	81.48	-6.9%	95.92	-20.9%
U.S. COMPETITORS					
General Dynamics	85.50	90.37	-5.4%	78.02	9.6%
Lockheed Martin	102.07	107.42	-5.0%	93.39	9.3%
Northrop Grumman	69.71	73.93	-5.7%	76.66	-9.1%
Raytheon	57.89	62.49	-7.4%	54.50	6.2%
INT'L COMPETITORS					
EADS *	13.18	14.96	-11.9%	24.00	-45.1%
U.S. STOCK INDEXES					
S&P 500	1317.93	1375.93	-4.2%	1502.56	-12.3%
S&P 500 Aerospace and Defense Index	393.15	418.97	-6.2%	416.69	-5.6%

* Price in Euros

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

Tomorrow's good too.

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

Today and every day.





Airborne Laser wire-installation team

The Airborne Laser aircraft, which will be capable of detecting, tracking and destroying ballistic missiles in their boost phase of flight, currently is undergoing installation of its high-energy laser at Edwards Air Force Base, Calif. The job requires fitting the aircraft with approximately 1,200 new or revised wire harnesses over and above normal wiring for a base 747-400 aircraft. Wire harnesses are bundled cables or wires that pass data or power between two pieces of electrical equipment.

For installation, mechanics follow a product illustration sheet that uses a two-dimensional graphic representation of the aircraft. This image is not 100 percent accurate with the “as is” aircraft structure. Consequently, wire harnesses often are routed through the aircraft for the first time by the mechanics, creating large amounts of engineering and operations rework on the shop floor.

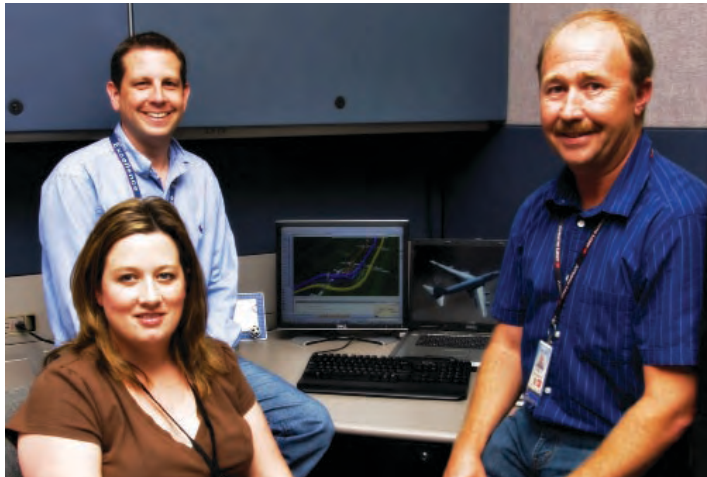
We found a way to deliver first-time-quality results and reduce cycle time by using Model Based Definition, a Lean Engineering Best Practice that delivers fully integrated products in a virtual environment by using three-dimensional solid models. What was unique about our wiring implementation is that we integrated our engineering product development tools—the

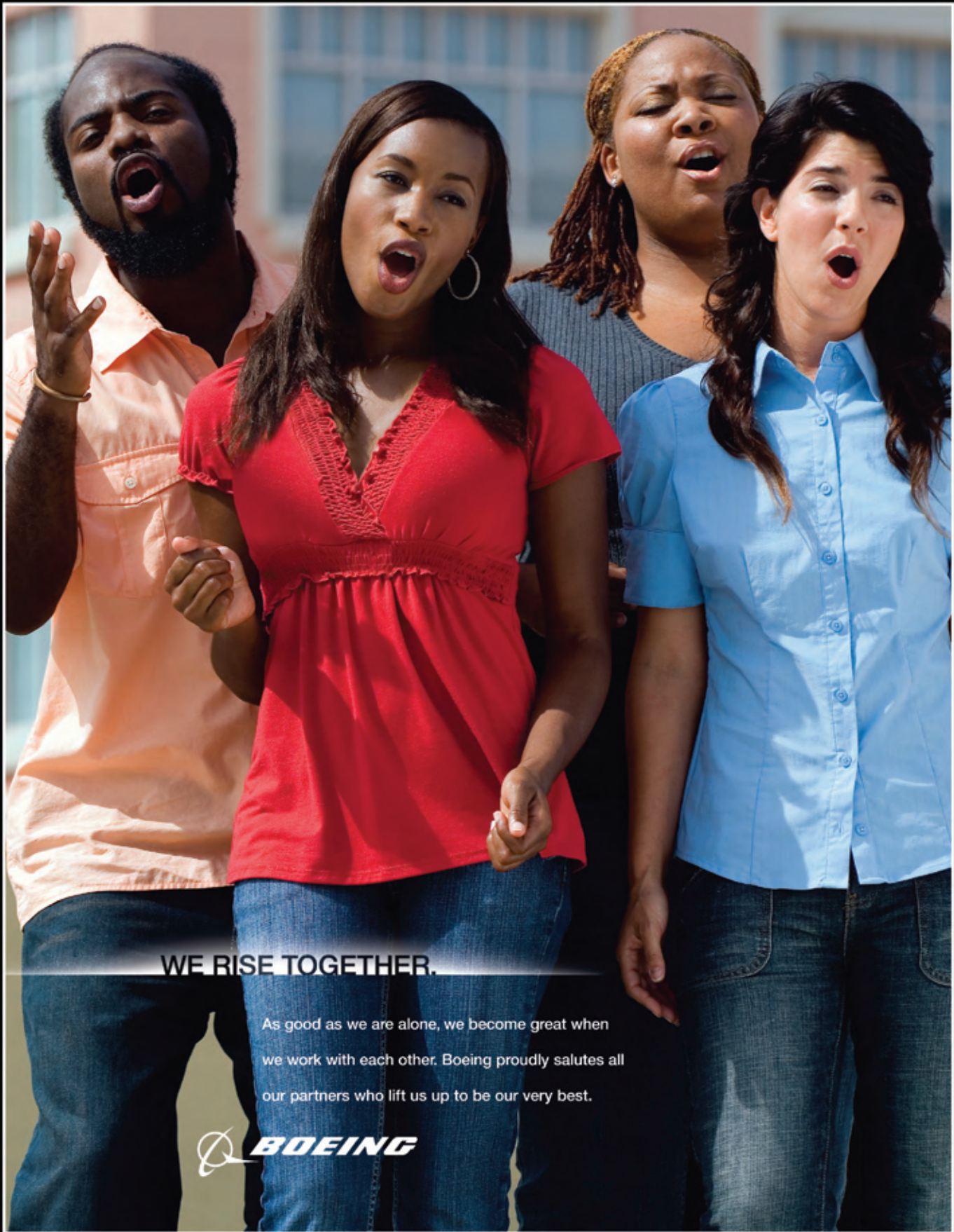
Dassault Systems’ V5 tool suite with the Visiprise (formerly HMS) Shop floor management tool—and created a digital mock-up of the as-designed installations and delivered it directly to the shop floor at Edwards AFB.

We couldn’t have accomplished what we did without the help of the Phantom Works Manufacturing and Supplier Integration team. They helped develop the integration code that permitted the two software tools to work together, allowing more accurate work instructions to be passed to the mechanics.

Although we’re still assessing the metrics, we’ve installed 151 wire harnesses with zero defects. And we’ve seen a greater than 90 percent reduction in installation time. While this was a pilot implementation, extrapolating that savings over the entire scope would have saved us more than \$17 million. Institutionalizing this technology will be a key element in driving affordability of ABL Tail 2, or the second ABL aircraft.

Top left: West Hills, Calif. Standing, from left: Alberto Rosales Jr., Bryan Zigler, Chad Warrington; sitting, from left: Thomas Cogswell, Ross Cardilino, Hector Hizon VANI GUNDARA PHOTO **Top right:** Palmdale, Calif. From left: Bob Christman, Carl Feyh TOM CAREY PHOTO **Bottom left:** Wichita, Kan. Clockwise from bottom left: Shara Nelson, Jason Murphy, Perry Cleaveland. Not pictured: Dan Diel BEVERLY NOWAK PHOTO **Bottom right:** Edwards Air Force Base, Calif. From left: Robert Moore, Lyn Joubert, Jeffrey Whitt, Sherri Gage, Steve Beaver, Janice Lackey, Doug Nilson, David Gates, Chuck Vahldick, Ernest Zapata, Dave Rintala. Not pictured: Lynn Dyke, Randall Congdon, Jerry Ko, Jeff Noon, Brett Poenish STEVE SOUND PHOTO





WE RISE TOGETHER.

As good as we are alone, we become great when we work with each other. Boeing proudly salutes all our partners who lift us up to be our very best.



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 support of community-based programs that promote unity and cooperation.



EA-18G

NOW ON DECK, A NEW DAY IN ELECTRONIC ATTACK.

The Boeing-led team is proud to announce the delivery of the first EA-18G to the fleet. Ahead of schedule, within budget and underweight, the arrival of the first Growler brings forward the most advanced electronic attack capabilities in history to help protect our nation's warfighters.

Raytheon



NORTHROP GRUMMAN

BOEING

This Hornet Industry Team print ad, developed by Integrated Defense Systems, supports the EA-18G Growler. The ad explains how the recent delivery of the first aircraft marks a new era in electronic attack capability for the U.S. Navy and demonstrates the program's success. The ad will appear in key Navy and Congressional publications.