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Frontiers

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DECEMBER 2009–JANUARY 2010 / Volume VIII, Issue VIII

At the **controls**

The 787 and 747-8 flight-test programs will be among the most intense ever—and Boeing's pilots are ready.

On the Cover

10 Let's go fly

With the new 787 Dreamliner and the 747-8 Freighter programs preparing for first flights, Boeing soon will embark on the biggest simultaneous flight-test undertaking in its history. It's an especially exciting time for the many Boeing pilots who have trained and prepared for years for what comes next—several thousand hours flying the new planes before they are certified and turned over to customers.

COVER IMAGE: BOEING PILOTS ARE PICTURED IN FRONT OF THE 747-8 FREIGHTER. TOM IMRICH, LEFT, IS ASSIGNED AS CO-PILOT ON THE FIRST FLIGHT OF THE NEW FREIGHTER; FRANK SANTONI IS CHIEF COMMERCIAL AIRPLANES TEST PILOT FOR BOEING TEST & EVALUATION; HEATHER ROSS IS A 787 TEST PILOT ASSIGNED TO THE FOURTH OF SIX FLIGHT-TEST PLANES. PILOT PHOTOS BY ED TURNER/BOEING; 747-8 PHOTO BY GAIL HANUSA/BOEING; COVER DESIGN BY BRANDON LUONG/BOEING.

PHOTO: BOEING PRODUCTION TEST PILOT SHEILA BEAHM IN THE FLIGHT DECK OF THE NEW 747-8 FREIGHTER, WHICH IS BEING READIED FOR ITS FIRST FLIGHT. LEO DEJILLAS/BOEING

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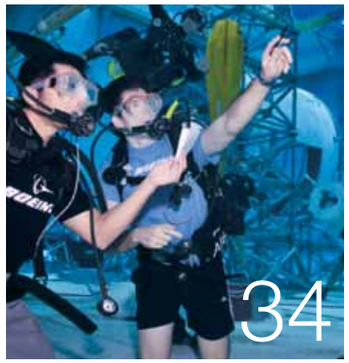
The machine people

Boeing has tens of thousands of machines that are vital to production systems across the enterprise. Many of the highly trained employees who maintain them and quickly make repairs received their training at Craft College, a successful and comprehensive Boeing program based in Auburn, Wash. PHOTO: MARIAN LOCKHART/BOEING

Stage setter

The recent successful test launch of the Ares I-X was an important milestone in the development of the Ares I rocket, which eventually could replace the space shuttles and send the next generation of astronauts into space. Boeing will build the second stage of the rocket, but first the White House will decide the direction of the U.S. human spaceflight program.
PHOTO: NASA

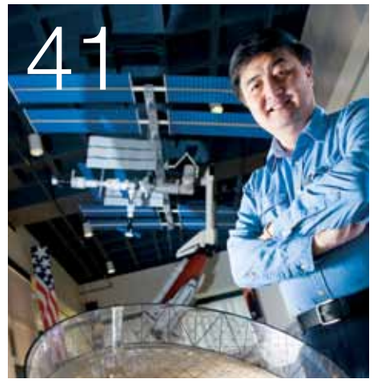


Think tank

For these Boeing employees, a day in the office sometimes means jumping into the world's largest indoor swimming pool—which is big enough to hold a mock-up of the International Space Station—as they help prepare the way for future astronaut visits to the station. The Neutral Buoyancy Laboratory in Houston was designed by Boeing and is operated by NASA. It holds 6.2 million gallons (23.5 million liters) of water and is used to simulate the weightless conditions experienced in space. PHOTO: NASA

From Earth to the moon

The year 2010 marks the 75th anniversary of the incorporation of North American Aviation, a Boeing legacy company that created aerospace masterpieces including the P-51 Mustang and F-86 Sabre Jet fighters, B-25 Mitchell bomber, X-15 rocket plane, and the Apollo spacecraft that carried astronauts on history's greatest voyage—to the moon and back. Pictured here: an OV-10D Bronco. PHOTO: BOEING ARCHIVES



Meet the inventors

Throughout the Boeing enterprise, highly talented employees are hard at work on the next scientific or engineering breakthroughs that will help drive the company's success. Recently, Boeing honored nearly 100 employees for their patented inventions or for innovative replication of previous inventions. Meet some of these big thinkers.
PHOTO: PAUL PINNER/BOEING

INSIDE

Snapshot

READY TO MAKE WAVES
Boeing mechanic Sean Taylor (right) and Raytheon representative Keith Hauter install a radar antenna in the nose of a U.S. Navy P-8A Poseidon test aircraft (T2) at Boeing's Developmental Center in Seattle. The APY-10 radar, developed by Raytheon, was installed using new tooling that saves time and cost. The P-8A is a modified Boeing Next-Generation 737 that the Navy will use for a variety of missions including anti-submarine warfare, anti-surface warfare, and intelligence, surveillance and reconnaissance. **JIM ANDERSON/BOEING**

Quotables

"Next year will be a year of recovery and in 2011 airlines will return to profitability."

– Randy Tinseth, vice president of Marketing for Boeing Commercial Airplanes, speaking to Bloomberg about Boeing's view of the economic outlook for global airlines, during the Nov. 15–19 Dubai Airshow in the United Arab Emirates.

"I never imagined part of my job description would be diving with astronauts."

– Matt King, a Boeing Systems engineer with the International Space Station program, who regularly scuba dives in the NASA Neutral Buoyancy Laboratory in Houston as part of Boeing support for upcoming zero-gravity ISS assembly operations. For more on the lab, see story and photo on pages 34–35 of this issue of *Boeing Frontiers.*

IAM PROMOTIONS

No promotions listed for periods ending Oct. 30 and Nov. 6, 13, 20 and 27.

ETHICS QUESTIONS?

You can reach the Office of Ethics & Business Conduct at 1-888-970-7171; Fax: 1-888-970-5330; Web site: http://ethics.whq.boeing.com

Why We're Here

New technology and streamlined searches help this librarian get employees the information they need.

BY KAREN ROBERTSON AND PHOTO BY PAUL PINNER/BOEING

Search: and deploy

Based in Huntington Beach, Calif., Boeing librarian Karen Robertson helps employees around the world quickly find the information and data they need, as much of the Boeing library is virtual. In this *Frontiers* series, which profiles employees talking about their jobs and how what they do fits into Boeing's overall goals, Robertson describes this valuable service—being made easier and more accessible with new software tools.

One of my roles in Library Services is to support our virtual library, which serves employees regardless of their location. I lead our electronic subscriptions team and we work with Boeing Supplier Management to establish and manage contracts for online access to journals, specifications and standards, databases, and even electronic books, or e-books. This allows us to provide employees with online access not only to our own Boeing documents but also to externally published information.

We are making a lot of progress with new software tools, the technical skills of our increasingly Web-savvy staff and our knowledge of what information employees need. For example, we've worked with the Enterprise Search team to include the contents of our library catalog in Google searches of the company intranet. An employee can pull up the full text of a Boeing document from the library server just by searching the Boeing intranet for that document number—no need to search the library catalog.

And to make it easier to find relevant technical papers, reports and articles from outside of Boeing, our team implemented a search tool that delivers results from 22 external publications and our catalog with one search. Recently, we won an award from the Special Libraries Association for innovations in technology. The association recognized our accomplishments in connecting Boeing communities through content by integrating our library catalog, gathering special collections, and creating customized information "Gateway" Web pages for specific user groups. For instance, we recently set up a Gateway for employees preparing for the Wireless Communication Engineering Technologies certification exam.

Our virtual library allows us to serve the large Boeing population with a small staff. In the first six months of 2009, Boeing employees directly downloaded more than 425,000 papers and standards from technical publishers. But as librarians we also work individually with employees who ask us to research a topic, help them use an information database, facilitate better information organization and retrieval, or set up alerts to keep them updated on a subject.

The library has a strong customer-service culture. I'm proud to be part of a dedicated, talented and agile team that helps employees build and share knowledge, solve problems, and learn new ways to do their jobs. ■

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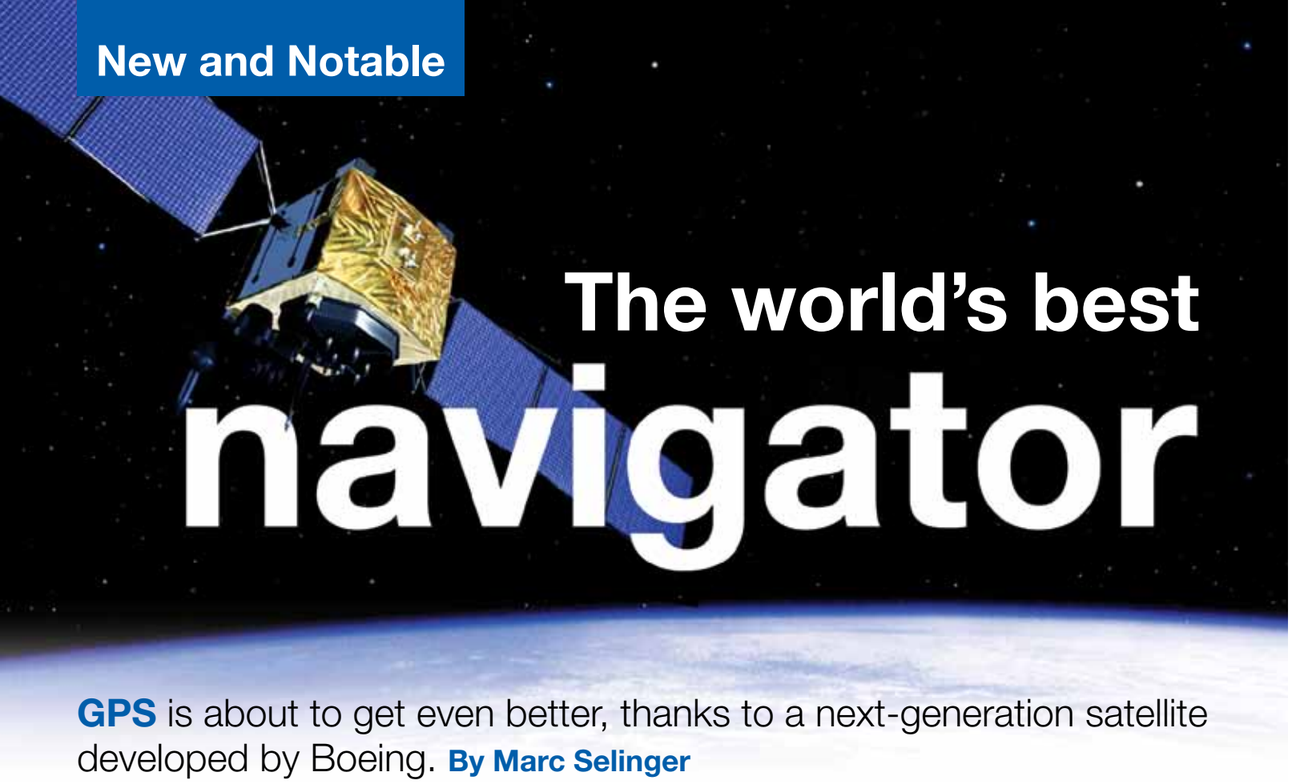
For research assistance, visit the Library & Learning Center Services page at *http://librarylearning.web.boeing.com* on the Boeing intranet. For additional help, click the **Ask A Librarian** link on that page.



The world's best navigator

GPS is about to get even better, thanks to a next-generation satellite developed by Boeing. **By Marc Selinger**

The Global Positioning System, or GPS, has been a guiding star for the U.S. military and civilians worldwide for decades. And thanks to Boeing, that navigation system will soon get even better.

Boeing Space and Intelligence Systems is putting finishing touches on the first of the GPS Block IIF satellites, the newest series of GPS spacecraft for the U.S. Air Force. Boeing will deliver the first of the satellites to the Air Force in early 2010 to prepare for a mid-2010 launch.

GPS is a space-based, worldwide navigation system providing users with highly accurate, three-dimensional position, velocity and timing information 24 hours a day. Boeing has been the prime contractor for most GPS satellites and is under contract to build 12 of these next-generation models.

"Boeing has a long history of building GPS satellites for the U.S. Air Force," said Craig Cooning, vice president and general manager of Boeing Space and Intelligence Systems. "The GPS IIF system will bring more capability and improved mission performance to the GPS constellation."

Boeing also provides the Operational Control Segment that controls the entire existing GPS constellation (more than 30 satellites) and will control the next-generation models.

Created by the Defense Department to enhance U.S. military warfighting capability, GPS is available for use, free of charge, to anyone with a GPS receiver. Since its development, the system has seen rapid adoption by civilians—with new applications continuously being developed.

Increased civil and commercial use of GPS, coupled with lessons learned from years of military operations, drove a requirement to modernize the system and augment capabilities. In 1996, Boeing was initially selected to support the Air Force in guiding the introduction of new capabilities and technologies into the Block IIF platform.

This next-generation satellite is the product of Boeing's heritage with 39 successful satellites from GPS Block I and Block II/IIA missions and more than 30 years of teamwork with the Air Force. ■

marc.selinger@boeing.com

GRAPHIC: Boeing's first Global Positioning System IIF, shown in this artist's concept, has completed a series of tests, and the program is meeting key milestones. The first IIF is scheduled to be delivered to the U.S. Air Force in early 2010. LINDA MATSUMOTO/BOEING

Guiding star

Each Boeing GPS IIF satellite will deliver:

- Two times greater predicted signal accuracy than heritage satellites
- New signals for more robust civil and commercial aviation applications
- Better resistance to jamming in hostile environments, meeting the needs of emerging doctrines of "navigation warfare"
- A 12-year design life providing long-term service and reduced operating costs
- An on-orbit, reprogrammable processor that can receive software uploads for improved system operation

Let's **talk**

Talk candidly with your manager about performance and development

It's the time of year when Boeing employees and managers are encouraged to talk candidly about Performance Management, including progress toward goals and objectives and developing future skills.

"Performance Management is all about helping employees develop so they can reach their goals," said Joan Sato-Hernandez, director, Talent Management. "Regular conversations between managers and employees create an ongoing framework of support that helps all team members reach their full potential."

Two important Performance Management objectives need to be completed in the coming months:

- Close-out discussions between managers and employees, from Nov. 30 to Jan. 8. Employees are encouraged to prepare for these meetings by completing an informal self-assessment.
- Between Jan. 4 and March 1, employees formulate their Business Goals and Objectives, as well as their Development Plans, for 2010. Employees should apply the S.M.A.R.T. (specific, measurable, achievable, relevant and timely) framework to ensure the successful accomplishment of each goal. Completing this phase helps employees clarify roles, responsibilities and performance expectations. It is also an opportunity to discuss development goals for the employee targeted to his or her current job and career goals.

To encourage conversations between managers and employees throughout the year, Boeing plans to unveil an upgraded Performance Management tool in January. Employees who need to prepare Business Goals and Objectives prior to January should use the templates posted on the on the Strategy, Compensation and Benefits Web site (*http://hr.web.boeing.com/index.aspx?com=9&id=106*) under Performance Management.

– Ron Taylor and Andrew Favreau

PHOTO: Executive office administrator Anita Taylor and her manager, Lawrence Oliver, speak candidly about her performance and opportunities for development within the company. BOB FERGUSON/BOEING

Speed-of-light defense

Earlier this year, Boeing demonstrated the ability of mobile laser weapon systems to perform a unique mission: track and destroy small unmanned aerial vehicles (UAVs).

During U.S. Air Force–sponsored tests at the Naval Air Warfare Center in China Lake, Calif., the Mobile Active Targeting Resource for Integrated eXperiments (MATRIX), which was developed by Boeing under contract to the Air Force Research Laboratory, used a single, high-brightness laser beam to down five UAVs at various ranges. Laser Avenger, a Boeing-funded initiative, also shot down a UAV.

"The Air Force and Boeing achieved a directed-energy breakthrough with these tests," said Gary Fitzmire, vice president and program director of Boeing Missile Defense Systems' Directed Energy Systems unit. "MATRIX's performance is especially noteworthy because it demonstrated unprecedented, ultra-precise and lethal acquisition, pointing and tracking at long ranges using relatively low laser power."

– Marc Selinger

PHOTO: An unmanned aerial vehicle is hit by the high-energy laser beam fired from a Boeing-developed, trailer-mounted test bed known as the Mobile Active Targeting Resource for Integrated eXperiments, or MATRIX. U.S. AIR FORCE RESEARCH LABORATORY

Flight plan

Boeing test pilots who will fly the Dreamliner and 747-8 Freighter will soon be in the spotlight, but the goal is to make the first flights as routine as possible

By Eric Fetters-Walp

When the new 787 Dreamliner and the 747-8 Freighter first take flight, the experience will mark an apex, rather than a beginning, for the Boeing test pilots behind the controls.

"It's akin to an athletic team. You train and train for the big event. And when you get to it, it's almost a relief as you get onto the field and get the opportunity to do what you know so well," said Frank Santoni, chief commercial airplanes test pilot for Boeing Test & Evaluation.

Boeing's test pilot corps will be in the spotlight in the year ahead. Not only will the two new commercial jetliners undergo thousands of hours of flight testing, but Boeing is part of a team with the U.S. Navy conducting a formal flight-test program of the new P-8A Poseidon maritime patrol and surveillance aircraft, a modified 737.

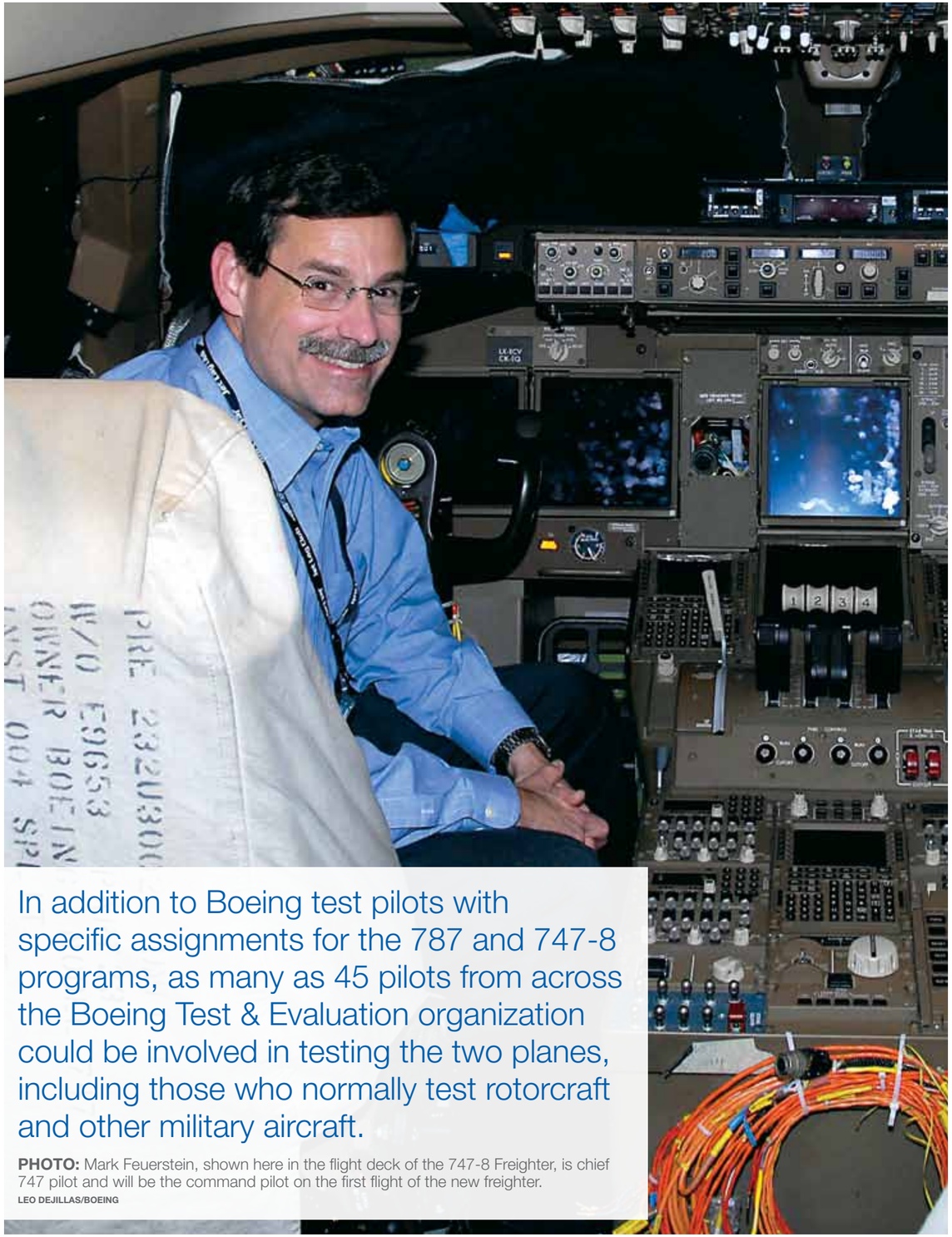
The last time Boeing simultaneously ran two commercial flight-test programs of this scale was 25 years ago, when the 757 and 767 were put through their paces. For many of the test pilots involved in today's 787 program, it's also their first experience testing an all-new airplane. It has been 15 years since the 777 was introduced.

"During the 777 testing, we had a number of airplanes flying at the same time," said Chuck Killberg, director of Flight Operations and chief pilot for Boeing Test & Evaluation, the enterprisewide team responsible for the test and evaluation of new Boeing airplanes. "But we haven't had, in the history of the company, a testing program as extensive as the one coming up. It'll be a big job. But our team is prepared to take it on and not miss a beat in the commitments we made to [Commercial Airplanes and Integrated Defense Systems] programs."

It's a time of anticipation amid great preparation for the few who will be behind the controls for first flights of the 787 and 747-8. Ironically, the goal of the test pilots during these momentous events is to make sure the flights are as routine as possible.

"A first flight will always be interesting

PHOTO: Tom Imrich, senior test pilot for the 747 program, waves from the doorway of the first 747-8, which is being prepared in Everett, Wash., for flight tests starting in early 2010. Imrich will be co-pilot on the first flight. GAIL HANUSA/BOEING



In addition to Boeing test pilots with specific assignments for the 787 and 747-8 programs, as many as 45 pilots from across the Boeing Test & Evaluation organization could be involved in testing the two planes, including those who normally test rotorcraft and other military aircraft.

PHOTO: Mark Feuerstein, shown here in the flight deck of the 747-8 Freighter, is chief 747 pilot and will be the command pilot on the first flight of the new freighter.

LEO DEJILLAS/BOEING

and exciting," but not exciting in a dangerous sense, explained Tom Imrich, who's scheduled to co-pilot the 747-8 Freighter on its first flight with Mark Feuerstein. "It's very rare and few and far between that you find something that doesn't go as planned."

The engineering test pilots at Boeing—those who perform the intensive tests needed anytime a new model rolls out or upgrades are made to existing models—are involved from the earliest design stages of a new airplane program. Which is why, in addition to a shared love of flying, the test pilots all have broad technical experience.

"We're dealing with and speaking with engineers through the development process. So we need to speak with a knowledge and vocabulary we both can understand," said Kirk Vining, who will captain the third 747-8 through its flight tests.

Vining earned a degree in aeronautical engineering and spent 14 years as a test pilot for Bombardier before joining Boeing. Many of his colleagues have test-pilot experience from their time in the military. Mike Carriker, who gained experience as a test pilot and flight instructor during 12 years in the U.S. Navy, said the differences between testing military aircraft and commercial airplanes aren't as stark as some people might think.

"Technically, there's no difference. You have a task to do, and a task to do safely, except there are no ejection seats in these airplanes," said Carriker, who is scheduled to captain the 787 Dreamliner's first flight with test pilot Randy Neville.

Previously, test pilots for Boeing's passenger jets and military aircraft worked for different parts of the enterprise. All test pilots soon will be part of Boeing Test & Evaluation, an Engineering, Operations & Technology organization that will oversee flight testing for Commercial Airplanes and IDS. Through this companywide approach, Boeing can better support all its flight-test needs. In fact, beyond the specific pilots designated for certain key roles in the 787 and 747-8 flight-test programs, as many as

The six Dreamliner test planes will undergo about 5,000 hours of testing, or more than 200 days.

PHOTO: (From left) Jeff Croft, Engineering leader for the 787 Systems team; Mike Carriker, chief test pilot for the 787 program; Mike Delaney, vice president and chief project engineer of the 787 program; Mike Sinnett, vice president and chief engineer of Systems for the 787 program; and Mike Bryan, 787 test pilot, enjoy a light moment between taxi test runs of the first 787 Dreamliner in Everett, Wash., earlier this year.

GAIL HANUSA/BOEING

45 pilots from across BT&E—including those who normally test rotorcraft and other military aircraft—could be involved with testing these airplanes. That doesn't include another 50 or more pilots who will support the programs in various roles.

In addition to the engineering test pilots, Boeing has production test pilots, who fly and certify every airplane that rolls out of the factory before the planes are turned over to the customers. Engineering test pilots sometimes assist in those production tests as well.

Heather Ross, who's assigned to the fourth of six 787 test planes, has worked both as a production test pilot and now as an engineering pilot. Ross, who also has flown in the U.S. Air Force and for United Airlines, said there's a distinct difference between the different test pilot roles.

"As a production pilot, the major part of your job is quality assurance. You're verifying the airplane does what Boeing says it can do," Ross said. "As an engineering test pilot testing a new airplane, we're still defining how it can fly and what it can do."

Both the 787 Dreamliner and 747-8 flight-test teams have been able to sit in the actual flight decks of their new airplanes in recent months, following years of preparing in simulators. "It's been very satisfying to get our hands on the airplane and start testing it out," said Vining, the 747-8 pilot.

While the initial flights of the new models will focus on the overall performance of the airplanes, the subsequent flight tests will focus on the minute details and specific systems. Those details are as interesting as the bigger things, Carriker said. "For example, the 787 has a new windshield, the first new windshield we've designed since 1979," he said.

How thoroughly will the new 787 be tested? Consider that the flight-testing program for the Boeing 707 six decades ago totaled about 600 hours. The six Dreamliner test planes will undergo about 5,000 hours of testing, or more than 200 days, according to Carriker, who helped test the 777 when it was introduced.

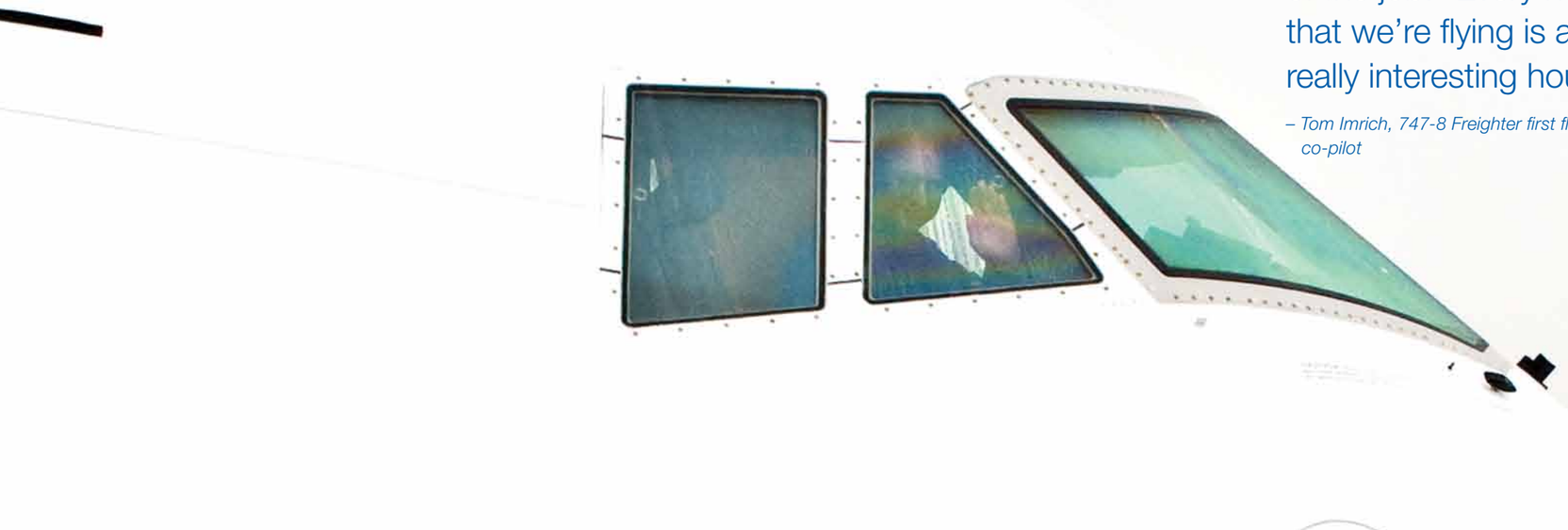
Some of that increase in testing hours is due to the growing technological

"As an engineering test pilot testing a new airplane, we're still defining how it can fly and what it can do."

– Heather Ross, 787 test pilot

PHOTOS: (Left) The first 787 Dreamliner went through its first taxi tests in July with Mike Carriker and Randy Neville testing the airplane's steering and braking capabilities at Paine Field in Everett, Wash.
GAIL HANUSA/BOEING

(Inset) Test pilot Heather Ross in the flight deck of the second 787 Dreamliner in between ground taxi tests.
RANDY NEVILLE/BOEING



> Being behind the controls of an airplane, up in the sky, is the most rewarding part of the job. "Every hour that we're flying is a really interesting hour."
>
> *– Tom Imrich, 747-8 Freighter first flight co-pilot*

sophistication of Boeing's jetliners over the years, explained Santoni, the chief commercial airplanes test pilot. Also, with the 787, there is special testing needed for each of the engine options (Rolls-Royce and General Electric), which wasn't required on the earliest jets. And federal safety regulations for airplanes are more detailed and stringent than in decades past, which accounts for many of the additional testing hours, he said.

During that testing period, a "day at the office" could include flying for eight hours at various locations around the world, from the heat of the California desert to the mountains of South America for high-altitude certification. At times, pilots will fly with an engine idled. Some of the pilots will perform repeated stall maneuvers. "Sometimes, you fly it every day for days on end. We're very good at going to where the most efficient testing can be done," Carriker said.

Flying the new 747-8 is a natural step for Imrich after his experiences with earlier generations of the 747. He flew on the first 747 Boeing ever built before it was parked as a museum piece. While working for the Federal Aviation Administration, he issued the first type rating for the 747-400 model in 1988 and he co-piloted the final 747-400 on a production flight test last spring.

Imrich said he particularly looks forward to the more challenging flight tests, such as those typically done in the past in Iceland. "For me, I've always worked in the field of bad weather and low-visibility landings and takeoffs." But like his fellow test pilots, Imrich said just being behind the controls of an airplane, up in the sky, is the most rewarding part of the job.

"Every hour that we're flying is a really interesting hour," he said. ■

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PHOTO: Tom Imrich, senior test pilot for the 747 program, looks out from the flight deck of the first 747-8. He will be co-pilot for the airplane's first flight.
GAIL HANUSA/BOEING

Citizen Boeing

At Boeing, corporate citizenship means helping to make the world a better place, and the company is contributing time, money and resources to ensure that happens

The Boeing Company calls it "corporate citizenship." The concept may have other names, such as "corporate social responsibility," "corporate responsibility" or "corporate sustainability." But they all express the same thing—how a company conducts its business to have a positive impact on society and communities.

For insights into Boeing's approach to corporate citizenship and why it's important, even in a difficult economy, *Frontiers* recently spoke with Jim McNerney, chairman, president and CEO; Rick Stephens, senior vice president of Human Resources and Administration; and Anne Roosevelt, vice president of Global Corporate Citizenship.

What does "corporate citizenship" mean at Boeing?

McNerney: It's our vision of the implied contract between business and society. We recognize the interdependence between our business and our communities, and we know Boeing makes a significant impact on the world. We want that impact always to be a positive one.

So we take a comprehensive approach to corporate citizenship. First, we are a business committed to operating both profitably and from a foundation of solid values such as customer satisfaction, safety, quality and integrity. We strive to make our products and services more clean and efficient—and help our customers become more competitive.

We also believe it is important that we help make the world a better place, so we contribute time and money to strengthen communities around the world. We have unique knowledge, skills and relationships that we often share as we help others—and as we help others help themselves. For example we bring together customers, competitors, suppliers and other companies in driving industrywide efforts to identify sustainable biofuels. We work with customers and governments toward introducing more efficient air-traffic-management practices and systems around the world. We work with educational systems and their communities to help better prepare students with the skills they will need as part of an interactive, networked and tech-savvy work force. And we hone our leadership skills and take Lean+ or other skills-based principles into the nonprofit organizations where we volunteer.

"Our giving back to our communities is both a responsibility and an opportunity. We can make a significant difference in people's lives—now and for generations to come."

– Jim McNerney, Boeing chairman, president and CEO

"We want to unleash the power of other corporate-citizenship assets … These tools can work together powerfully to help build greater self-sufficiency in our communities and long-lasting growth."

– Rick Stephens, senior vice president of Human Resources and Administration

PHOTOS: (Portraits, from top) Jim McNerney, Boeing chairman, president and CEO; Rick Stephens, senior vice president, Human Resources and Administration; and Anne Roosevelt, vice president, Global Corporate Citizenship. **(Company and employee activities, from left)** Applying chrome-free primer to Apache helicopters in Mesa, Ariz.; promoting math and science education in China; recycling at the KC-135 Programmed Depot Maintenance area in San Antonio; sprucing up homes of the elderly and disabled in Orange County, Calif.; working with a student on math skills in Mesa; cleaning up in Southern California; and inspiring early learning in Turkey.

So "corporate citizenship," the concept, is much bigger than "Global Corporate Citizenship," the functional organization?

McNerney: Definitely. GCC, the organization, is one of those charged with integrating our corporate-citizenship efforts. The Government Operations, Boeing International, and Environment, Health and Safety functions are other big players in that. But many other people and organizations beyond these help make Boeing a good—and global—corporate citizen. In fact, every Boeing employee contributes in some way.

Stephens: The GCC team plays an important role as an integrator. Its people maintain a broad array of relationships with stakeholders. Just as our sales, business-development and program teams bring customer perspectives into the company, we expect our GCC teammates to add our communities' perspectives to the mix. With well-rounded input that links our values and purpose with our business performance, leaders are able to make well-informed, values-based decisions.

How has the Boeing approach to corporate citizenship evolved?

Roosevelt: Two years ago, we expanded our focus from community and education relations to global corporate citizenship—in an acknowledgment of higher expectations from our stakeholders. Under Rick's leadership, we are developing an integrated, cross-enterprise strategy. We changed our function's name from Community & Education Relations to Global Corporate Citizenship and convened the companywide Corporate Citizenship Integration Council to discuss and shape Boeing's actions related to our citizenship goals.

Stephens: We're looking to go beyond simply dispensing corporate cash grants and organizing site-specific volunteer activities. We want to unleash the power of other corporate-citizenship assets—including our tremendous intellectual capital, our systems approach to programs, our ethics and diversity programs, in-kind donations, relationships with universities, the Employees Community Fund, and both traditional interest-based and skills-based volunteering. These tools can work together powerfully to help build greater self-sufficiency in our communities and long-lasting growth in our economies. They also can help motivate employees to see Boeing as the best place to be engaged and productive.

Where does corporate citizenship fit in with our business strategy?

McNerney: The two are definitely related—the stronger our business, the better able we are to make a positive impact on our world; and the more positive an impact we make, the better the chances our business will grow stronger.

Profitable companies can—and should—build healthy communities. In our case, Boeing fuels commerce and provides meaningful employment, the starting points of corporate citizenship. Each of us contributes in some way to delivering reliable, innovative and efficient products and services that truly affect people's lives. We act as a leader in responsible business practices, in helping not-for-profit organizations address local needs, and in bringing together diverse organizations to address larger issues (many of which affect our business). We also apply our core competencies—such as Lean+ and our expertise in integrating large-scale systems—to help make our communities better.

Is there a relationship between corporate citizenship and our ability to execute on programs or win new business in a tough economy?

McNerney: Corporate citizenship by its very nature is a mix of altruism and business reality. Our giving back to our communities is both a responsibility and an opportunity. We can make a significant difference in people's lives—now and for generations to come—by what we do today. But we are also contributing to the company's future as we do so. Our work on the environment is one example of that. We're helping to clean up our communities, conserve resources, reduce emissions and identify environmentally sustainable sources of energy, all of which helps preserve the world for future generations of people. It also enables Boeing to keep building and supporting new generations of airplanes—and employing the people to do so. Make no mistake about it: Our customers buy our products based primarily on the business value and quality of the products and services we deliver. But they also usually take into account our relationships with them and their communities. Those relationships—and the trust they build—can be the difference between winning and losing in close competitions.

Why worry about creating a better world when so many employees these days are concerned about simply maintaining their standard of living or having a personal life?

McNerney: We don't require employees to be involved in corporate-citizenship efforts. But most employees want to be more involved in their communities and many want to do so as part of Boeing because they believe strongly that it's the right thing to do. This company has a long history of helping to make the world a better place and I think today's employees are just as committed to that as past generations have been. People simply have high expectations of themselves and of Boeing—even when the workload is at its peak.

Stephens: In fact, data show that today's employees—as well as those who may be attracted to Boeing in the future—increasingly expect their employers to be good corporate citizens and to provide opportunities for them to get involved in their communities. So our corporate-citizenship behavior has an important influence on retaining and inspiring top-notch performers, as well as on recruiting.

McNerney: Let's remember, too, that community-based activities can help people develop their leadership skills. Some employees are making good career moves as a result of applying what they learn through volunteer activities. We can take certain Boeing skills into our communities, and we can bring the leadership skills we learn in our communities back into Boeing.

Are we really making a difference?

McNerney: Boeing employees all around the world are driving positive change in what can seem like small ways but are really long-lasting and powerful. Our people get things done. They are truly inspiring. And yes, we definitely are making a difference.

To view a recent webcast about corporate citizenship, visit *http://videowm.boeing.com/ben/bb954/enter.htm* on the Boeing intranet. ■

PHOTOS FROM PAGES 18–19 BY BOB FERGUSON/BOEING, MIKE GOETTINGS/BOEING, YINGSHU ZHANG, LANCE CHEUNG/BOEING, PERRY HAVELAAR/BOEING AND THE MOTHER CHILD EDUCATION FOUNDATION.

Leading edge: Volunteers use aerospace skills to help people at ground level

PHOTOS: (Top) Boeing propulsion systems engineer Shah Selbe co-led a volunteer project to improve water supply quality and reliability for a hospital in Malawi, Africa. BOB FERGUSON/BOEING

(Above) Workers repair piping and construct a Rainwater Catchment System at the southern Malawi site. COURTESY OF ENGINEERS WITHOUT BORDERS–USA

The same engineering skills that Boeing's Shah Selbe uses to help satellites maneuver in space are ensuring delivery of clean water to a health clinic in southeast Africa.

Selbe, working out of El Segundo, Calif., serves as co-lead for a volunteer project in the African nation of Malawi to develop solutions to water issues that touch the lives of people halfway across the globe. The success of the effort, coordinated through Engineers Without Borders–USA, led Boeing to honor the propulsion systems engineer with the 2009 Boeing Exceptional Volunteer Service Award.

In 2008, Selbe joined the global nonprofit's Malawi Project team to help resolve crucial water treatment and transport issues for the Malamulo Hospital Campus. The hospital, located in a rural area of southern Malawi, is home to the country's leading HIV/AIDS prevention program, but its water system was inadequate and inconsistent, and many potential sources of water are contaminated.

The goal of the project is to bring inexpensive clean water to the entire hospital campus—by identifying water sources, repairing piping and constructing a Rainwater Catchment System.

"As a liquid propulsion subsystem engineer working on how communications satellites move around once they're in geosynchronous orbit, I deal with technical issues regarding liquids and pressure changes," Selbe said. "So what I did on this project, including drafting of the technical documentation, is similar to what I do at work."

The project also required Selbe to develop and employ some unexpected skills—ranging from training and communication to negotiation to project and resource management. "I really enjoy what I do at Boeing—making satellites move in space is pretty cool," Selbe said. "But this EWB project was rewarding in a whole different way. We're working to make sure that the Malamulo hospital can continue its work for people living with HIV/AIDS, and also to deliver a reliable source of clean drinking water for children who go to school on the campus. How cool is that?"

Selbe's volunteer work may also touch lives in other parts of the globe. He hopes that the innovative rainwater catchment system he designed for Malawi will soon be adapted for use in other Engineers Without Borders–USA projects in Tanzania and South America. ■

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Rebuilding homes—and building leadership skills

Five years ago, Systems Engineer Eliza Thompson joined the Boeing St. Louis Rebuilding Day volunteer effort, which helps upgrade homes to enable elderly and disabled citizens to continue living in them independently. Each year since, Thompson has led the entire event, which has grown from 170 Boeing employee volunteers to more than 920. Thompson was named as a semifinalist in this year's Boeing Exceptional Volunteer Service Award.

Rocket scientist inspires students to pursue aeronautics

It's hard to know how many schoolchildren across Southern California have been inspired by Dean Davis over the past 31 years. That's how long this "rocket" scientist and passionate aerospace advocate has been sending industry engineers and scientists into classrooms—with kites, balloons, rockets, experiments, lesson plans and even a traveling space museum. The 2009 Boeing Exceptional Volunteer Service Award semifinalist spends 40 hours a week in educational outreach for the American Institute of Aeronautics and Astronautics. That's on top of his 40-plus hours at Boeing, where the advanced space research and development team leader designs future manned space colonies and solar power satellites. (See the related Historical Perspective in the May 2009 issue of *Frontiers*.)

All stories by Geoff Potter and portraits by Bob Ferguson/Boeing

Hands-on learning

Volunteering offers employees opportunities to learn and lead **By Geoff Potter and Carrie Howard**

A challenging economy doesn't have to put the brakes on career development. Many Boeing employees have built valuable job and leadership skills by volunteering.

"Volunteering is an exceptional way for our employees to develop or expand their skills," said Patrice Mingo, director, Strategic Programs, Global Corporate Citizenship. "For example, it gives people the chance to exercise leadership and program management skills, even if they don't use those skills in their current job."

Studies show that nearly 70 percent of what employees learn professionally comes from assignments, whether primary, part-time or volunteer, according to Steve Bass, director, Leadership Development. "Heading up a finance committee at church or leading a Scout troop is the equivalent of doing a special project at work," he said.

"Volunteering gives you an opportunity to take on a challenging leadership role in a friendly environment, where you can try new things that you might not be as comfortable doing at work," Bass said. "And when people get involved with something they feel passionate about, they develop deeper skills at an accelerated rate compared to just doing what their boss wants them to do."

Systems engineer Eliza Thompson, a semifinalist for this year's Boeing Exceptional Volunteer Service Award, agrees. "It's taught me a lot about inspiring and enabling people," she said of her experience leading more than 900 Boeing employees in the annual Rebuilding Together–St. Louis home renovation event. "It's taught me organizational skills, and it's definitely given me a large network!"

The benefits extend from the company to the community—and back, according to Mingo, who leads volunteer programs for Boeing. "Volunteering is a powerful force to achieve 'One Boeing': When employees focus on the needs of their communities, the lines between business units, legacy programs, projects and sites begin to blur and we actually demonstrate 'One Boeing.' And that is good for our communities, our employees and our company." ■

To learn about opportunities in your area, visit the GCC Volunteerism page at *http://community.web.boeing.com/volunteer.cfm* on the Boeing intranet.

To learn more about Boeing and Engineers Without Borders–USA, visit *http://community.web.boeing.com/ewb-usa* on the Boeing intranet.

Another helpful resource is inSite, Boeing's social media tool, which you can access at *https://insite.web.boeing.com/culture/displayGroups* on the Boeing intranet.

"Volunteering is a powerful force to achieve 'One Boeing.'"

– Patrice Mingo, director, Strategic Programs, Global Corporate Citizenship

PHOTOS: (Top) Volunteers from Engineers Without Borders–USA begin upgrades to a water distribution system for a hospital in Malawi, Africa. **(Above)** Schoolchildren in Togo thank Boeing for its contributions to improvement projects at a nearby school. Grant funds from Boeing helped make this project possible.
COURTESY OF ENGINEERS WITHOUT BORDERS–USA

Play by play

Commercial Airplanes Structures engineers turn to PlayBook to tap the years of experience, knowledge and best practices of their colleagues

By Kathrine K. Beck and photo by Gail Hanusa/Boeing

In professional sports, a playbook gives team members descriptions and diagrams of what to do on the field, a knowledge of plays and formations based on past success. Boeing Structures Engineering has a playbook, too.

"The kind of information that's in the PlayBook, you really can't find anywhere else," said Barclay Fitzpatrick, a structural analyst with Boeing Commercial Airplanes and part of the team that developed PlayBook. It's a Web site showcasing Structures and Payloads Engineering best practices and lessons learned. Using PlayBook is like having a conversation with someone who's done it all before, and who has learned from many years of experience what works and what doesn't, he said.

The Web site contains information provided by hundreds of Boeing experts on technical subjects across all Commercial Airplanes programs. It gives engineers quick access to processes they need to do their jobs—processes that are specific to Boeing. It helps engineers who are managing projects learn how things are done best, according to Fitzpatrick. And it lets Commercial Airplanes employees collaborate and share knowledge and best practices—actions that can help Boeing thrive.

"This is knowledge specific to our business, not technical fundamentals learned in engineering school," said Deborah Limb, Structures Engineering director, Commercial Airplanes. "The goal is to capture standard work and best practices and help teams see where they fit into processes."

PlayBook chapters address subjects from across the engineering design cycle: program organization and management, work statement and schedule negotiation, design and drawing release, working with suppliers, and certification. It also includes practical tips on subjects such as measuring engineering performance, writing an effective work statement, building plans and schedules, and interacting with suppliers the right way.

Susan Gulyas, a structures design engineer in Commercial Airplanes, leads the PlayBook content development team. PlayBook was designed to address the fact that "across different commercial airplane programs, people were conducting engineering business differently," she said. "We need to allow for creativity in engineering, but some things need to be done the same way. Having them in one place makes it easy to find them."

The PlayBook is searchable and continuously updated. It includes videos, text and online demos with subject-matter experts providing step-by-step audio explanations. Pop-up menus allow for quick navigation to any section.

Kevin Beyer, an Associate Technical Fellow who works on 747-8 trailing edge wing structures, was one of the subject-matter experts consulted for the project. He called PlayBook "very beneficial," as it provides new engineers with the knowledge they need to do their work efficiently and helps more experienced engineers with guidelines and best practices. Without it, he said, "you could go down a path that will take you a lot more time and a lot more effort."

Other Commercial Airplanes organizations are looking at using an application such as PlayBook, said Sophia Zervas-Berg, senior manager, Structures Engineering. "The PlayBook has the potential to be used across the enterprise," she said. ■

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Questions? From Outlook, send an e-mail to Susan Gulyas or Bradley J. Sleder.

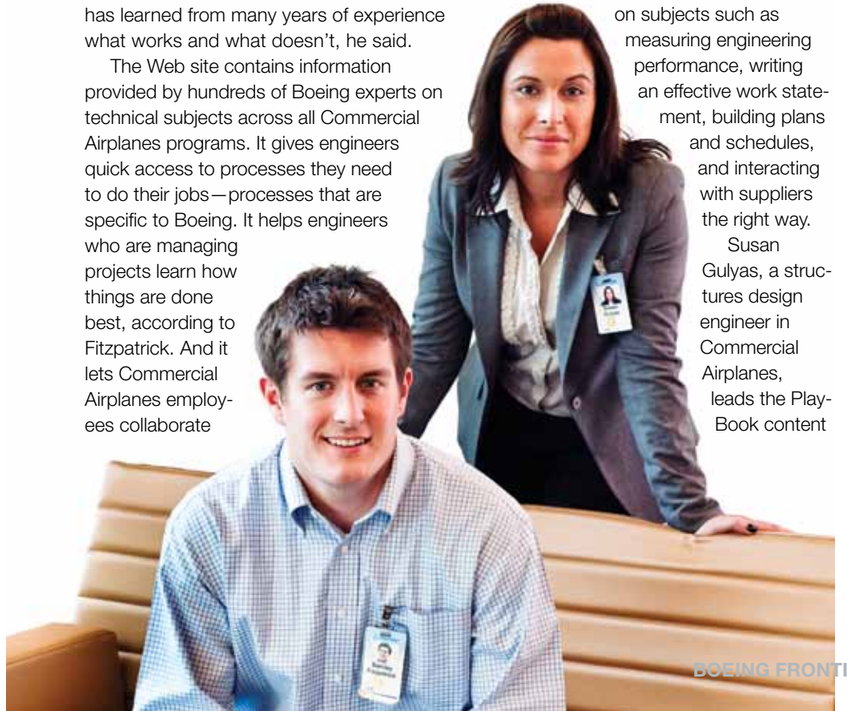

PHOTO: Structural analyst Barclay Fitzpatrick (left) and structures design engineer Susan Gulyas are part of the PlayBook content development team, compiling Boeing expertise in an easy-to-use format.

Class act

Craft College helps Boeing employees gain the skills needed to maintain—and quickly repair—thousands of production machines

By Dan Ivanis and photos by Marian Lockhart/Boeing

“Our goal is to teach our people not only how a machine works but why.” *– James Fleming, electronics and numerical control teacher, Craft College*

Across Boeing, tens of thousands of production-related machines, some big enough to fill a room, are vital to the company’s vast businesses and production systems.

Occasionally, machines break down or don’t always perform to specification, and when that happens the consequences can be widespread. In Boeing’s Commercial Airplanes factories, for example, the production cycle could be compromised, leading to scrapped parts, rework, additional costs, schedule slips and unhappy customers.

But Boeing’s Craft College is helping keep machine downtimes to a minimum. It is a comprehensive training program for the mechanics, technicians, plumbers, millwrights, oilers and others who maintain, diagnose and fix these machines.

Before Craft College, this type of training was scattered and inefficient, according to Mike DePew, senior manager of Equipment Services for Boeing Fabrication’s facility in Auburn, Wash. “The number of classes Boeing offered could be printed on the back of a business card,” he said.

Not anymore. An estimated 5,200 Boeing employees have taken Craft College classes over the past five years, or about 20 students per week.

Craft College, a cooperative effort between Boeing’s Learning, Training and Development organization and Fabrication’s Equipment Services, is based in Auburn—no surprise since the vision for the program came from DePew. It was started seven years ago with the aim of improving machine maintenance in the Auburn Fabrication plant. Since then, the college has been growing across the company.

The Fabrication facility could be the poster child for the Craft College program’s success. The site has some 3,800 machines, and since the college opened, the Fabrication facility has enjoyed an annual 10 percent year-over-year reduction in the number of hours machines are down, or unavailable, due to both planned and unplanned maintenance.

“Our planned downtimes are shorter and we have less unplanned downtime because we know what we are doing,” said DePew, a 25-year Boeing employee who began his career as a numerical control mechanic working on the same types of machines.

Craft College has a few designated classroom labs in the Puget Sound area. But nearly all of the program’s hands-on simulators are portable, so that classes can be taught anywhere. Although it is based in Auburn, Craft College caters to Boeing employees throughout the United States. Its instructors regularly teach classes in Southern California, St. Louis, Mesa, Ariz., Huntsville, Ala., Portland, Ore., Wichita, Kan., and other locations including Alaska and Hawaii.

The curriculum combines textbook and hands-on learning with entry-level, midlevel and advanced courses, some of which lead to professional certifications.

“They teach me what I need to know and don’t go over stuff I already know,” said Tim White, a numerical control mechanic at the Auburn Fabrication site who has received several professional certifications through his studies with Craft College. “They do a good job of giving us what we need to do our jobs.”

James Fleming, who teaches electronics and numerical control for Craft College, said the aim of the program is to “get the right person the right training at the right time.”

“Our goal is to teach our people not only how a machine works but why,” said Fleming, also a former numerical control technician with 25 years experience. “Once they develop that understanding, they are able to work on a number of machines more easily and with a minimum of additional training.”

In 2008, Craft College won a best practice award for launching a learning program from Corporate University Xchange, a national provider of corporate university research, benchmarking and advisory services. Craft College uses Lean+ tools and principles, such as just-in-time delivery, flexible production and continuous improvement to keep costs down and deliver its classes efficiently. All classes are developed in modules, which allows training about particular machines to be broken out and delivered in critical situations.

“The machines and technology we’re talking about are evolving constantly,” DePew said. “Our classes evolve with the technology, and our employees will as well. Some of them will take the same class three or four times during their career, just so they can stay current.”

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PHOTOS: (Left) Rickey Rodeffer (center), an instructor in Boeing’s Craft College, uses a simulator to help Teresa Holder (left) and Tim White, numerical control mechanics in Commercial Airplanes, learn more about pneumatic systems. **(Above)** Craft College instructor James Fleming (left) helps Sam Wong, a numerical control technician in Commercial Airplanes, align a Cincinnati T-35 five-axis milling machine.

October sky

PHOTO: NASA's 327-foot-(100-meter-) tall Ares I-X test rocket lifts off from Launch Complex 39B at Kennedy Space Center on Oct. 28. The rocket produced 2.96 million pounds (13,167 kilonewtons) of thrust at liftoff. This was the first launch from Kennedy's pads of a vehicle other than the space shuttle since the Apollo Program's Saturn rockets were retired. NASA

The **Ares I** rocket could send the next generation of U.S. astronauts into space.

BY AMY L. REAGAN

A fiery streak lit up the midday sky over NASA's Kennedy Space Center in late October, the first time in more than a generation that NASA had tested a new rocket. The Ares I-X flight test was a key milestone for NASA's Constellation Program and for the Ares I rocket, which is being developed to launch the next generation of astronauts into space once the space shuttles are retired.

As it has been since the dawn of the Space Age, Boeing is at the fore of developing this important capability.

Boeing is the design and production partner for the Ares I upper stage and instrument unit avionics. The upper stage is the second stage of the rocket; the avionics, or "brains," of Ares I will provide guidance, navigation and control for the rocket until it reaches orbit.

Since winning the contracts two years ago, the Boeing Space Exploration team in Huntsville, Ala., has worked closely with NASA to validate the upper stage and avionics designs. Boeing employees have supported and conducted trade studies to determine the best materials and designs for the rocket, and worked to develop processes and procedures that will be used to manufacture the upper stage and avionics units.

The team has made great strides, according to Jim Chilton, Boeing's vice president of Exploration Launch Systems. "By working closely with the customer and having an intimate understanding of their requirements and needs, we've been able to develop a safe and reliable vehicle that can return humans to the moon."

Even as the Ares I program moves forward after the successful first flight of the Ares I-X, there are questions about the direction of America's human spaceflight program, as well as the future of the Ares program. In October, a presidential commissioned blue-ribbon panel reviewing U.S. human spaceflight plans submitted a list of options to President Obama. The administration could announce its decision on the nation's future space policy before the end of the 2009 (see box below).

In the meantime, Boeing's Ares team is determined to fulfill its mission.

"The most important thing for our employees to focus on right now is performing on the contracts we have in hand," Chilton said. "We're in a very dynamic time, but focusing on performance and productivity will ensure we continue to have a role in America's human spaceflight plans."

The NASA-Boeing team is co-located at Marshall Space Flight Center in Huntsville, Ala. "Being close to the customer and being able to run into them in the hallway allows us to work through any problems quickly and efficiently," Chilton said.

This close customer interaction will continue when Boeing begins production of the upper stage and avionics units at NASA's Michoud Assembly Facility, outside New Orleans, in late 2010. NASA and its contractors are already preparing Michoud for the Ares upper stage and avionics work.

Because the tooling required to produce the upper stage is about the height of a 2.5-story building, the first step in the facilities work is to reinforce the floors in the Boeing Ares areas. Once the floor is reinforced, a robotic weld tool and a machining center will be installed. Also, construction has begun on a Vertical Assembly Building where the upper stages will be assembled.

About 15 Boeing employees work at Michoud. That number is expected to grow to about 120 by the end of next year. Steve Larson, Boeing facilities manager and the first employee hired at Michoud to support the Ares program, said of the progress being made at the facility in preparation for production, "It's exciting to see the construction work and the facility really starting to become the location for

WHITE HOUSE TO DECIDE COURSE FOR NASA HUMAN SPACEFLIGHT

In October, a 10-member independent committee appointed by U.S. President Obama to review the country's human spaceflight plans concluded that NASA needs increased funding of $3 billion a year to continue efforts to return to the moon using the current Constellation architecture that includes Ares I. The Review of U.S. Human Space Flight Plans committee, led by retired aerospace executive Norman Augustine, provided the administration several other options, including extending operations of the International Space Station to 2020 and replacing Ares I with commercial launch vehicles for low Earth orbit missions.

The committee's report followed months of public meetings, tours of NASA centers, and meetings with industry representatives and other experts. In June, Boeing Space Exploration leaders met in Huntsville, Ala., with members of the committee to share information about Boeing's role in space exploration and the capabilities Boeing offers for human spaceflight. Pat Schondel, Boeing vice president for Integrated Defense Systems Government Relations, said the report represents a wake-up call for the human spaceflight program by focusing attention on the critical funding challenges faced by NASA.

"We look forward to the president and his administration reviewing the findings of the committee and hope the severity of NASA's underfunding in exploration resonates with the president," Schondel said.

"Focusing on **performance and productivity** will ensure we continue to have a role in America's human spaceflight plans."

– Jim Chilton, Boeing's vice president of Exploration Launch Systems

Ares and Constellation work."

This isn't the first time Boeing has been at Michoud. In the 1960s, Boeing was the prime contractor of the first stage of the Saturn V, which propelled the massive moon rocket on the first leg of its journey into space. Boeing manufactured the first stage at Michoud.

"Boeing and the Michoud Assembly Facility have an impressive legacy of supporting human spaceflight. We're excited that we can once again team with NASA and the local community to continue that legacy," said Rick Navarro, Boeing director of stage operations for the Ares I and Boeing site leader at Michoud.

Before production begins, however, Boeing and NASA employees at Marshall Space Flight Center are developing the manufacturing and welding processes for the upper stage and avionics units.

"By doing this work at Marshall before production begins at Michoud, we can identify areas that need improvement, reduce costs and work through any issues prior to the start of actual production," Navarro said. "We also are ensuring Lean+ principles are instilled in the design and processes from the earliest stages of the program."

As the program has matured, the Ares team has reached out to experts across Boeing to utilize their experience and capabilities.

A team in Seattle is manufacturing an Ares I interstage test article (the interstage is the interface between the Orion, the Apollo-like crew capsule that will launch on the new rocket, and the Ares I upper stage). And employees from the Space Shuttle program in Houston have been sharing their vehicle and integration experience with their Ares counterparts, some spending significant time in Huntsville supporting the Ares team.

Sharing experience is vital to performing on existing contracts and winning new ones, Chilton said. "One of our strengths at Boeing is we can look across the company for knowledge and solutions to emerging challenges. Many, many people across Boeing own the success of the Ares team." ■

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UPPER STAGE

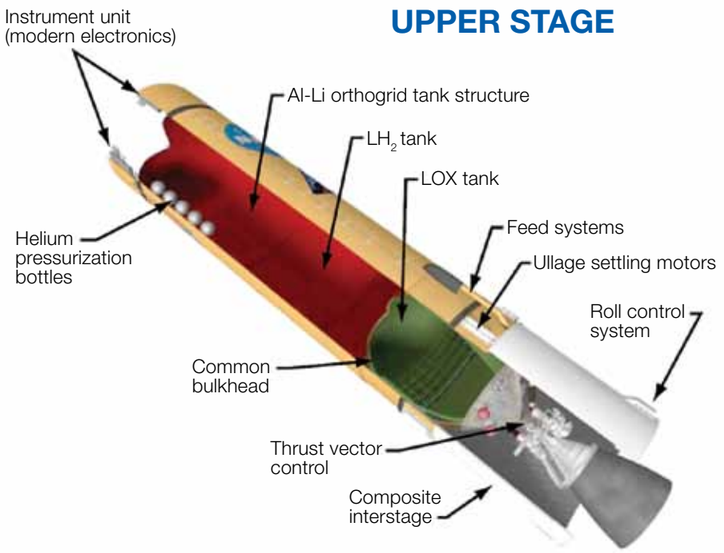

PHOTO: Boeing's Rebecca Ahern, Scott Scarberry and Bill McGee discuss the requirements for welding an Ares liquid hydrogen tank dome. In the background is a full-size dome test article on the robotic weld tool, one of the largest tools of its kind in the world, located at Marshall Space Flight Center in Huntsville, Ala. MIKE MCCORMICK/BOEING

GRAPHIC: Boeing is NASA's design and production partner for the Ares I second, or upper stage, and instrument unit avionics. NASA

Second harvest

Boeing's work on a terminated satellite program could yield bountiful technology for another

By Dave Garlick

Earlier this year, the U.S. Air Force terminated the competition for the Transformational Satellite Communications System program, much to the disappointment of a dedicated group of engineers in Space and Intelligence Systems who had spent five years developing a highly capable design.

The program was shelved due to shrinking budgets and shifting priorities within the U.S. Defense Department. But the need for the system's capability did not go away.

Fortunately, Boeing can potentially harvest and field some TSAT technologies on other platforms, such as Wideband Global SATCOM (WGS). The first two WGS satellites are in service over the Pacific and Middle East regions and a third is scheduled for launch by the end of this year. The WGS program is on track to field six satellites by 2013 and is already the Defense Department's highest-capacity communications satellite.

Upgrades to future WGS satellites could address two of the three major missions TSAT was intended to satisfy. "Because of our efforts on the TSAT program," said Mark Spiwak, WGS program director, "WGS can be evolved in a low-risk manner very effectively to meet the growing demand for Airborne Intelligence Surveillance and Reconnaissance and Anti-Jam Communications on the Move capabilities."

An enhanced WGS may not look too different from the current model, but it could perform in substantially new ways. "For a small incremental investment, we can offer the U.S. government upgraded WGS satellites with more than twice the capability of the existing design," Spiwak said.

Today's WGS design supports the Airborne Intelligence, Surveillance and Reconnaissance mission, and improvements already are planned for the fourth, fifth and sixth WGS satellites that will expand this capability even further—such as the bandwidth required to handle the huge amount of sensor and video data that is transmitted by the Global Hawk unmanned aerial vehicle.

Upgrades to WGS are just one of the options the Air Force is considering. The technology harvested from TSAT also could be adapted for use on other government or commercial satellites.

Mike Schavietello, WGS deputy program manager, pointed out that the Air Force made a large investment in TSAT and the technology could be lost if it is not used. It is not unlike the problem NASA faces as it sets its sights on a return to the moon 40 years after the Apollo missions, he said. The know-how will go away, people will move on to new jobs and the readiness level of the technology will erode," Schavietello said. "The moon shots used to be routine and now we find ourselves having to develop the technology all over again." ■

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"WGS can be evolved in a low-risk manner very effectively to meet the growing demand for Airborne Intelligence Surveillance and Reconnaissance and Anti-Jam Communications on the Move capabilities." – Mark Spiwak, WGS program director

GRAPHIC (Above): The Wideband Global SATCOM satellite, shown here in an artist's rendering. JIM SANTONI/BOEING

PHOTO (Left): Upgraded WGS satellites will support wideband data transfer from unmanned aerial vehicles. U.S. AIR FORCE

Crafting the EAGLE

Building a great jet fighter requires the right mix of automation and highly skilled workers **By Kathy Cook**

As a final assembly mechanic on the F-15 Eagle, Bret Nelson is one of the many Boeing men and women who employ "good ol' fashioned craftsmanship" to help build this advanced jet fighter that can fly almost three times the speed of sound.

"Building the F-15 is more like building a Rolls-Royce," Nelson said. "It has to be. It goes close to Mach 3, so everything must be looked at very closely."

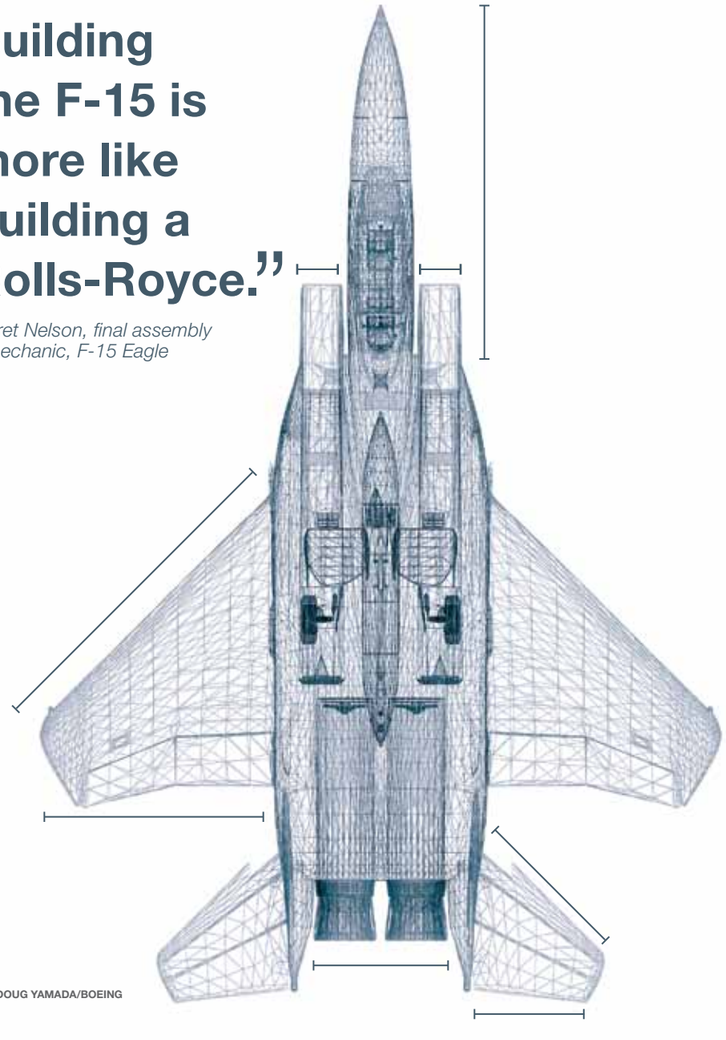
One of the longest-running production lines at Boeing, the F-15 first came off the line at Boeing's St. Louis facility in 1972. More than 1,600 of the jets have since flown for the U.S. Air Force as well as air forces in Israel, Japan, Saudi Arabia, Singapore and South Korea.

"If a segment of the manufacturing process can best be carried out through automation, such as drilling several holes in a precise formation to a certain depth, we use automation," explained Dan Schell, director of Assembly and Delivery Operations. "But we also depend on highly skilled artisans. That means people," he said.

Indeed, the human element is critical in building this complex, technology-packed jet fighter. "Because of what the plane has to do, the designers had to make it light and strong; it requires a lot of small parts. It's like doing a puzzle—you need hands and eyes to put it together the right way," said George Louis, sheet metal assembler and riveter on the F-15 aft assembly line. Some of the work areas are so small, according to Kendall Perry, subassembly sheet metal assembler and riveter, there isn't even room for a machine.

"Building the F-15 is more like building a Rolls-Royce."

– Bret Nelson, final assembly mechanic, F-15 Eagle



GRAPHIC: DOUG YAMADA/BOEING

"The F-15 requires a lot of skill in making sure everything fits and works together. If you can build an Eagle, you can build anything."

– Ron Steward, F-15 Quality inspector

GRAPHIC: DOUG YAMADA/BOEING

PHOTO: Electrician Barry Betz heat shrinks protective wrap over an electrical splice in an F-15 aft fuselage. PETER GEORGE/BOEING

PHOTO: Quality inspector Ron Steward checks F-15 assembly work. PETER GEORGE/BOEING

"When I think of what I bring to the F-15, I think it's the integrity of the aircraft," Nelson said. "Everything has to fit just right. There are a lot of components in a small space. As a mechanic, we utilize many tools to perform a great many functions. As we install, we check fit and clearances, adding that human factor, bringing quality to the final product," he said.

"We certainly have new technology—lasers, power-assisted tools; we have programs in the computers that help us," said Ron Steward, F-15 Quality inspector. However, "More skill goes into building an F-15 than other types of products. It's not a 'snap-together' product like a car. The F-15 requires a lot of skill in making sure everything fits and works together. If you can build an Eagle, you can build anything."

The F-15 line includes five shops where workers assemble parts into complex subassemblies that ultimately become part of larger sections of the aircraft. The subassemblies feed teams who build the fuselage frame before workers move on to the 'skinning,' or fastening the metal skin of the aircraft over the framework.

That work goes beyond assembly to include dozens of hours of training, with annual refreshers for critical tasks such as fuel operations or installing pyrotechnics.

As the F-15 has evolved, Boeing also has evolved its manufacturing. Key to these improvements has been input from the people who build it every day.

A primary source of ideas to improve and refine manufacturing processes has been High Performance Work Organizations, or HPWOs. These are groups of co-workers who are responsible for a common function

> **"It's the people who make the Eagle the great plane it is."**
>
> *– Don Rogers, superintendent of Flight Operations, St. Louis*

or product, share common goals, and who are committed to continuously improving the quality of output. "HPWOs are responsible for a wide range of innovations on the shop floor that go beyond how to safely build the jet and touch on how to improve the capability of the Eagle," said Andy Stark, superintendant of the F-15 center fuselage line.

"Thanks to HPWOs, we've taken the 'I' out of it, and now it's 'we.' It's about the team. It's more personal, like owning our own business. With ownership, you want the best quality product for your customer," said Ada Turner, sheet metal assembler and riveter and lead on F-15 Center Fuselage.

"We couldn't build this plane without the knowledge of our assembly workers," said Bill Richards, F-15 Final Assembly superintendent. Added Schell: The use of technology where it makes sense, plus "a well-trained and experienced work force, combined with standard work instructions and strict disciplines, results in the high-quality, high-tech products our customers have come to expect from Boeing."

Don Rogers, superintendent of Flight Operations in St. Louis, sums it up best: "It's the people who make the Eagle the great plane it is." ■

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PHOTOS: (Top) A Strike Eagle from the U.S. Air Force's 48th Fighter Wing. KEVIN FLYNN/BOEING

(Above left) Ada Turner, sheet metal assembler and riveter and lead on F-15 Center Fuselage, performs drilling operations. PETER GEORGE/BOEING

(Above right) Sheet metal assembler and riveter Matthew Nicol inspects an F-15 under construction. PETER GEORGE/BOEING

(Right) Assembly mechanic Sean Koh prepares F-15 structure for skin panels at the Installation and Test Station. PETER GEORGE/BOEING

Back to the *future*

Boeing team in Australia develops advanced communications system using 'old' technology

By Fiona Tristram

A Boeing Defence Australia team has achieved another first in high-frequency technology, and in the process changed the way the capability can be used in modern communications.

The Modernized High Frequency Communications System, or MHFCS, designed and built by Boeing Defence Australia, will help bring high-frequency communication back into vogue after being considered "old technology."

"Boeing's High Frequency Modernization Program team has built and delivered the most advanced high-frequency system in the world," said Nan Bouchard, vice president and general manager of Boeing Command, Control & Communications Networks. "This is an outstanding achievement and a true indication of Boeing's commitment to developing advanced technology solutions globally for our customers."

Successfully introduced into Australian Defence Force operations in September, the system can securely transmit voice and data services such as e-mail, facsimiles and the Internet in areas where traditional telephone services are limited or unavailable. It is considered the world's most advanced strategic high-frequency communications network because of its automation levels, range and clarity, traffic volume, and connection speed.

It will be used on a number of Australian Defence Force platforms, including Collins Class submarines, Air Warfare destroyers and AP-3C Orion aircraft. It is designed to improve immediate communication transmissions between mobile platforms and land personnel or facilities, without the need for third parties to create a connection.

PHOTO: An "antenna rosette" used in Boeing's Modernized High Frequency Communications System. The antenna is designed and manufactured by Radio Frequency Systems. RADIO FREQUENCY SYSTEMS

Stephen Hudson, chief engineer for the new communications system, compared its development to building a 3G cellular telephone network, but using high-frequency communications. "If you think about the cell phone you use every day, it requires thousands of base stations to transmit and receive your calls and texts," he said. "With MHFCS, because we are using high-frequency technology, we only require four stations to provide a similar global communications service."

The system, which Boeing Defence Australia will market internationally, can communicate with distant ships, aircraft and ground units and operates as a backup to satellite communication systems. And for the first time, the system provides Australia with national sovereignty over its communications in case of conflict.

Steve Parker, vice president and general manager of Boeing Network and Space Systems, Australia, said the system has the capacity to change high-frequency communications globally. "It can provide nations with the highest level of global connectivity while, for the first time, maintaining national sovereignty and information security.'' ■

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Water World

Boeing employees work in world's largest indoor swimming pool supporting the International Space Station. By Adam Morgan

Matt King, Systems engineer on Boeing's International Space Station program, ate his bowl of cereal just like any other morning. But unlike most days, King would not be putting on his slacks, button-down shirt and tie. Nor would he later be sitting at his desk performing procedure reviews in support of NASA, or any of his other tasks related to the day-to-day operations of the International Space Station.

Instead, King donned swimming trunks and loaded about 50 pounds (23 kilograms) of scuba [self-contained underwater breathing apparatus] gear to his back. Then he jumped into the world's largest indoor swimming pool.

He is one of three Boeing employees qualified to dive with NASA in its Boeing-designed Neutral Buoyancy Laboratory. The facility provides controlled neutral buoyancy operations to simulate the zero-g, or weightless, condition that is experienced by spacecraft and crew during spaceflight. For astronauts, the facility provides important preflight training for spacewalks: Large, neutrally buoyant items have an equal tendency to float or sink and can be easily manipulated, much like in orbit.

On this morning, King was trying to find possible solutions for an access issue recently encountered on the space station. One to three times a month, on average, Boeing employees dive into the lab at NASA's Sonny Carter Training facility in Houston. There they work with NASA providing mission, training and design support, input on on-orbit hardware construction, and other tasks as part of Boeing's space station support contract. When not getting wet, the Boeing employees travel to the facility several times a week to support NASA spacewalk training.

"Many times," King said, "we'll play an active role in the dives where we're down there right in the middle of the action looking for solutions to problems or finding a better way to install hardware. Sometimes our role is more passive, where we are observing what the astronauts are doing, and we look for issues that might arise on orbit. The majority of the time we are observing, but those observations often can lead to improvements in processes or opportunities to dive at a later date, so they are very important." Boeing is the prime contractor to NASA for the space station. In addition to designing and building all the major U.S. elements, Boeing also is responsible for ensuring the successful integration of any new hardware and software, including components from international partners, as well as for providing sustaining engineering work.

To be considered for one of Boeing's diving positions, employees must first obtain their scuba certifications from a nationally recognized organization. The diver then must pass a NASA physical along with the space agency's own buoyancy lab certification, which includes showing proficiency in tasks specific to the lab.

"The diving environment in the [Neutral Buoyancy Lab] is quite a bit different than the typical open-water scuba diving," said Juan Reyes, Systems engineer for Boeing's space station program. "We are diving around a lot of equipment, so there is a great potential for you or your gear to get snagged."

"When I first started with Boeing as an intern in 2004, I never imagined that part of my job description would be diving with astronauts," King said. ■

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NASA's Neutral Buoyancy Lab, which was designed by Boeing, is recognized as the largest indoor pool in the world. It measures 202 feet (62 meters) long, 102 feet (31 meters) wide and 40 feet (12 meters) deep, half above ground level and half below. It holds 6.2 million gallons (23.5 million liters) of water. Even at this size, a full-size space station mock-up must be configured differently to fit into the pool. Often, the International Space Station configuration is changed to fit training needs.

PHOTO: Matt King (left) and Juan Reyes join NASA divers in the Neutral Buoyancy Laboratory in Houston. The two Boeing employees are pictured with full-size mock-ups of the International Space Station in the background, including the ISS truss structure, which is the "backbone" of the station. NASA

Texas **3-step**

Boeing's Houston site proves to be a triple performer when it comes to the environment

By Adam Morgan and photos by Elizabeth Morrell/Boeing

In a quiet setting deep in the heart of Texas, Boeing employees often spend the lunch break outside. Here they stroll along man-made ponds surrounded by tall Texas pines that provide shelter to several native wildlife, including birds, squirrels, deer, frogs and ducks.

This peaceful setting is the Bay Area Boulevard building—the cornerstone of Boeing's Houston site. The 339,000-square-foot (31,500-square-meter) building sits on a 21-acre (8.5-hectare) lot tucked away in a wildlife environment at the border of metropolitan Houston and the wetlands of the Texas Gulf Coast.

Recognized in 2008 by the local ABC news affiliate as one of "Houston's Best Places to Work," the Houston site is viewed by many employees as a great setting to keep morale high amid the fast-paced, bustling city life.

"This is a place where employees can see how important our environment truly is and the positive impact it can have on our daily lives," said LaDonna Handugan, Systems engineer for Boeing's International Space Station program and Community Involvement co-chair for REACH Houston, a networking organization for recent college graduates and new hires at Boeing.

With more than 2,500 employees, the Houston site serves as the official headquarters for Boeing Space Exploration, which includes Boeing's Constellation, International Space Station and Space Shuttle programs. Combat Systems, Global Services & Support, and Boeing Research & Technology are also represented at the site.

"This is a place where employees can see how important our environment truly is and the positive impact it can have on our daily lives."

– LaDonna Handugan, Systems engineer, Boeing International Space Station program

Employee action to preserve the environment received recognition recently when the Houston site achieved not only its LEED and ISO 14001 certifications but also its ENERGY STAR labeling for the Bay Area Boulevard building—the first Boeing building to achieve LEED Gold status for existing construction and the first site to carry all three of these major environmental standards.

"These certifications lay the foundation for continually improving our environmental performance for reducing pollution and waste, increasing recycling rates and improving energy efficiency," said Brewster Shaw, vice president and general manager for Boeing Space Exploration and Houston site leader.

Reaching this level of environmental achievement did not happen overnight.

After Boeing bought the six-story granite and glass building in 2004, a planning team began looking into ways to provide a more comfortable work environment and minimize the building's energy consumption, according to Bill Richard, Houston Site Services manager.

By retrofitting the air-conditioning and heating systems, along with installing more-efficient lighting and automated controls, energy consumption at this facility was reduced by more than 2 million kilowatt hours annually, or enough electricity to power about 170 homes.

"Like much of the work we perform in Houston, the upgrades we've made to our building operations are on the cutting-edge of technology," said Paul Diggins, Houston site director.

For example, if employees work outside peak hours, they can call a phone number, enter their area's code and expected duration for which they'll need light, and the lights will automatically stay on during the set time.

The building air-conditioning control system is pretty smart, too. It learns over time and tunes itself to maximize efficiency by monitoring many variables such as heat loads from people and lights, outside humidity, and air temperature. The system has saved the site $250,000 per year since it was installed in 2007.

For more information on Boeing's environmental efforts, view the company's 2009 Environment Report at www.boeing.com/environment or visit the Environment Information Center at http://ehs.web.boeing.com/enviro on the Boeing intranet. ■

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PHOTOS: (Far left) The Bay Area Boulevard building in Houston is the first Boeing facility to be recognized for achieving three environmental standards. **(Above left)** Rick Rivas checks air-conditioning control system gauges at the Houston site. **(Above right)** Employees often take their breaks walking trails on the 21-acre (8.5-hectare) Houston site. From left are David Miller, Cables & Fluids Verification engineer; LaDonna Handugan, Systems engineer; and Daniel Nishimura, Business & Planning analyst—all with Boeing's International Space Station program.

The U.S. Green Building Council's Leadership in Energy and Environmental Design, or LEED, green building certification system is the foremost program for the design, construction and operation of green buildings. The International Organization for Standardization, or ISO, established the ISO 14001 as a global standard to continually improve an organization's environmental goals. The ENERGY STAR program, which is co-sponsored by the U.S. Environmental Protection Agency and the Department of Energy, is dedicated to helping businesses and homeowners save money and protect the environment through energy-efficient products and practices.

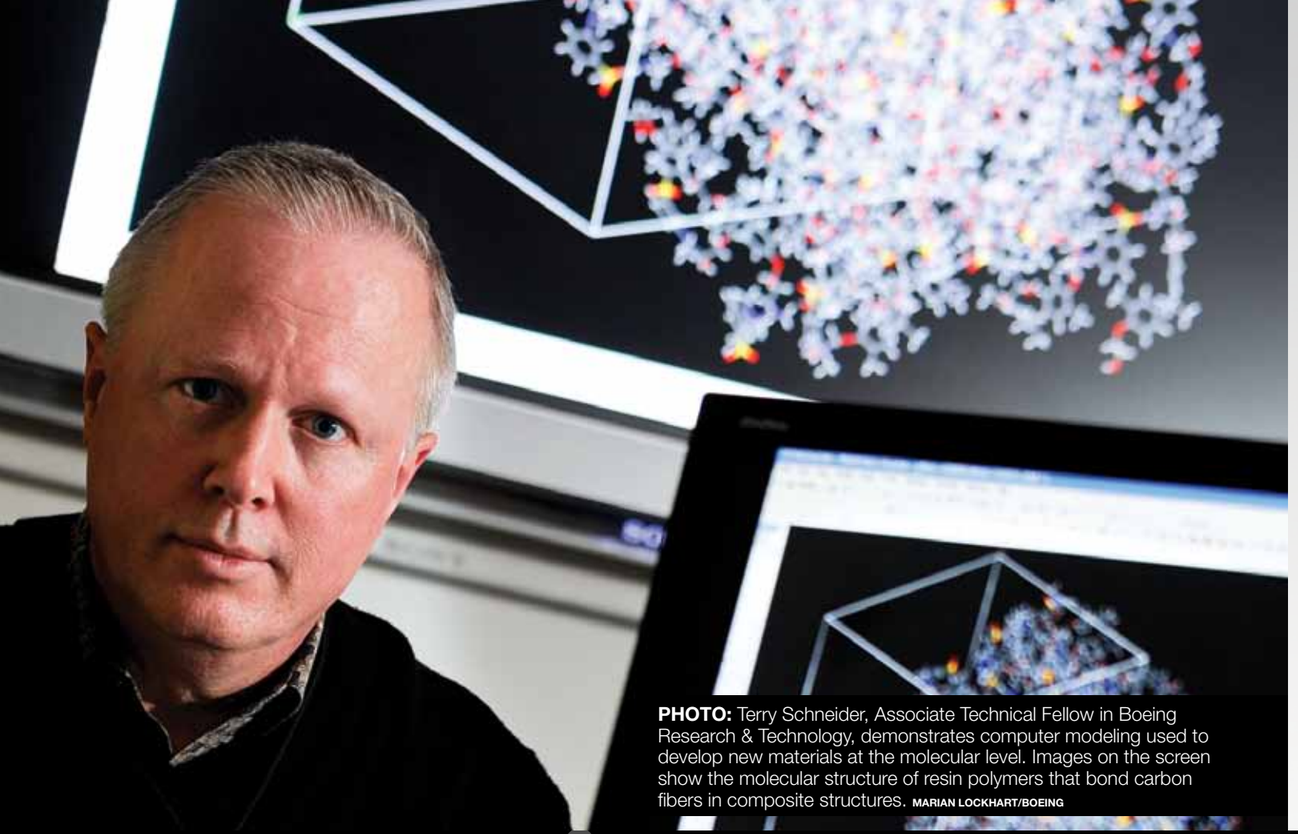

PHOTO: Terry Schneider, Associate Technical Fellow in Boeing Research & Technology, demonstrates computer modeling used to develop new materials at the molecular level. Images on the screen show the molecular structure of resin polymers that bond carbon fibers in composite structures. MARIAN LOCKHART/BOEING

Atoms **to airplanes**

New structures technologies, developed across Boeing, are helping accelerate product development **By Bill Seil**

Terry Schneider, an Associate Technical Fellow in Boeing Research & Technology, works in "atoms to airplanes" modeling, or the complete process of modeling an airplane computationally from a molecular level up to the full-scale, complete airframe.

One important goal of this work is to optimize the chemistry of polymers to increase the load-carrying capability of the carbon fiber in composites, which could significantly reduce the weight of next-generation composite structures.

"This is exciting work because we're able to rapidly assess hundreds of polymer candidates in a matter of weeks—a process that might take years in a lab," Schneider said. "We're also able to quickly determine their performance in large-scale laminated structures and screen for the best-performing candidates. This opens the door to huge cost savings in the future."

Work such as this demonstrates the benefits to Boeing generated by the company's enterprisewide approach to making research investments in key areas such as structures, a term that describes the physical airframe components of airplanes and other aerospace products. Critical aviation design issues—including weight, reliability and safety—all depend on the quality of research and planning that drives structures engineering.

Boeing has long been a leader in structures technology, and research conducted throughout the enterprise has steadily improved the design of structures and the materials used to make them. The challenge today is to increase the company's competitive edge by investing in research that generates maximum benefit for Boeing's range of products, both commercial and military.

That's why, in 2008, the company created its Enterprise Technology Strategy (ETS), which takes a coordinated, "One Company" approach to technology development. The strategy is built around eight technology areas, or domains, that support Boeing's many business programs and can create a sustainable technical competitive advantage that helps the company grow.

Among these domains is Structures, which has two broad areas of research. First, it looks at the methods, tools and processes that go into the design of new structures, as well as advanced structural architectures. Second, it develops new materials for use in aerospace products. Company-funded materials research, for example, has led to the development of commercial airframes made from composite materials, as used in the 787 Dreamliner.

Structures engineers refer to structures as "the bread and butter of everything that flies." And the Structures domain brings people together to ensure the best of technology—and the best of the enterprise—goes into Boeing products.

Like the other domains, Structures taps into research talent around the world, including teams at universities, corporations and aerospace suppliers. Advances in materials development have taken a major leap with the use of computer modeling at the molecular level, said domain leader Andy Bicos.

"With today's software, we can design materials on a computer and work with material suppliers, who produce it and send us samples," Bicos said. "We then test the samples to see how close to the designed properties the actual supplier-made material has come."

While many factors are considered when developing a new material, the ultimate goal is increasing performance while driving down weight and cost. Right now, composites are offering the greatest opportunity for improvement. But Bicos noted that metals can always make a comeback, depending on program requirements and technology advancements. The domain is continuing to look at new aluminum alloys that could be competitive with composites.

Research also is taking place to create structures that support additional functions. For example, designing health management systems into structures could help identify abnormalities before they become problems. Or aircraft wiring could be integrated into structures, rather than attaching it by brackets.

Rod Dreisbach, Senior Technical Fellow adviser to the Structures domain, said the potential of multifunctional structures, along with other new technologies, underscores the importance of the eight domains working together.

"The domains aren't independent silos," Dreisbach said. "As we find new ways to coordinate their activities, we'll greatly enhance their overall effectiveness."

Akif Bolukbasi, a Senior Technical Fellow who serves as Structures domain leader for Integrated Defense Systems, said the synergies resulting from the domain system are of great value to IDS. For example, research into composite structures conducted by Boeing Research & Technology and Commercial Airplanes has a number of possible applications in Integrated Defense Systems.

Good cross-domain planning and coordination helps develop research projects that address high-priority business opportunities and capability gaps, along with technical requirements, in time for Boeing to present a winning bid, according to Bicos. This approach reduces the chances of individual programs engaging in overlapping research. Ultimately, the domain comes up with a research portfolio that falls

"Our job is to find and put the best available structures and materials on airplanes. The domain is helping us to do that better and faster."

– Randy Coggeshall, Structures domain leader, Boeing Commercial Airplanes

PHOTO: Terry McClure, a quality assurance technician in Seattle, inspects the world's largest aerospace-grade structural component built using advanced out-of-autoclave processing technology. The successful Out-of-Autoclave Launch Vehicle Shroud Demonstration was a major step toward economically building the large-diameter composite structures needed for NASA's future development of heavy launch vehicles. GEOFF BUTLER/BOEING

into “core technology” areas—needs that are essential to the company’s programs (see sidebar below). In addition, the executive level identifies “key technologies,” research given the highest importance.

Jerry Young, director of Structural Technology with BR&T, said the business units were working together prior to the introduction of the domains, but the new structure enhances this collaboration by creating more formal processes. The domains also give senior management a clearer picture of research taking place across the enterprise.

Engineers across Boeing are involved in important “computational materials” work—materials development done on computers, Young noted. In Southern California, engineers are using computers to develop new re-entry and ablation systems for space vehicles. St. Louis engineers are working with universities to simulate next-generation titanium and aluminum materials. Computer simulations of polymers and coatings are taking place in the Puget Sound area.

“This is the perfect laboratory because computers can simulate a material or experiment multiple times and the results will come out the same,” Young said. “When you do this in the real laboratory the results may be consistent, except for one instance. Then you have to go back and find out why that happened.” ■

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This article is part of a continuing series that looks at the Enterprise Technology Strategy and its eight Technology Domains. Here are the previous stories in the series.

Introduction to the ETS and the domains: May 2008, Page 41

Support & Services Domain: October 2008, Page 38

Systems Engineering & Analysis Domain: November 2008, Page 38

Platform Performance Domain: August 2009, Page 38

PHOTO: Andy Bicos, Structures domain leader, stands behind an oxide-based ceramic matrix composite structure at Boeing’s Ceramics Development Lab in Huntington Beach, Calif. The cylindrical demonstration unit will help Boeing evaluate new opportunities for ceramics in thermal protection and structural applications. MICHAEL GAIL/BOEING

At the core of the matter

The Structures domain organizes its research activities around these core technologies:

- **Multifunctional structures:** Optimize the design of airframes and other structures by incorporating systems, wiring or other functionalities.
- **Advanced methods and tools for integrated design:** Develop next-generation analysis methods and tools, as well as enhancements to the current set of tools.
- **Performance-driven materials:** Discover, create and mature new material system product forms that enable breakthrough system performance at an affordable cost. Areas of research include next-generation composites, ceramic composites, advanced metals and emerging materials.
- **Structural concepts development:** Explore structural concepts that would achieve breakthrough weight and cost performance.
- **Rapid certification and qualification:** Develop and strategically implement innovative methods to accelerate and integrate material development, qualification, testing and structural certification in less time and with less cost compared with traditional methods.

MINDing business

Boeing honors its top innovators, whose ideas are crucial to the company’s long-term success

By Cindy Naucler Glickert

At this very moment, people in Boeing are working on the latest breakthroughs in science and finding new ways to replicate previous ideas. These innovative thinkers are supporting the company’s growth, productivity and long-term success with new ideas that sharpen Boeing’s competitive edge.

Each year, Boeing honors its top innovators. At the 2009 Boeing Special Invention Awards and Technical Replication Awards regional ceremonies, held in September and October, 93 employees were honored for their recently patented inventions or innovative replications of previous inventions.

“Each of these innovators truly represents the best in striving to find new ways, chart new courses and inspire others,” said Martha Ries, Intellectual Property Management vice president. This organization sponsors the annual Special Invention Awards program and is responsible for teaming with employees to identify, protect and leverage the company’s intellectual property. “These inventions enhance Boeing’s product performance, improve productivity, increase safety, reduce costs and enable new business opportunities,” Ries said.

This year marked the debut of the Technical Replication Awards. This honor recognizes Boeing inventors for replicating the most successful innovations and implementing them on other programs—which drives product and process improvements.

“It takes both the technical invention and the understanding of common requirements to replicate a solution,” said Amy Buhrig, director of the Boeing Enterprise Technology Strategy and executive sponsor of the Technical Replication Awards. “The efforts of these technical replicators to collaborate and inspire others bolsters our competitive advantage.” ■

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Meet some of Boeing’s top innovators in the following pages.

2009 honorees and their innovations

NORTHWEST REGION

SPECIAL INVENTION AWARDS

David L. Allen, Edward J. Porisch, Mary Ann T. Nakasone, Bruce K. Pollock and Kent Loving: *Multi-Network Aircraft Communication Systems and Methods*

David W. Massy-Greene, Hai Nguyen and John B. Sims: *Method and Apparatus for Loading Software Aircraft Parts*

James T. Farricker, Garry G. Herzberg, Paul S. Stout and Joshua A. Taylor: *Router for Establishing Connectivity Between a Client Device and On-Board Systems of an Airplane*

Kevin S. Callahan, Trevor M. Laib and Bradley J. Mitchell: *Cut to Fit Powered Seat Track Cover*

James N. Buttrick Jr., Roger A. Gage, Darrell D. Jones and Theodore M. Boyl-Davis: *Methods and Apparatus for Track Members Having a Neutral-Axis Rack*

David F. Topping: *Linked Aircraft Reliability and Solution Analysis System and Method*

David S. Kinney, John B. Maggiore, James L. Millar and Sean A. Newsum: *Method and Apparatus for Obtaining Vehicle Data*

Lawrence S. Baum, Molly L. Boose and John H. Boose: *Intelligent Graphics Plug Map System and Method of Use*

Timothy Aldrich: *The Security Monitoring Infrastructure System; Method and Systems for Anomaly Detection Using Internet Protocol Traffic Conversion Data*

Richard H. Bossi, Gary E. Georgeson, Hong H. Tat, Michael D. Fogarty and Stanley W. Richardson: *Hybrid Inspection System and Method Employing Both Air-Coupled and Liquid-Coupled Transducers*

James R. Underbrink: *System and Method for Adaptable Aperture Planar Phased Array*

Michael D. Fogarty, Gary E. Georgeson, Lyle R. Deobald and Daniel J. Wright: *System and Method for In-Situ Monitoring of Composite Materials*

Norman J. Englund and John S. Finigan: *Compliant Coupling Force Control System*

Kevin E. Clark, Richard K. Johnson, Jon P. Michel and Michael L. Gilbertson: *Clamp for Securing an Object to a Structure*

TECHNICAL REPLICATION AWARDS

James N. Buttrick Jr., Todd M. Harris, Barry Faulkner and Edward E. Feikert: *Flex Track Drilling Applications*

Arlene Brown, Russell J. Heeter, James T. Iwamoto and Diane L. Heidlebaugh: *Lightweight Expanded Aluminum Foil*

MIDWEST REGION

SPECIAL INVENTION AWARDS

Steven J. Miener and Kevin L. Brown: *Illuminated Optical Inspection Prism Apparatus*

Christopher S. Huskamp: *Method and Apparatus for Direct Manufacturing Temperature Control*

Peter A. Derenski and Kevin Julian Chang: *Aerial Refueling Receptacle Raised Fairing Marking*

Dennis K. McCarthy and Daniel D. Wilke: *Automated Damage Assessment, Report, and Disposition*

Charles E. Goodman and William B. Hayes: *Methods and Apparatus for Analyzing Flutter Test Data Using Damped Sine Curve Fitting; Method and Apparatus for Evaluating Data Representing a Plurality of Excitations of Sensors*

Thomas A. Zientek: *Uploaded Lift Offset Rotor System for a Helicopter*

Brian D. Laughlin: *MIN/MAZ Inventory Control System and Associated Method and Computer Program Product*

TECHNICAL REPLICATION AWARDS

Jeffrey A. Johnson, Michael J. Moss, Kathryn R. Flaspohler, Dan Harrington, Lorne M. Mitchell, Andrew W. Krisby, Brian W. Fuesz, Darrell R. Bearce and Erik N. Auger: *Analytic Framework for Network Enabled Systems*

Edward E. Feikert, (and honored in Northwest Region awards: James N. Buttrick Jr., Todd M. Harris and Barry Faulkner): *Flex Track Drilling Applications*

SOUTHWEST

SPECIAL INVENTION AWARDS

Kevin Julian Chang (and honored in the Midwest Region awards: Peter A. Derenski): *Aerial Refueling Receptacle Raised Fairing Marking*

Roger W. Clark, David J. Manley, Arvin Shmilovich and Yoram Yadlin: *System for Aerodynamic Flows and Associated Method, and the Lift Augmentation System and Associated Method*

Eric T. Burke, Michael E. Haws and Scott Kiefer: *System Diagnostic Utility*

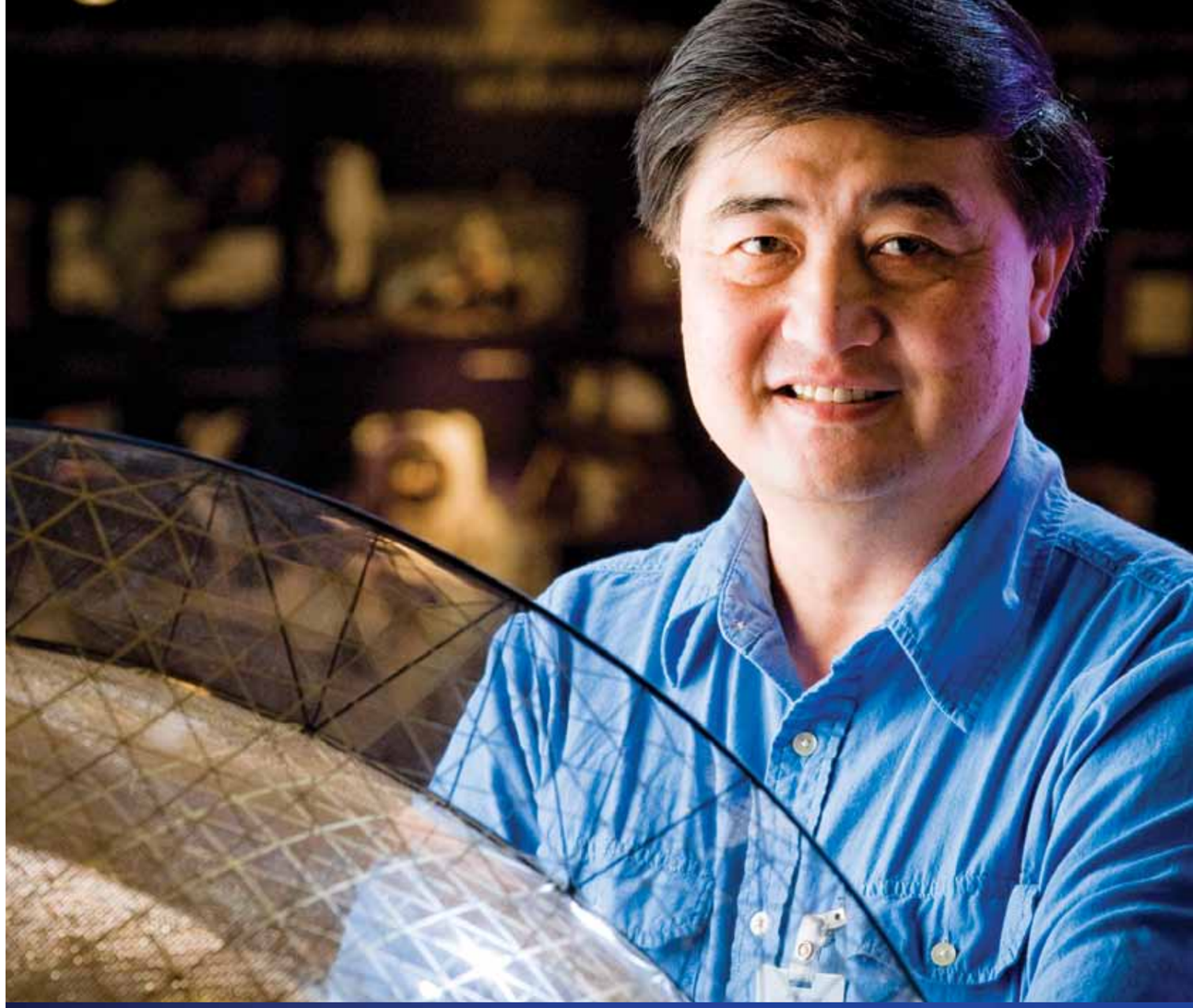
Che-Hang Charles Ih: *Dynamic Modeling Technique for the Deployment of Large Satellite Antennas*

Steven G. Keener and Cesare Peralta: *Hybrid Fastening System and Associated Method of Fastening*

Jeffrey H. Hunt and Tom Gylys: *Wavefront Correct System, Fiber Gain Medium and Method of Coupling Pump Energy into the Same, and High Speed Beam Steering/Field of View Adjustment*

TECHNICAL REPLICATION AWARD

Gordon E. Letney, Joseph E. Catlin, Herbert H. Kempin, Kerry Hu, Michael A. Cooper, Dave A. White and Timothy M. Force: *LabNet*



Meet the innovator: **Charles Ih**

One of the most vexing challenges in deploying satellites with large antennas is predicting the attitude control performance during antenna deployment once the spacecraft reaches higher Earth orbit. It's impossible to test on the ground. That's why Charles Ih's invention, Dynamic Modeling Technique for Deployment of Large Satellite Antennas, is considered a breakthrough. Ih's invention produces computer-generated high-fidelity models that let engineers precisely predict the performance of a satellite's antenna deployment.

"We used the high-fidelity modeling technique to predict the attitude controller performance before launching the Thuraya D1 satellite, which has a huge L-band antenna, and it was a tremendous success," said Ih, an Integrated Defense Systems Associate Technical Fellow for Space & Intelligence Systems, who is based in El Segundo, Calif. "Since then, this technology has become a gold standard for modeling the deployment of future, similar Boeing spacecraft because it can be generated quickly and accurately."

Ih's work has had far-reaching impacts on winning and executing subsequent satellite contracts as well as enhancing Boeing's leadership in this competitive industry. He was one of six innovators in the Southwest Region to win the 2009 Special Invention Award. **PHOTO: PAUL PINNER/BOEING**

Meet the innovator: **James Buttrick**

James Buttrick is the first to point out that many people helped him design the Flex Track Drill. But Buttrick, a Commercial Airplanes Technical Fellow with Materials & Processes Technology in Everett, Wash., led a team in replicating the technology. The device, which has improved safety and quality while saving time and costs, is a portable, automated machine for precisely drilling contoured and flat surfaces of large aircraft structures.

The drill, about the size of a microwave oven, travels on flexible interlocking rails, which are vacuum-attached to the aircraft and can wrap around a fuselage, run across a wing, or traverse contoured aircraft sections. Used first for building parts for the F-15 jet fighter, it has since been replicated for use on 787 Dreamliner wing assembly and vertical fin. It is being developed for implementation on the 777 fuselage.

Key to making the replication a success, he said, was having people such as Mike Vander Wel, who leads the Enterprise Technology Strategy's Manufacturing domain, recognize the technology would bear fruit and support its funding. "Also important was having people who sweat the details—the engineers, programmers and machinists. The replication award is really an acknowledgment of those who made the system a success," Buttrick said.

The Flex Track Drill has resulted in several patents, and the technology has been licensed for sale outside of Boeing, which generates royalties for the company. It was selected as one of four Boeing 2009 Technical Replication Awards. **PHOTO: ED TURNER/BOEING**

And the winners are…

Dozens of Boeing employees are recognized every year by external technical affiliations for their achievements and contributions to science, technology, engineering and math. Here are those recognized in 2009.

AMERICAN HELICOPTER SOCIETY

Howard Hughes Award: The Smart Materials Actuated Rotor Technology Team, including Ram Janakiram and Friedrich Straub

Paul E. Haueter Award: Philip Dunford

Harry T. Jensen Award: The Army/Industry Apache Health Monitoring Team, including Hieu Ngo and Perumal Shanthakumaran

Robert L. Lichten Award: Laura Buck

Francois-Xavier Bagnoud Award: Andrew Elliot Augenstein

AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Distinguished Service Award: David Knowlen

Fellows: Kevin Bowcutt, Dale Pitt and John Vassberg

Associate Fellows: Kenneth H. Landis, Darby G. Cooper, Michael T. Kezirian, Joseph S. Brinker, Richard Y. Chiang, Marty K. Bradley, Michael L. Drake, Stanley D. Ferguson, Paul M. Vijgen

Technology Pioneer Award: Airborne Laser System Development Team

Network/Information Technology Award (for Philadelphia section): V-22 Network Centric Operations Team

Sustained Service Award: Vera Martinovich

Mechanics and Control of Flight Award: Eugene Lavretsky

Space Operations and Support Award: Tracking Data and Relay Satellite–I Recovery Team

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Conference for Industry and Education Best Moderator: Terri Morse

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Computers and Information in Engineering Leadership Award: Rod Dreisbach

Old Guard Early Career Award: Kalan Guiley

AMERICAN SOCIETY FOR TESTING AND MATERIALS

W.T. Cavanaugh Memorial Award: Laura Hitchcock

ASIAN AMERICAN ENGINEER OF THE YEAR

Asian American Engineer of the Year Award: Jae H. Kim, Thomas T. Bui, Jayant D. Patel

ASM INTERNATIONAL–THE MATERIALS INFORMATION SOCIETY

Gold Medal for the Advancement of Research: James McNerney

ASSOCIATION OF OLD CROWS MARINE CORPS OUTSTANDING UNIT AWARD

Program Manager Award: Michael K. Gibbons

BLACK ENGINEER OF THE YEAR AWARDS

Stars and Stripes Award: Leo A. Brooks

Career Achievement in Industry Award: Jim Wigfall

Modern Day Technology Leaders Award: Jamie Haynes, Delano Lewis, Obinna Orjih, Jerry F. Turley

CAREER COMMUNICATIONS

Most Important Blacks in Technology: Joan Robinson-Berry and Jim Wigfall

HISPANIC ENGINEER NATIONAL ACHIEVEMENT AWARDS CONFERENCE

Hall of Fame Inductee: John J. Tracy

The Chairman's Award: Alejandro (Alex) M. Lopez

Community Service: Mina Martinez

Luminary Award: Valerie Perez, Erika Sanchez

Role Models of the Week: Alfredo Rodriquez, Randy Lander

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

Presidents Special Citation Award (for commitment to promoting diversity in the technical work force, in partnership with IEEE): Boeing

Outstanding Large Company Award (Region 5): Boeing

INSTITUTE OF INDUSTRIAL ENGINEERS

UPS Minority Advancement Award: Majid Abab

Engineering Educator of the Year Award (Puget Sound): Steve Snelling

NATIONAL ORGANIZATION OF GAY AND LESBIAN SCIENTISTS AND TECHNICAL PROFESSIONALS

Engineer Award: Anthony J. Gingiss

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Engineer of the Year Award (Missouri): Stephen A. Hutti

Outstanding Engineering Achievement (Pennsylvania): Philadelphia Wind Tunnel Modernization

ORGANIZATION OF CHINESE AMERICANS

Honoree: Gordon Keh

SAE INTERNATIONAL

Engineering Aerospace Leadership Award: John Tracy

Aerospace Chair Award: Sanford Fleishman, June Ogawa, David Amirehteshami

Franklin W. Kolk Air Transportation Progress Award: Sham S. Hariram, Sharanpal (Paul) Sikand

Marvin Whitlock Award: Sham S. Hariram

Forest R. McFarland Award: David Amirehteshami, Clayton Monk

Technical Standards Board Outstanding Contribution Award: Edward Bayne

SOCIETY OF LOGISTICS ENGINEERS

President's Award for Merit: Harry Fanning II

SOCIETY OF WOMEN ENGINEERS

SWE Achievement Award: Aslaug Haraldsdottir

SWE Fellow: Sandra Postel (retired)

Young Engineer of the Year Award (Puget Sound): Kelly Griswold

WOMEN OF COLOR IN TECHNOLOGY

Technologist of the Year Award: Norma Clayton

Professional Achievement Award: Susan Ying

Managerial Leadership Award: Nancy-Kim Yun

Technology All-Stars: Christina Chiu, Grace Jiang, Wanda Robinson, Yun-Ho Sikora, Renita Young

Technology Rising Stars: Madeline Augustin, Anjali Mehra

Meet the innovator: **Molly Boose**

It may be easier to find a needle in a haystack than to navigate an aircraft's electrical system, which can include miles of wiring and thousands of connectors and plugs. That's why Molly Boose and her co-inventors came up with the Intelligent Graphics Plug Map.

"The invention is a software system that uses pattern recognition to automatically understand the pin layout." said Boose, a Technical Fellow with Boeing Research & Technology in Seattle. A technician can easily retrieve information on the proper way to repair wires or fix a broken pin in a plug.

The IG Plug Map can process hundreds of diagrams within minutes, which if done manually would take hundreds of hours. It improves a technician's ability to troubleshoot an electrical problem, saves maintenance time, reduces costs and ultimately improves safety.

"Many problems can be overwhelmingly complex and people may tell you 'it can't be done,'" Boose said. "But I believe if you face a problem by envisioning the solution, you'll find a way.

"Over the past decade, we've submitted 16 intelligent graphics inventions and each time the Intellectual Property Management organization has guided us through the process—coaching us on writing disclosures, instructing us on patent protection rules and even defending several of our patents," she said.

The IG Plug Map is one of 14 inventions in the Northwest Region to receive the Special Invention Award. PHOTO: ALAN MARTS/BOEING

Meet the innovator: **Pete Derenski**

As a former U.S. Air Force pilot with more than 5,000 hours of flying, Pete Derenski knows firsthand the challenges of refueling in flight. It's hard enough to line up two airplanes 30 to 40 feet (9 to 12 meters) apart while they're traveling at 400 miles per hour (645 kilometers per hour). But at night?

"So when Julian Chang, my good friend and co-inventor, said there had to be a way to improve an operator's ability to see during nighttime missions, I knew he was onto something," said Derenski, a Boeing Research & Technology Technical Fellow with Human Systems Integration in St. Louis.

Together with Chang, an Integrated Defense Systems C-17 Electrical Systems and Lighting engineer in Long Beach, Calif., Derenski invented the Aerial Refueling Receptacle Raised Fairing Marking Design. The patent-pending invention is a design of lines painted on an aircraft's raised aerial refueling receptacle that improves a tanker boom operator's depth perception and visual cues during nighttime refueling missions. "We used visual illusions to fool the eye into seeing more of something that was already there," Derenski said.

The invention is one of seven Special Invention Award winners in the Midwest Region. PHOTO: RICHARD RAU/BOEING

Meet the innovators: **Steve Keener and Nick Peralta**

After learning of ergonomics risks associated with repetitively applying the right amount of torque to nuts and bolts, Steve Keener (right) and Cesare "Nick" Peralta made sure the new fastening system they were designing would create a safer work environment for Boeing mechanics. Their invention, the Hybrid Fastening System and Associated Method of Fastening, has helped improve employee safety, strengthened the quality of the fastening work, and greatly reduced costs.

"Our initial objective was just to create a better overall fastening process," Keener said. "But as we learned of the repetitive-motion problems, a key emphasis became designing a system that would help reduce the risk of repetitive-motion injuries."

Keener, a Technical Fellow with Boeing Research & Technology in Huntington Beach, Calif., teamed with Peralta, an Integrated Defense Systems C-17 Manufacturing Engineering project manager in Long Beach, Calif., to invent the system. It won a 2009 Special Invention Award in the Southwest Region.

According to Peralta, the duo strengthened the fasteners by designing a hybrid system that uses a relatively new titanium alloy combined with Boeing's patented pre-coating process, which enables a higher level of automation. The new hybrid system reduces assembly, repair and rework costs, compared to current threaded-nut installations. Through this system, "The mechanic no longer has to manually torque and re-torque nuts, avoiding injury from repetitive motions," said Peralta.

The system is being implemented on the C-17. It's also been adapted for use on the CH-47 and V-22 Osprey helicopter programs. "Now we're looking for other programs that can benefit," said Keener, "as well as a potential future technical replication award." PHOTO: GAIL HANUSA/BOEING

Dollars and sense

Despite bleak industry predictions for 2009, Boeing Capital is on track to meet its business plan **By John Kvasnosky**

PHOTO: A Boeing Capital Corporation 717-200 is shown on the ramp at Victorville, Calif. Fresh from Midwest Airlines, the twinjet is headed for a new life at Mexicana's Click subsidiary. PAUL PINNER/BOEING

At the beginning of 2009, the script for Boeing's aircraft financing and leasing unit, Boeing Capital Corporation, read like it was ripped from a TV drama. The global economy was the worst since the Great Depression. There were predictions airlines would not have adequate delivery financing for new airplanes on order and that manufacturers would shell out billions to close financing gaps.

But as 2009 winds down, airplanes are being delivered in large numbers and there isn't a lack of financing. Boeing did resume customer funding for the first time in three years, but requirements were quite manageable—well below the early estimate of $1 billion for the year. BCC continues to handle a high level of customer transactions, but it is on track to meet or exceed its business plan for the sixth straight year. What a difference a year can make.

Financing facts – Early this year, BCC was virtually alone in forecasting a modest gap of between zero and $5 billion in required aircraft financing for 2009, when others were predicting a shortfall of tens of billions of dollars. "When you look back," said BCC President Walt Skowronski, "I don't think they considered some of the pieces accurately. They left out some major funding sources and severely underestimated others."

Airplane financing depends on several sources: commercial banks, aircraft-leasing companies, export-credit agencies (ECAs), the airlines' own cash reserves and the capital markets.

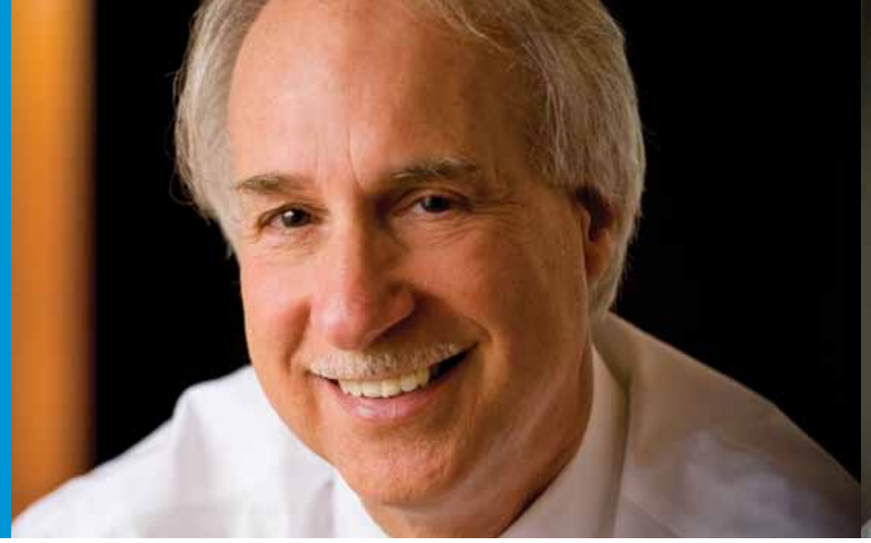
"Some forecasters left out the ECAs; they supplied almost a third of funding this year," Skowronski said. "We also saw the rise of regional banks that stepped up to fund airlines in their respective countries. The capital markets ended up being a substantial source, especially for U.S. airlines. Over the year, we were pleased to see our research and analysis vindicated."

Redoubtable remarketing – BCC began 2009 with a record number of airplanes returning from lease that did not have new leasing commitments, including the 717 fleet formerly leased by Midwest Airlines.

"We also saw the rise of regional banks that stepped up to fund airlines in their respective countries. The capital markets ended up being a substantial source, especially for U.S. airlines."

– Walt Skowronski, president, Boeing Capital Corporation

PHOTO: BOB FERGUSON/BOEING



"Ex-Im Bank is truly a national treasure for U.S. exporters." The bank provided a record $21 billion in support to U.S. exporters in the fiscal year ending Sept. 30, including $8.6 billion for large commercial airplanes.

– Mike Cave, incoming president, BCC

PHOTO: BOB FERGUSON/BOEING

"Typically when we remarket aircraft, we do one or maybe two airplanes at a time. Seldom do you see a fleet of 25 coming back," said Tim Myers, BCC's vice president for structured financing.

In a combined remarketing effort with Commercial Airplanes, BCC found a good customer match. Mexicana agreed to lease all 25 twinjets to replace aging and less-economical Fokker F-100s at its Click subsidiary.

"We moved from inking the deal to delivering the first aircraft in less than 90 days," Myers said. "It was a comprehensive solution including training and spares provisioning. Think about what it takes to train pilots, mechanics and ground support crews, at five crews per airplane. A 'One Boeing' solution made it happen, and we got terrific support from many parts of Commercial Aviation Services."

Eleven 717s have been delivered to Mexicana and two more will deliver by year-end. The remarketing team also handled customer restructures, normal lease returns and several aircraft sales, and is managing several MD-11 Boeing Converted Freighters.

"We had the highest amount of transitions ever," Myers said. "Today, we're under budget and have a very small number of aircraft on the ground."

Technical talent – BCC's asset management and technical services team is as eclectic as its aircraft portfolio. They use proficiencies in aviation maintenance, aircraft operations and marketing to accomplish what is required for aircraft transitions.

"A lot of emotions and money are involved in the aircraft-leasing world. Transitioning airplanes involves negotiations, modifications, conversions and more," said Thomas Hansen, asset management director. "You have to understand customer requirements and be able to compromise to reach agreement with operators from all over the world. It takes a solid technical background combined with sound economic judgment."

Resiliency is also important. "One of the most difficult things I've experienced is working alongside airline people during a restructuring," said project manager Tim Hillman. "You meet them and over time become friends, and then you have to be part of the process that changes their opportunities. It touches you personally."

Process performance – BCC's 2009 success goes back to its preparations for tough times—reducing portfolio, paying down debts, leaning out, and putting strong processes and compliance plans in place, according to Chief Financial Officer Kevin Millison.

"What worried me was whether BCC's processes would scale up for all the work we were going to do," Millison said. "Happily, all worked, flawlessly, and at a lot higher volume and with a lot more complexity. Through Lean+, we created capacity and flexibility to deal with volume, and we didn't sacrifice our compliance requirements."

Looking ahead – After six years with BCC, which included refocusing the organization from a mission of growth to one of customer focus, Skowronski will retire at year-end, turning over leadership to Mike Cave.

A 26-year veteran of Boeing, Cave, 49, previously served as senior vice president and chief financial officer of Commercial Airplanes and as vice president, Finance, for Boeing Information, Space & Defense Systems. He has held a variety of other assignments across the company's defense and commercial businesses.

In a recent speech in Seattle, Cave credited the U.S. Export-Import Bank with helping U.S. companies, including Boeing, expand their reach into international markets. The bank provided a record $21 billion in support to U.S. exporters in the fiscal year ending Sept. 30, including $8.6 billion for large commercial airplanes. Boeing is one of the largest U.S. exporters. "Ex-Im Bank is truly a national treasure for U.S. exporters, and a model program within the U.S. government, returning some $135 million in profits to the taxpayers in fiscal year 2009 alone," Cave said.

Skowronski has led Boeing Capital since November 2003. "What the team has accomplished this year is financially and operationally outstanding, and we've seen it do this for six straight years running. And these results have been realized in some extremely difficult economic times and financial markets," Skowronski said. "To have a business operate like that is a point of pride for every member of the team."

Aircraft financing is more stable than a year ago, but uncertainties remain. Skowronski said he will have more than a passing interest in watching how things work out in 2010 and into the future. "It's a fun and fascinating area and once you're exposed to it, you can't help but want to stay tuned in." ■

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PHOTOS: (Below left) Two 757-300s formerly leased by Boeing Capital to ATA Airlines await redeployment to their new operator, Continental Airplanes, on BCC's ramp at Victorville, Calif. PAUL PINNER/BOEING **(Below)** A contractor employee works on the seating of an ex-Midwest 717, reconfiguring it to the layout required by its new lessee, Mexicana. PAUL PINNER/BOEING

New on the menu

Food Services is taking a big bite out of waste at Boeing cafeterias—and helping improve the environment

By Kathleen Spicer

At Boeing cafeterias in St. Louis, employees use plates made from 100 percent recycled paper rather than Styrofoam containers for carryout lunch items. Styrofoam has also been eliminated at Boeing cafeterias in the southwest.

In the Seattle area, a pilot program is saving several hundred tons of compostable cafeteria waste from being dumped in landfills every year.

It's a success story that is playing out from Philadelphia to Seal Beach, Calif., to the Puget Sound region as Food Services, part of Boeing Shared Services Group, is significantly reducing Boeing's environmental footprint in day-to-day cafeteria operations.

In addition to traditional conservation activities, such as recycling aluminum cans and plastic bottles, new initiatives under way around the company have inspired opportunities for Boeing, employees and local suppliers to work together to practice responsible environmental stewardship.

Ken Botham, Food Services manager for the Northwest region, said collaboration with food service providers is the centerpiece of the improvement strategy.

"We've developed strong partnerships with our main food service providers to achieve healthier menu items for employees and better conservation processes," Botham said.

Several initiatives have gained momentum this year. Fryer oil recycling was implemented at all locations; resource-saving kitchen equipment, such as the energy-efficient, multiuse ovens at the Boeing site in Everett, Wash., is significantly lowering operating costs and energy consumption.

As a result of the pilot project in St. Louis—the switch from Styrofoam containers to recycled paper for carryout lunch items, and to washable plates for those who eat in the cafeterias—Boeing has cut the amount of Styrofoam in trash by 50 percent and reduced the amount of Styrofoam sent to landfills by 8,816 pounds (3,999 kilograms) each quarter, according to Laurel Lutz, Food Services manager in St. Louis. "It's been a great way to involve our customers and partner with them on the benefits and cost-savings of recycling," Lutz said. Cafeterias in the Southwest region have also eliminated Styrofoam in their cafeteria operations.

These Food Service activities also support Boeing's goals to improve recycling rates and energy efficiency 25 percent by 2012.

"The road to sustainability and socially responsible food service operations is a long-term journey, but it's the right direction to take," Botham said. "Our goal is to evaluate local efforts as they become available and work with our suppliers to integrate new conservation technologies and emerging environmental practices while continuing to meet business needs." ■

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PHOTO: (Far left) ARAMARK chef Ron Windom serves a meal to Food Services manager Laurel Lutz at the Building 100 cafeteria in St. Louis. All St. Louis cafeterias now use recyclable plates for carryout meals and washable plates when dining in. RON BOOKOUT/BOEING

(Lower left) Eurest Dining Services executive chef Derrell Mullin (foreground) and chef Darren Masterton use energy-efficient ovens in the Building 40-92 cafeteria in Everett, Wash., to prepare lunch items for employees. The new ovens cut utility costs by almost half. GAIL HANUSA/BOEING

(Below) New containers like the one pictured here with Eurest general manager Tony Parker are now used in Northwest cafeteria kitchens to make collecting compostable food waste easy and efficient. CINDY DANA/BOEING

Catering to the environment

Boeing is working with its food service suppliers around the United States to improve daily conservation practices. These include:

- Recycling programs for aluminum cans, plastic bottles, cardboard, paper and used cooking oils (all locations)
- Reducing plastic packaging and moving toward environmentally progressive materials such as compostable serving trays and food containers (partially implemented at some locations)
- Reusable carry bag and mug programs (most locations)
- Food-composting programs (Northwest region)
- Reducing energy and water consumption for cafeteria lighting and equipment (under way at most locations)
- Reduction of Styrofoam (partially implemented at some sites)
- Partnering with Boeing Wellness to create healthful food options (all locations) that support sustainability, such as antibiotic-free chicken and pork and cage-free eggs (Northwest region)

To learn more, visit *http://foodservices.web.boeing.com* and the Environment Information Center at *http://ehs.web.boeing.com/enviro* on the Boeing intranet.

Cafeteria waste to nutrient-rich soil

Whether empty egg cartons or organic food scraps, coffee grounds or food-soiled napkins, a significant amount of waste is no longer going from Boeing cafeteria kitchens in the Puget Sound region to landfills.

What began as a food composting pilot program at the Kent, Wash., site is expanding throughout the region. In partnership with Boeing food service provider Eurest Dining Services, the goal of the Shared Service Group Food Services program is to reduce waste to landfills and improve sustainability practices in daily food service operations. Other examples of compostable organic waste include waxed products and oil-soiled cardboard.

Cindy Dana in Site Services Food Services said results of the composting effort show that Boeing cafeterias in the region generate about 350 tons (320 metric tons) of compostable waste each year that now is diverted from landfills.

The process begins by sorting food waste into compostable and non-compostable. The compostable waste then is put in recycling containers that are picked up by Cedar Grove Composting, a local facility 10 miles (16 kilometers) from the Renton factory. The waste is composted and converted into a nutrient-rich soil.

The goal is a 95 percent recycle rate in all Puget Sound cafeterias and employee dining areas in the next five years, according to Ken Botham, manager of SSG Site Services Food Services.

The high and the mighty

1928

1934-1935

GRAPHIC: The NAA Logo. BOEING ARCHIVES

PHOTOS: (Top) James Howard "Dutch" Kindelberger (left) and John Leland "Lee" Atwood led North American Aviation and charted its course for success. BOEING ARCHIVES **(Above)** North American Aviation first set up shop in this Dundalk, Md., factory. BOEING ARCHIVES

From the Mustang to the Sabre Jet, from the Apollo spacecraft to the B-I bomber, North American Aviation left a lasting legacy of aerospace excellence

By Mike Lombardi and Erik Simonsen

They brought us the iconic P-51 Mustang and the F-86 Sabre Jet fighters, designed record-setting supersonic and hypersonic aircraft and built the Apollo spacecraft that took astronauts on history's greatest voyage—to the moon and back.

The men and women of North American Aviation were part of a powerhouse of engineering, manufacturing and technology formally incorporated as a company 75 years ago.

Now part of The Boeing Company, the roots of North American Aviation can be traced to 1928 with the formation of a holding company in the United States by the same name. It brought together interests in Curtiss Aeroplane, Douglas Aircraft and Transcontinental Air Transport. The holding company later purchased aircraft manufacturer Berliner-Joyce as well as the General Aviation Manufacturing Co., which had controlling interest in the U.S. branch of the Fokker Aircraft Corp.

In 1934, New Deal legislation in the United States forced the breakup of all aviation holding companies and the North American Aviation holding company was dissolved. Its manufacturing capabilities, represented by Berliner-Joyce and General Aviation (Fokker), were consolidated into a single manufacturing company, which was incorporated on Jan. 1, 1935, as North American Aviation Inc.

James Howard "Dutch" Kindelberger, chief engineer of the DC-1 program at Douglas Aircraft, was named to head the new company. He brought along two fellow Douglas designers, J.S. "Stan" Smithson and John Leland "Lee" Atwood, who 30 years later would succeed Kindelberger as leader of North American Aviation.

Starting in the former Berliner-Joyce plant in Dundalk, Md., the company's only work was finishing a handful of Berliner-Joyce airplanes. Kindelberger directed work on two designs that would help to launch the new company. The first was an observation plane known as the O-47 Owl, and over the next five years 238 were built for the U.S. Army Air Corps. Assembly also began on a second aircraft type—the NA-16 monoplane trainer. Designated the BT-9 by the U.S. Army, it would evolve into one of the world's most famous trainers—the T-6 Texan.

The facilities in Dundalk would prove inadequate for the production of modern aircraft, and Kindelberger persuaded the board and a number of employees to move to Southern California, where they'd have year-round flying weather. A site near Inglewood at Los Angeles Municipal Airport (Mines Field) was selected, and on Jan. 1, 1936, a modern plant was opened.

With the success of the NA-16 series, North American investigated new designs. A number of different twin-engine models were flown—the XB-21, the NA-40 and the XB-28. But the design that found success was the B-25 Mitchell medium bomber. During World War II the B-25 saw action on every front, serving with all branches of the U.S. armed forces and most allied air forces. The B-25 may be best remembered as the plane used for the legendary "Doolittle Raid." On April 18, 1942, under the command of Col. James H. Doolittle, 16 of the medium bombers launched from the pitching deck of the aircraft carrier USS *Hornet* and headed for military targets on the Japanese mainland.

1940

1947

PHOTOS: (Top) The last North American P-51D Mustang fighter was built at the company's Dallas plant. BOEING ARCHIVES **(Above)** The F-86 Sabre Jet swept-wing fighter dominated the skies during the Korean War. BOEING ARCHIVES

Although North American Aviation had great success with the B-25, its fighter designs made the company a household name. In response to a request from Great Britain for P-40 Warhawk fighters, Lee Atwood said the company could design a better fighter. In just 127 days North American Aviation designed and built what would become one the most beautiful and popular designs of all time as well as one of the most deadly fighters. First flown on Oct. 26, 1940, the Mustang incorporated many innovations including the first use of the laminar flow wing. When the British married the Mustang, designated P-51 in U.S. service, with the Rolls-Royce Merlin engine, the result was arguably the finest fighter of World War II.

During the war, the North American Aviation facility in Los Angeles was one of the most efficient in the world and set a single-type production record when it delivered 571 P-51s in just one month. The company also opened a plant in Dallas to build T-6 "Texan" trainers, P-51 Mustangs and B-24 Liberator bombers, and a plant in Kansas City, Kan., to build B-25s. By the end of the war the three sites had built 40,000 airplanes, more than any other manufacturer.

When the war ended in the Pacific Theater, on Aug. 14, 1945, North American Aviation had 8,000 airplanes on its order books. Several months later, there

1953

PHOTO: The F-100 Super Sabre was the first production airplane to fly at supersonic speed in level flight. BOEING ARCHIVES

1964

PHOTO: The XB-70 Valkyrie bomber prototype achieved speeds above Mach 3 (three times the speed of sound). BOEING ARCHIVES

1969

PHOTO: The North American–built Apollo Command and Service modules in Lunar orbit. BOEING ARCHIVES

were only 24. As the emphasis shifted from mass production to more sophisticated jet aircraft, Kindelberger and Atwood embraced new technology that would shape the next several decades of aviation.

North American's four-engine B-45 Tornado medium jet bomber, which first flew in March 1947, became the first multi-engine jet bomber for the U.S. Army Air Force. (The U.S. Air Force was formed on Sept. 18, 1947). The B-45 could carry 22,000 pounds (10,000 kilograms) of ordnance, and eventually served in the Korean War as a bomber and for high-altitude reconnaissance. Later that same year, on Oct.1, on a dry lakebed at Muroc Army Air Field, Calif., North American test pilot George Welch pulled back on the stick of the XP-86 (later designated F-86), and the first U.S. swept-wing jet fighter was airborne. More than 8,680 of the jets would be produced, and it had great success in aerial combat during the Korean War against the Soviet-built MiG-15.

Only six years after the F-86 Sabre Jet was introduced, the F-100 Super Sabre took to the skies, becoming the Air Force's first operational supersonic fighter. The F-100 also served with many NATO countries. More than 2,290 were built.

By 1954, Atwood had decided that North American needed to diversify its business to remain competitive. After building tens of thousands of the airplanes that helped win World War II, North American Aviation focused on the emerging markets for spaceflight, missile guidance systems, rocket propulsion and electronics.

Winning the Apollo contract in November 1961 was critical to this new strategy. The company designed and built the Apollo Command and Service modules, and built the second stage of the 363-foot (111-meter) Saturn V moon rocket. North American's Rocketdyne Division (now owned by Pratt & Whitney), designed and built all the engines for the Saturn V. Boeing built the first stage and Douglas built the third stage, underscoring a remarkable legacy of achievement in space for three of the companies that make up Boeing today.

Helping prepare the way for the journey to the moon and back was knowledge gained by nearly 200 flight tests of North American's rocket-powered X-15 research aircraft, which was used to verify systems for the Gemini and Apollo spaceflight missions. The X-15 established several speed and altitude records, ultimately reaching Mach 6.7 (4,970 miles per hour, or 7,995 kilometers per hour), and 354,400 feet (67 miles, or 108 kilometers).

But even as the country focused on manned spaceflight and the moon trip in the 1960s, North American Aviation continued developing cutting-edge aircraft. It won the competition to develop a bomber that could cruise at three times the speed of sound at 75,000 feet (22,860 meters). The XB-70 Valkyrie first lifted off the runway at the company's Palmdale, Calif., site on Sept. 21, 1964. Although the B-70 never entered operational service, it proved a technological triumph. The next two decades saw a merger with Rockwell Standard and the development of another fast bomber, the Rockwell B-1. Canceled in June 1977, the B-1 received new life under the Reagan administration when Defense Secretary Casper Weinberger announced in October 1981 that 100 B-1Bs would be built.

Described by pilots as flying like a fighter with the range of a bomber, today the Boeing B-1B Lancer is providing critical support to U.S. and allied warfighters in Afghanistan.

Seventy-five years after it all began with wood and fabric planes from North American Aviation that could only fly at 100 miles per hour (160 kilometers per hour), to building the space shuttle that travels at 7 miles per second (11 kilometers per second) in orbit some 150 miles (241 kilometers) above the earth—Boeing today continues North American's proud legacy of innovation, quality and aerospace leadership. ■

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BY ANY OTHER NAME

In 1967, North American Aviation merged with Rockwell Standard, creating North American Rockwell. To enhance its international identity, in 1973 North American Rockwell was renamed Rockwell International. It ultimately became part of Boeing when the aerospace and defense segment of Rockwell International was purchased by the company in December 1996.

Today

PHOTO: The legacy of North American Aviation continues with the space shuttle. BOEING ARCHIVES

Boeing Company – **BA**

NYSE: Industrials/Aerospace & Defense

As of 11/27/09

$52.45

Stock snapshot

52-week range:	
52-week high	**$55.48**
52-week low	**$29.05**

International competitors

EADS* – **EAD.PA**

As of 11/27/09	**11.98**
52-week range:	
52-week high	**16.57**
52-week low	**8.12**

**Prices in euros*

U.S. stock indexes

S&P 500

As of 11/27/09	**1,091.49**
52-week range:	
52-week high	**1,110.32**
52-week low	**676.53**

S&P 500 Aerospace and Defense Index

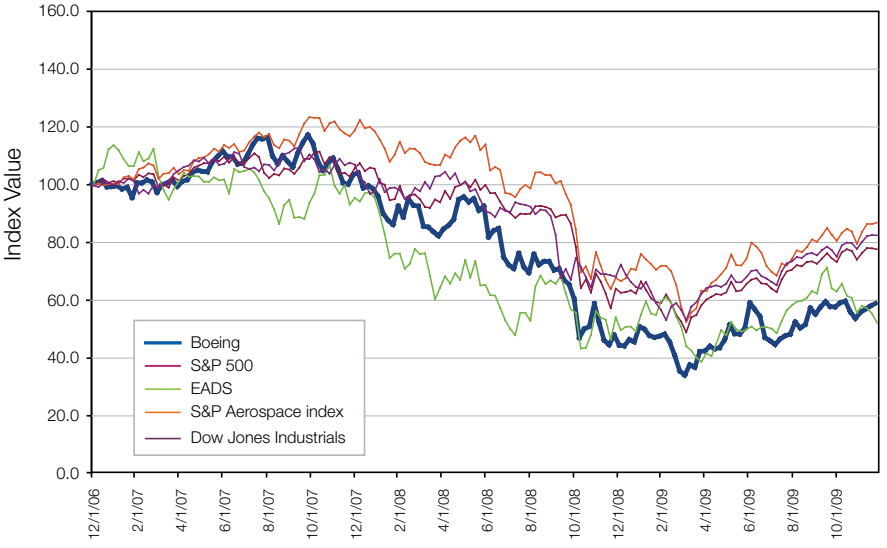
As of 11/27/09	**324.99**
52-week range:	
52-week high	**330.67**
52-week low	**194.13**

Dow Jones Industrials

As of 11/27/09	**10,309.92**
52-week range:	
52-week high	**10,464.40**
52-week low	**6,926.49**

Stock price chart

The chart below shows the stock price of Boeing compared with other aerospace companies, the S&P 500 index, the S&P 500 Aerospace and Defense Index, and the Dow Jones Industrials. Prices/values are plotted as an index number. The base date for these prices/values is Dec. 1, 2006, 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 stock, ShareValue Trust performance

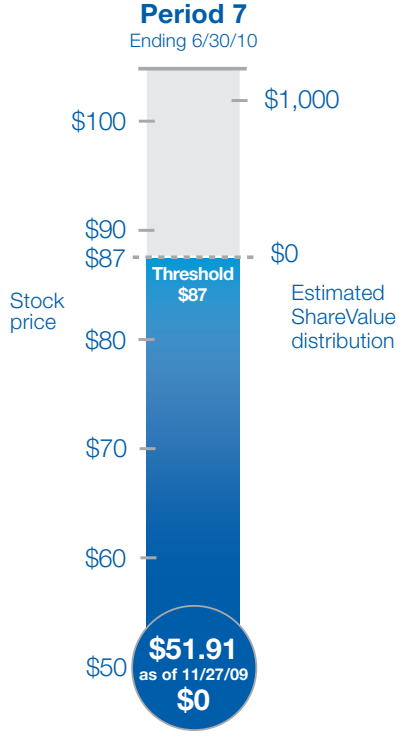
ShareValue Trust, or SVT, is an incentive plan that allows eligible participants to share in the success of their efforts to improve productivity and grow the business.

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

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

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

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



IN MEMORIAM:

The Boeing Company offers condolences to the families and friends of the following employees.

William Andrews, estimating and pricing specialist; service date June 29, 1985; died Oct. 26

Daniel Appenfelder, systems engineer; service date Nov. 12, 1980; died Nov. 12

Ronald Armstrong, calibration specialist; service date Dec. 24, 2001; died Oct. 20

Robert Bell, flight mechanic; service date July 23, 1997; died Oct. 15

Larry Diskin, procurement manager; service date June 3, 1991; died Oct. 29

Ibrahim El-Sebakhy, structural analysis engineer; service date May 16, 2008; died Oct. 30

Michael Furlong, design engineer; service date Nov. 19, 1986; died Nov. 18

Victor Grass, maintenance mechanic; service date Aug. 25, 1975; died Nov. 9

John Hammac, systems engineering manager; service date Nov. 3, 1999; died Nov. 21

Luther Howard, technician; service date Feb. 4, 1992; died Nov. 16

H.C. Jones, supplier quality specialist; service date April 12, 1994; died Nov. 18

Scott Kinney, aviation maintenance technician inspector; service date June 25, 2004; died Oct. 26

William Legg, aircraft and engineering electrician and mechanic; service date Jan. 5, 1987; died Nov. 8

Jeffrey Mace, sheet metal assembler; service date April 10, 2009; died Oct. 31

Daniel McDonald, lieutenant; service date Aug. 5, 1992; died Nov. 17

Linda Olsen, office administrator; service date June 10, 2005; died Nov. 16

Gary Rousseau, manufacturing technician; service date June 29, 2007; died Oct. 31

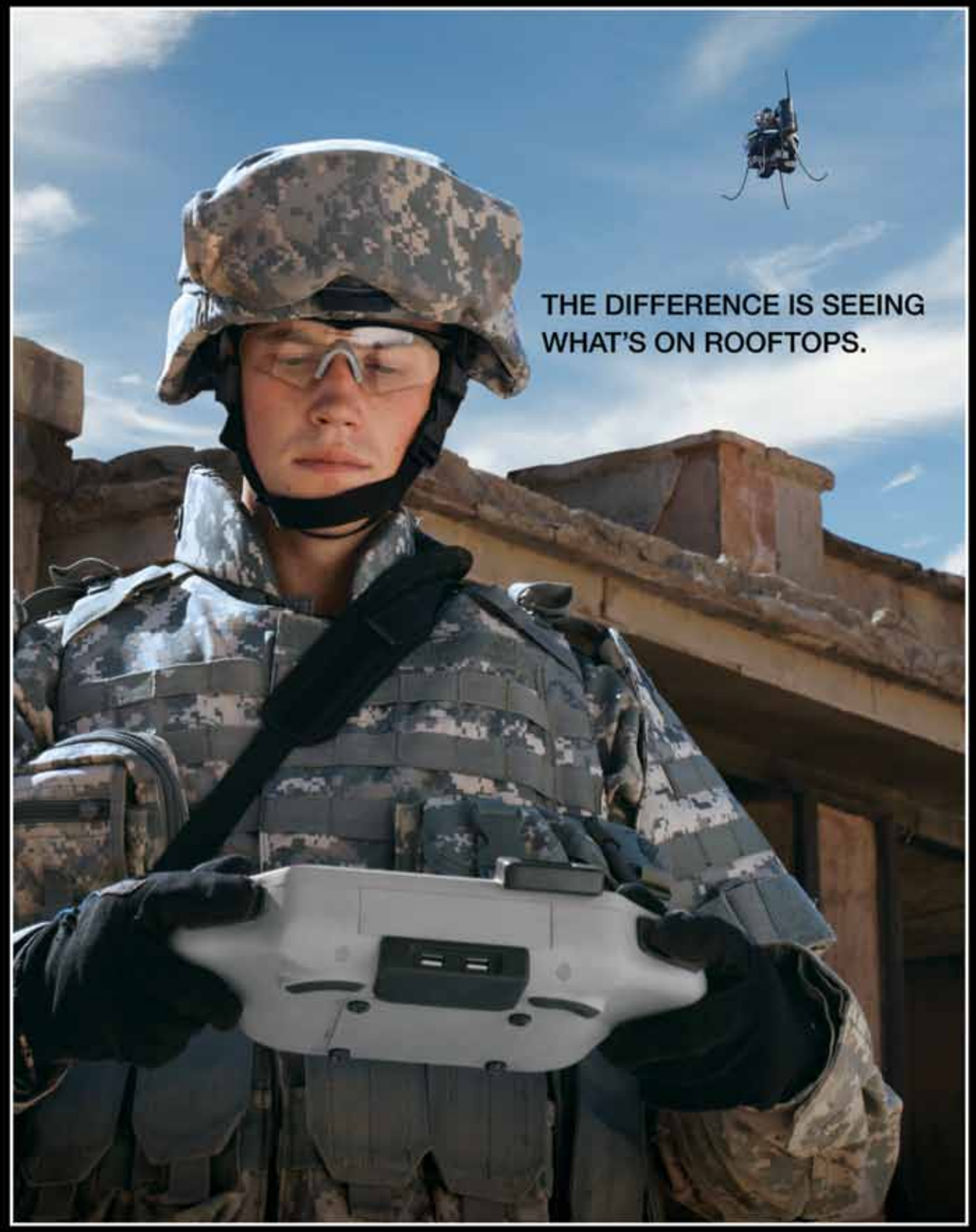
Sandra Schulz, writer/editor; service date Nov. 21, 1997; died Oct. 17

Kenneth Schuppan, systems engineer; service date July 16, 1979; died Nov. 2

Brian Sollenberger, product integration engineer manager; service date June 5, 1989; died Oct. 31

Cheri Swanberg-Wallace, confined space monitor; service date Dec. 6, 1996; died Nov. 17

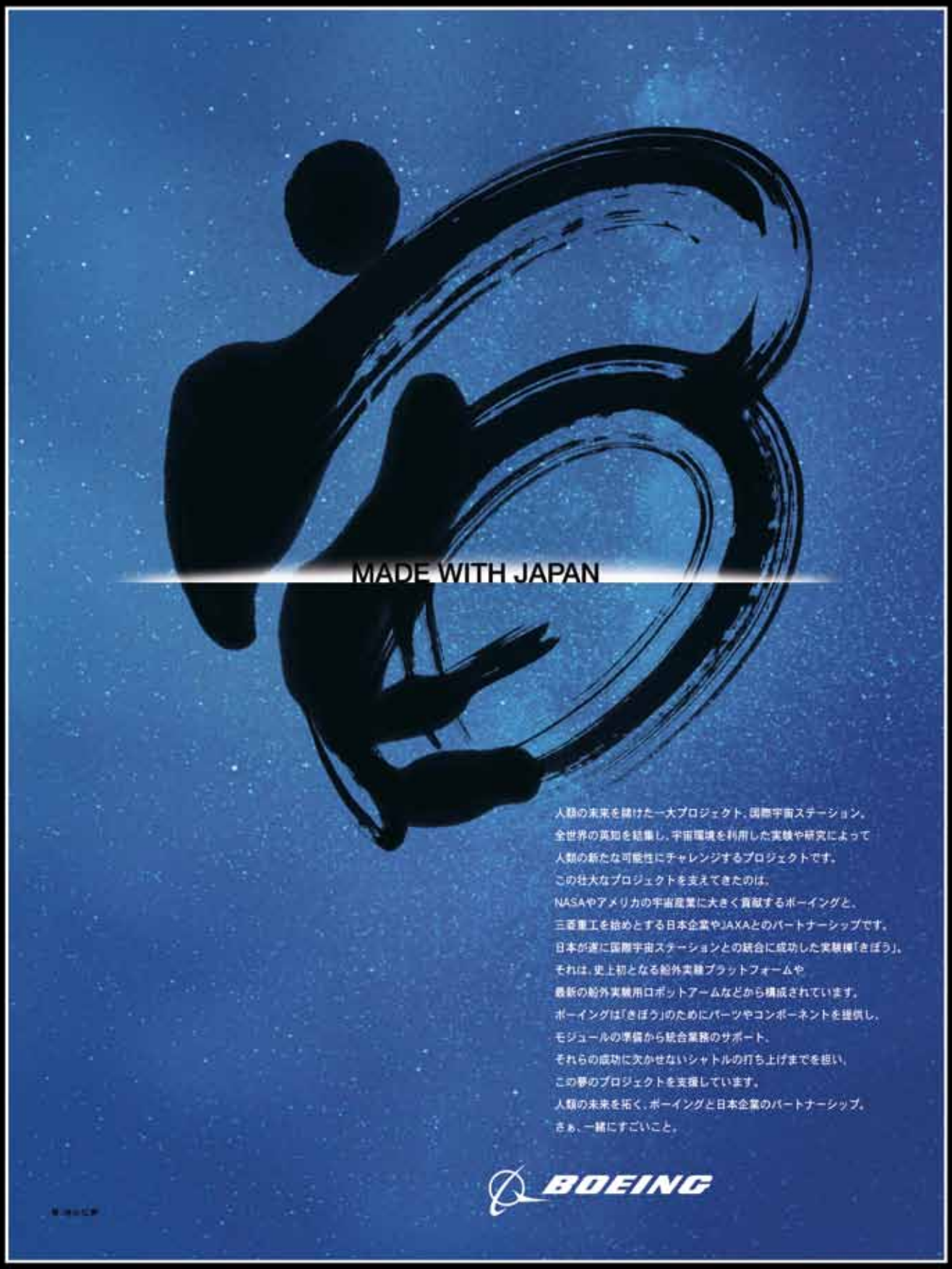
Mark Wilson, software engineering manager; service date Jan. 10, 1984; died Nov. 13



FLARE FOR THE DRAMATIC

A Boeing 737 Airborne Early Warning and Control plane for Australia's Wedgetail program dispenses flares in a demonstration of its self-protection systems during recent testing over the Puget Sound in Washington. Flares and chaff act as a decoy to help protect the plane and crew from missile attacks. This image was taken from a still camera mounted on a Lear 25 jet accompanying the flight. Two of six Wedgetail jets ordered by the Royal Australian Air Force were delivered last month. PHOTO CREDIT: BOEING

This new Integrated Defense Systems print ad is one of a series of new ads supporting the U.S. Army's transition from the Future Combat Systems program to its new modernization strategy. The ads are designed to position Boeing and the modernization effort as offering relevant and critical capabilities that will make a real difference in the protection and safety of Army warfighters. The ad will run in key military and congressional trade publications.



"Space" is second in a series of advertisements that reinforce Boeing's partnership with Japan, a relationship that began more than 50 years ago. The campaign features the art of calligraphy, a symbolic tradition of the Japanese spiritual culture that communicates not only words but also a deeper and richer meaning. This ad highlights Boeing's collaboration with Japanese manufacturers such as Mitsubishi Heavy Industries and with JAXA [the Japan Aerospace Exploration Agency] on producing critical components for the International Space Station. It has been running in publications such as Nikkei Business, Toyo Keizai, WING, Nikkei Shimbun *and* President.