

Boeing Frontiers

July 2006

Volume V, Issue III

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BUILDING THE DREAM

Global partners on the Boeing 787 Dreamliner program are building facilities worldwide to support producing the jetliner.

Look inside for a peek at some of these new sites.

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How modeling abilities help

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Boeing: 90 years and counting

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THIS IS NOT A PROMISE. IT'S REAL.

To the warfighter refueling in combat, it's what's real that counts, not promises. Boeing's leadership in aerial refueling comes from continually delivering the advanced tanker technology on which our warfighters depend. And we're ready to fuel the future, for real, like no one else can.

 **BOEING**
Forever New Frontiers

This Integrated Defense Systems tanker ad is one of five new ads designed to reinforce Boeing's leadership position in aerial refueling. All five ads depict a Boeing tanker refueling different mission-critical fighter and airlift aircraft; in this ad, an F-15 is about to be refueled. This print campaign appears in Washington, D.C., publications, key trade magazines and base papers.



ON THE COVER: Boeing 787 Dreamliner graphic by Mark Hall

Boeing Frontiers



COVER STORY

SITSEEEING 12

Global partners on the Boeing 787 Dreamliner program have recently opened a total of six sites across the world to support 787 production. Among them: Japan's Mitsubishi Heavy Industries, whose 787 wing tool is ready (above). Here's a look at some of the locations that are bringing the Dreamliner to life.

TOOLS FOR BIG TASKS

32 The employees of Precision Engagement & Mobility Systems, one of three Integrated Defense Systems profit-and-loss centers, work on military aircraft and weapons, as well as the systems that tie them together. Here's a look at this business.

FEATURE STORY

COMMERCIAL AIRPLANES

Life's what you make

16 Boeing Fabrication, the largest supplier to Boeing Commercial Airplanes, is following new strategies and using new tactics to secure roles on high-potential programs including the Boeing 787 Dreamliner. Here's a look at what several Fab sites are doing.

The first 787 test Auxiliary Power System Tailcone Muffler (right) was delivered by Boeing Auburn to Hamilton Sundstrand Power Systems on time to support testing the airplane's auxiliary power unit.

HAMILTON SUNDSTRAND PHOTO



Golden idea

18 The value of the 787 goes beyond its performance. GoldCare, a comprehensive life-cycle-management service developed for the Dreamliner, offers a strategic new business choice for customers to operate and transition their fleets.

We hear what you're saying

20 The development of the short-field performance package for Boeing 737s illustrates how Boeing turned feedback into a product feature that meets customer needs—and helps keep Boeing competitive.

FEATURE

90 and still going strong

40 This month marks Boeing's 90th anniversary. In commemoration, *Boeing Frontiers* offers a pictorial look at some of the people whose work over the years has made Bill Boeing's vision come true.

In 1922, the Boeing drafting department was located in the "Red Barn." At the right of this photo is Helen Holcombe, who became a pioneer for women engineers when she joined Boeing in 1917.



BOEING ARCHIVES PHOTO

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DEPARTMENT OF DEFENSE PHOTO BY AIRMAN PEDRO A. RODRIGUEZ, U.S. NAVY

A busy year

22 It's been an eventful 2006 so far for the Bell Boeing V-22 Osprey tilt-rotor aircraft team. Here's a look at some of the program's milestones in 2006—along with a report on ways the Boeing Rotorcraft Systems Composites Center of Excellence in Philadelphia is helping the program meet a cost-reduction commitment.

INTEGRATED DEFENSE SYSTEMS

Pinpoint focus

26 Boeing is the prime contractor for the Airborne Laser, which will place a high-energy chemical oxygen-iodine laser in a modified Boeing 747-400F to detect, track and destroy ballistic missiles in their boost phase of flight. Here's a cutaway look at the ABL and its systems.

An MV-22 Osprey makes a tactical landing to offload U.S. Marines at Camp Lejeune Marine Base, N.C. The Marines are attached to 1st Battalion, 8th Marine Regiment embarked onboard amphibious assault ship USS *Bataan*.

Fundamental truth

24 Behind Integrated Defense Systems' goal to improve program execution is a focus on fundamentals and consistent performance. In this article, three IDS program managers explain the role the basics play in executing their programs.

COMPANYWIDE

Not just pretending

36 Boeing engages in a wide variety of modeling and simulation activities that provide realistic simulations to internal customers across the enterprise—and to external customers. Here's a look at some ways these modeling and simulation capabilities provide a competitive—or safety—edge.

Learning on the job

31 The Team Strategic Action program, a program within the Learning, Training and Development organization, is helping Boeing cross-functional teams access new markets. At its core: a business-driven action-learning design that ties learning to real business growth while helping leaders develop themselves.

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LETTERS

Sound of success?

Regarding your article “Meet your future workspace” in the June 2006 issue: I work in the West tower of building 4-81.3, which is shown on pages 12 and 13, and I wear earplugs at my desk. The noise as they work on the wing line in the factory can be continuous (except for factory work breaks and lunch time)—and I am not even located above the wing line!

Yes, I’ve heard the argument that the noise is a sign of Boeing making money. I’m just wondering if those who are touting how wonderful this “Future Workspace” environment is have ever actually had to sit near the wing line.

—Shawna Calhoun
Renton, Wash.

Your story “Meet your future workspace” presented many great ideas regarding Boeing’s plans for the workplace of tomorrow. As the article stated, one of the primary objectives of the new work environment is to increase productivity. The story described new ways to encourage cooperation and collaboration among Boeing employees, and this is commendable.

However, another obvious way to increase productivity is to provide settings within Boeing facilities where we can concentrate on our work with minimal distractions. This issue was not addressed anywhere in the article. Why not? Many jobs at Boeing are highly technical, and many of our projects require great attention to detail. A noisy workplace can be devastating to productivity. It is essential that Boeing provide an atmosphere that is conducive to concentration, as well as collaboration.

—Richard Fuhr
Everett, Wash.

Letters guidelines

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

“I’m just wondering if those who are touting how wonderful this ‘Future Workspace’ environment is have ever actually had to sit near the wing line.”

—Shawna M. Calhoun
Renton, Wash.



and you’ll make life just a little bit easier and safer for all.

—F.A. Borowiecki
Everett, Wash.

Bravo, Boeing

In a recent U.S. Navy News Clips dispatch, I saw an article from the *St. Louis Post Dispatch* saying that Boeing employees called to active military duty under Sept. 11–related orders between June 2004 and March 2006 would receive a \$3,000 lump sum payment from Boeing

in recognition of their service. This is an outstanding gesture and makes me even more proud to be associated with Boeing.

—Clay Fulcher
Houston

Reserve(d) irony

Note with some degree of irony that Boeing has chosen to provide lump-sum payments to reserve employees who serve on extended active duty. I served for approximately 21 years on active duty and in the reserves. All that I can recall receiving during my reserve service was grumbling concerning the inconvenience caused when I departed for active duty and grumbling when I returned from my “vacation.” Due to the way the company determined military “differential” pay, there was not much money in it either. What a difference a decade or two makes.

—John Jenkins
Kent, Wash.

Safe biking

With the warmer summer temperatures upon us, more people are biking to work. This letter is to those select few who climb on their bicycles in the morning and leave their brains behind.

I almost hit one of you at the Everett, Wash., plant when I was driving in to work because you were wearing black—which isn’t easy to pick out of the background at 5:30 a.m. Also, you weren’t wearing a helmet, and you decided that bicyclists can ignore red lights at intersections. I wish I could single you out, but you have quite a few other brothers and sisters out there who ride their bikes as if they were indestructible.

I sure hope that you don’t display the same reckless abandon in your work at Boeing.

To all the rest of you bicyclists out there, continue being safe, making yourself visible,



SNAPSHOT

ANGELS IN THE AIR A C-17 Globemaster III from the 14th Airlift Squadron, Charleston Air Force Base, S.C., flies away after releasing flares over the Atlantic Ocean near Charleston during a recent training mission. The “smoke angel” is caused by the vortex from the wingtips.

U.S. AIR FORCE PHOTO BY TECH. SGT. RUSSELL E. COOLEY IV

QUOTABLE

There’s no compromise between doing things the right way and performance. These are pretty basic things: The ability to chart the course, the ability to expect a lot from yourself and others and to inspire them to meet those expectations.”

—Boeing Chairman, President and CEO Jim McNerney, on Boeing executive competencies and ethical leadership, in the June 13 *Wall Street Journal*

This airplane is not just a little more fuel efficient, but 20 percent more fuel efficient than its predecessors. That’s a huge difference.”

—Meryl Getline, a pilot and author who writes the “Ask the Captain” Q&A column for *USA Today*, writing about the Boeing 787 Dreamliner airplane, in the June 12 *USA Today*

It’s pretty amazing that a platform can continue to transform over time and be so relevant as it is today.”

—Ken Eland, Boeing CH-47F program manager, at the June 15 unveiling of the CH-47F Chinook, in the June 16 *Delaware County (Pa.) Times*. The F-model Chinook, part of the U.S. Army Cargo Helicopter modernization program, features a modernized airframe and advanced digital cockpit.

IAM PROMOTIONS

No promotions listed for periods ending May 26 and June 9, 16 and 23. The period ending June 2 included the following promotion: Orgn: GG-GG-PFMH; PLOC: Auburn, Wash.; Job no.: 41908; Shift: 2; Sen. date: 05/02/89; Clr. date: 05/30/06

ETHICS QUESTIONS?

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

■ HISTORICAL PERSPECTIVE

The Dash-80 (top) and a B-52 Stratofortress salute the rollout of the first KC-135 and the last KC-97 at the Boeing site in Renton, Wash., on July 18, 1956.

Start of a PROUD MISSION



BOEING ARCHIVES PHOTO

The first KC-135 tanker aircraft rolled out 50 years ago this month

By MICHAEL LOMBARDI

It's a rare treat to see a classic 1957 T-bird or Corvette classic car cruising down the road. It might not seem as nostalgic to see a KC-135 Stratotanker fly overhead, even though the airplane type went into service the same year as those classic cars. Yet the Boeing C/KC-135 family—which this month celebrates the 50th anniversary of the first KC-135 rollout—continues to thrive, flying a variety of support missions for the U.S. Air Force as well as allied air forces. The most important of these: the role of aerial tanker, a flying gas station able to refuel other military planes while in flight.

The KC-135 was born out of necessity and innovation. In the early 1950s, Strategic Air Command was beginning to operate the new jet-powered Boeing B-52 Stratofortress that with in-flight refueling was capable of striking targets anywhere in the world. At the time, however, the only tankers in the SAC inventory were piston-engined Boeing KC-97s. The difference in performance between the two planes forced the B-52 to fly near its aerodynamic stall speed while performing the already difficult process of aerial refueling.

This situation created an opportunity for Boeing to introduce a jet-powered aerial refueling tanker—and further refine the “flying boom” refueling technology it invented in the late 1940s.

In 1948, the Air Force asked Boeing to develop a more efficient aerial fueling system that would address the deficiencies of the hose system developed in Great Britain. The existing system, which trailed a hose behind the tanker, had many drawbacks including slow rate of fuel transfer, as well as difficult and dangerous contact procedures.

In response, Boeing invented the flying boom. This system features a telescoping tube that trails underneath the tail of a tanker aircraft and is flown by an operator controlling two small wings called “ruddevators.”

The first airplanes equipped with the flying boom were 116 Boeing B-29 Superfortresses modified at the Boeing plant in Renton, Wash., and re-designated KB-29Ps (the letter “K” is the U.S. military code for a tanker aircraft). In response to a demand for even more capable tankers, Boeing re-designed the C-97 Stratofreighter into a dedicated aerial refueling tanker and built 811

KC-97 flying boom tankers, also at Renton.

Seeing the need for a jet-powered tanker to keep pace with the B-52, as well as the potential for such a plane to be used as both a commercial and military transport, Boeing used \$16 million of its own funds to develop a prototype jet transport, the Model 367-80—popularly known as the “Dash 80.”

The Dash 80 led to two airplanes: The 707, the world's first successful commercial jet; and the Model 717, the world's first production jet tanker—better known as the KC-135 (717 was also used as the product designation for the MD-95 after the Boeing-McDonnell Douglas merger). The Dash-80 is now on permanent display in the Boeing Aviation Hangar at the National Air and Space Museum's Steven F. Udvar-Hazy Center near Washington, D.C.

Today, Renton's known as the home of the 737. But it also has the distinction of having been the production site for Boeing aerial refueling “boom” tankers, including all C/KC-135 airplanes.

To honor its birthplace, the first KC-135 proudly displayed the name “City of Renton” on its nose when it rolled out on July 18, 1956. To christen the airplane, the wife of the mayor of Renton used a bottle of water from the Cedar River, which runs through both Renton and the Boeing site.

In the same ceremony, the last KC-97—

the world's first production aerial tanker and the last production piston-powered airplane Boeing built—was rolled out as well.

The last KC-135 entered the U.S. Air Force fleet in 1965. Nearly 500 of the 732 tankers built remain in service. Boeing continues to maintain, upgrade and support the KC-135 fleet, through the Support Systems business in Integrated Defense Systems.

In 1979, Boeing began replacing the KC-135's 1950s-vintage engine with the more fuel-efficient, quieter and cleaner CFM56 engine. The re-engined tanker, designated either the KC-135R or the KC-135T, is 27 percent more fuel-efficient with performance increases that allow two KC-135Rs to do the job of three KC-135As. Compared with the KC-135A, the reengined aircraft can offload 50 percent more fuel, is 25 percent more fuel efficient, costs 25 percent less to operate and is 96 percent quieter.

The only other company to provide flying boom tankers to the Air Force has been McDonnell Douglas, now part of Boeing. Twenty-five years ago, McDonnell Douglas began delivering the first of 60 KC-10 Extenders to the Air Force, based on the DC-10 commercial airliner. Today the KC-135 and KC-10 continue to serve around the world as the only flying boom tankers that can refuel Air Force aircraft. ■



Boeing test pilots Tex Johnston and Dix Loesch (on ladder) prepare to take the first KC-135 up for its first flight on Aug. 31, 1956.



ISTOCK PHOTO

Aiming for the win-win-win

Why performance-based health care networks make sense for Boeing

Boeing is working to provide employees information they need, as health care consumers, to make informed decisions about the quality and cost of the care they receive from doctors and other providers.

Boeing is undertaking one of the first steps in this process by introducing performance-based networks into its health care plans. A performance-based network is made up of doctors and providers who show they meet the health plan's quality and efficiency measures. Developing these performance-based networks is only the first step in a journey that will, over the long term, provide the kind of quality and cost information about health care providers that consumers are used to having when purchasing goods and services in every other consumer market.

The first performance-based network for one of Boeing's health plans was scheduled to take effect July 1 for Puget Sound region

employees and retirees represented by the Society of Professional Engineering Employees in Aerospace (SPEEA) and the Pilots Association. On June 1, Boeing said it would delay implementation until July 1, 2007, to provide additional opportunity for Regence Blue Cross Blue Shield to work with local doctors and enhance Regence's employee communications.

To learn more about performance-based networks and the drive toward health care quality measurements, *Boeing Frontiers* spoke with Rick Stephens, senior vice president of Human Resources and Administration at Boeing, and with Dr. Arnold Milstein, chief physician at Mercer Health & Benefits, the medical director of the Pacific Business Group on Health and an expert on private- and public-sector health care.

Q: Why did Boeing delay implementation of performance-based networks?

Stephens: We said success is so critical we need to make sure that we get this right. We are not backing away, we're just slowing down.

Some would like to think the delay was because of the uproar about the doctors that weren't in the network. Quite candidly, the number of providers who were excluded from the network was about 3 percent of the existing network—less than half of what the predicted number would be. There was no surprise there.

Q: Why does Boeing believe performance-based networks should be part of its health care plans?

Stephens: We want our employees to have good medical coverage, at an affordable cost. Performance-based networks are being developed with a focus on provider quality and efficiency. While we all say we want lower health care costs, in the end, we also all want high-quality performance. What we're trying to do is use an established set of measurements and incentives for the health care community—and for consumers to use those measurements to drive market changes.

Let me use Lasik eye surgery as an example. People know what Lasik is—what it can cost, what to compare, what the doctor's performance track record is, what questions to ask their doctor. But cost is only one component: How many procedures has the

doctor performed? How many have been successful? How many have not been successful?

As objective measurement data in other areas of health care becomes more widely used and more transparent, we all eventually will be able to make objective decisions about what health care services to get, and from whom.

Milstein: In any industry—and health care is no exception—once you make a shift from a market environment that assumes good performance to one that objectively measures and rewards performance, it is a cata-

BY THE NUMBERS

U.S. health care: Does it score?

How good is the quality of health care in the United States?

According to the Community Quality Index Study, a recent RAND Corporation study, "all adults are at risk for receiving poor health care, no matter where they live; why, where, and from whom they seek care; or what their race, gender, or financial status is." Research such as this supports Boeing's interest in introducing performance-based networks into its health care plans. It also underscores the need for employees, as health care consumers, to make informed decisions about the quality and cost of the medical care they receive.

"The gap between what we know works and what is actually done is substantial," wrote the authors of the study. "These deficits . . . pose serious threats to the health and well-being of the U.S. public."

Here are some of the study's findings.

55 Percentage of recommended care received by participating patients during the two-year period studied.

65 Percentage of recommended care received by participating patients with high blood pressure.

68 Percentage of recommended care received by participating patients with coronary artery disease.

45 Percentage of participating heart attack patients who received beta-blocker medication. In addition, only 61 percent received aspirin. These medications could reduce their risk of death by more than 20 percent.

39 Percentage of recommended care received by participants with pneumonia.

lyst for very big gains in both affordability and quality for the customer.

Q: Some providers argue with the measures being used.

Milstein: The adequacy of performance metrics is always in the eye of the beholder. The general rule of thumb is that those being judged will never think early versions of performance measures are good enough. Measurements of health-care performance will improve over time; the measurement approach currently being taken relies on today's most feasible scientific foundation and is credible.

Q: What happens when these networks are implemented and some employees find that their doctor is not in the new network?

Stephens: I think a year from now there will be a lot more doctors who will say that they got the message and Boeing is really serious about implementing performance-based networks. They'll realize they can't afford to lose those Boeing employees and their families as customers—and will do everything they can to ensure their data is made available and, where necessary, will make improvements in their practices. At the same time, it's likely there will be providers that are still not included in the network, which means employees may want to change doctors to receive the highest level of benefit coverage under our plans.

Q: Is Boeing the first large employer to go down this path in terms of performance-based networks?

Milstein: You're not the first, but you're among the first 10 percent of pioneers going down the path. I think that 10 years from now, people are going to look back at what Boeing is doing in partnership with its employees and describe it as visionary and part of the transformation of the American health care industry from an underperforming conglomerate into a high-performance system.

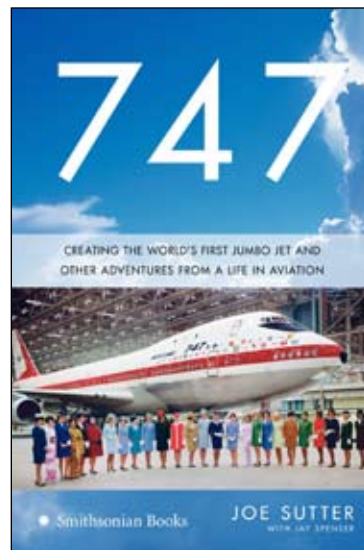
Stephens: Performance-based networks will get us all on the same page—as opposed to “someone wins and someone loses.” Employees win with the ability to shop for the right health care at the right cost. Employers win because they can judge the quality and cost-effectiveness of what they are paying for and will likely pay less in total. The medical community wins because it gains credibility and trust and strengthens the relationship between the doctor and the patient. It's a win-win-win. ■



TIM STAKE PHOTO

EVA Air 777-300ER to appear at Farnborough

Attending this month's Farnborough International Airshow in the United Kingdom? Keep an eye out for the new 777-300ER (Extended Range), shown above, which Boeing delivered to Taiwan's EVA Air last month. This jetliner features a special livery and will be on static display during the air show, which runs from July 17 to 23. The airplane is the third Boeing 777-300ER received by EVA, one of the launch customers for the 777. The twin-engine EVA Air 777-300ER carries 316 passengers in a three-class configuration. With a range of 7,880 nautical miles (14,594 kilometers), the jetliner is capable of serving such routes as Los Angeles–Taipei and Taipei–London.



Joe Sutter to sign books at Everett ESC opening

Joe Sutter, known as the “father of the 747,” and author of a new book about the airplane, is scheduled to be on hand to commemorate this month's grand opening of the new Employee Service Center in Everett, Wash.

Sutter, who retired from Boeing in 1986 and now serves as a consultant to Boeing Commercial Airplanes, will sign copies of the book at 2 p.m. on July 11 at the ESC store. The Everett ESC is located in the 40-22 building, column E10 (adjacent to Plaza 21).

Sutter's new book “747: Creating the World's First Jumbo Jet and Other Adventures from a Life in Aviation” tells the story of what it was like to create the largest, fastest and most recognizable airplane in the world. Almost everything about the 747 would be unprecedented. Its horizontal tail would be bigger than the wings of most airliners ever built. Jet engines big enough to lift it off the ground didn't yet exist. Runways at the world's airports couldn't handle it, and neither could Boeing's factories. Yet the 747 became one of the most successful airplane models ever.

The book is available at Boeing Stores and other retail outlets.

Alenia Aeronautica has built an all-new factory in Grottaglie, Italy, where barrel sections for the 787 will be created. This large tool will move the barrel section through the factory—from layup to auto-clave and then on to trimming and drilling and inspection.



INTERNATIONAL INDUSTRIALIZATION

New sites at 787 partners across the globe are coming online to produce the Dreamliner. Here's an inside look at six of these facilities

Vincenzo Caiazzo of Global Aeronautica noted how Vought and Alenia North America, which traditionally compete against each other, formed a joint venture to complete integration of 787 fuselage sections.

on forms to create one-piece 787 fuselage barrels—is 6.2 million cubic feet. It is just a small part of the whole building, which is about the size of 15 soccer fields or 24 American football fields.

“More than 300 workers will be at the Grottaglie facility by the end of this year,” said Maurizio Rosini, chief operating officer of Selex, the Alenia subsidiary that will run the Grottaglie facility. “That number will rise to nearly 800 by the year 2010.”

Those workers will create the composite center fuselage sections known as Sections 44 and 46 for the Dreamliner.

Using new automated composite tape lay-down machines and sophisticated forms, called mandrels, the team will first create the barrel sections. Then a massive transportation tool will move the barrel sections into an autoclave—the largest in Europe—which essentially will bake them under pressure to create a solid structure. The moving tool will return, taking the piece to be trimmed and drilled and then moving it to the inspection station. When complete, the barrel sections are to be flown on board a specially modified 747, called the Large Cargo Freighter, from Italy to Charleston, S.C.

TRANSFORMING A SOUTH CAROLINA SWAMP

In only one year, the South Carolina team has raised a world-class production facility where alligators, snakes and banana spiders once roamed a vast swamp next to the airport. Today, a sprawling complex occupies the space. The complex houses factories and a training facility for Vought Aircraft Industries and Global Aeronautica.

Vought will produce the aft fuselage sections of the 787, known as Sections 47 and 48, in its 342,000-square-foot facility. Each section will be a one-piece composite fuselage barrel, made using tools and processes similar to those found in the Italian factory. Layup of the composite material will happen in a 70,000-square-foot clean room.

By the end of the year, more than 100 employees will be working at the site in support of the 787.

“We are really proud of our new, state-of-the-art factory,” said Mark Dickey, general manager of Vought’s North Charleston site.

Dickey said preproduction testing began in June and work on the first 787 production pieces starts this month. In the first quarter of 2007, Vought will deliver its first barrel section to Global Aeronautica, a joint venture formed by Vought and Alenia North America to complete integration of 787 fuselage sections.

“Two companies that traditionally compete against each other decided to form an international joint venture to have access to a broad spectrum of integration activities for fuselage sections, normally performed by the prime manufacturer,” said Vincenzo Caiazzo, chairman of the board of managers for Global Aeronautica.

Global Aeronautica will connect the two Alenia center-fuselage sections from Italy and the wheel well and center wing box from Japan with one another, and the two Vought aft fuselage sections to each other, creating two large structures. Each will be “stuffed” with systems elements including wiring and tubing. In addition, the sections will be painted and tested before being loaded on the Large Cargo Freighter and flown to Everett, Wash., for final assembly.

Global Aeronautica is on track with the program plan to deliver the first integrated fuselage sections to Boeing early in the second



BY LORI GUNTER

The decisions made by Boeing more than three years ago are literally changing the landscape of three cities on three continents.

Factories have sprung from the ground in record time from the swamps in Charleston, S.C., the olive groves in Grottaglie, Italy, and the industrial center of Nagoya, Japan. This massive global industrialization effort—which includes the creation of more than 3 million square feet of new factory space—is aimed at achieving the objectives of the Boeing 787 Dreamliner program.

Six sites, which are coming online to support 787 production, recently opened their doors to provide a glimpse at their progress. These facilities reflect a collaborative business model that’s as revolutionary as the 787 airplane. This collaboration ensures Boeing gets the best ideas and uses the best abilities from throughout the industry to design and create a product that’s like no other.

“One of the reasons we formed global partnerships was to help spread the investment required to create a new airplane,” said Scott Strode, vice president of 787 Development and Production. “Because of advances in technologies such as composite materials, existing facilities could not accommodate either the kind of work, or the amount of work, that comes with a program like the 787.”

“To look at the first [center wing-tank-skin panel] is very rewarding and very humbling.”

—Scott Strode, vice president of 787 Development and Production

CREATING AN ITALIAN MASTERPIECE

Only in Italy can an airplane factory be seen as a canvas for a beautiful piece of art. Alenia Aeronautica, a Finmeccanica company, filled that canvas with an impressive facility in Grottaglie. The site features distinctive touches, such as large overhead cantilevered windows that spread natural light throughout the factory.

And it’s a vast factory to fill. The clean room—an environmentally controlled area where composite material is automatically laid



Mark Dickey (center), general manager of Vought's North Charleston, S.C., site, leads visitors on a tour of the spacious factory that Vought completed recently.

quarter of 2007, said Newt Newton, Global Aeronautica vice president and deputy general manager. There are nearly 50 people working for Global Aeronautica today with an anticipated work force of 100 by year-end. Peak employment is expected to be about 400.

Newton is particularly proud of Global Aeronautica's 338,000-square-foot factory. "We are focused on doing the job and doing it right," he said. "First it was creating the building, and now it is creating the Dreamliner."

ADDITIONS FOR NAGOYA'S INDUSTRIAL CENTER

All three of the Japanese heavy industry partners—Mitsubishi Heavy Industries, Kawasaki Heavy Industries and Fuji Heavy Industries—have built new factories dedicated to 787 work. Each includes machinery for laying down composite materials, a massive autoclave, trim and drill operations and nondestructive inspection machines. Yet each has distinct capabilities and features.

Mitsubishi Heavy Industries (MHI) will build the wing boxes of the 787. These contoured boxes provide the lift and fuel-carrying capacity needed for the airplane. The new 505,800-square-foot composite manufacturing factory is located just beyond the historic factory where World War II "Zero" fighters were designed and manufactured. Next door is another new facility, dedicated to finishing the wing boxes with systems installations and other details.

Fuji Heavy Industries' transport tool moves composite skin sections for the airplane's center wing section around the factory. To alert workers to stay out of its path, it plays traditional Japanese tunes.

This part of the factory is still under construction, with completion expected in the third quarter of 2006.

Takashi Fujimoto, director and 787 program manager for MHI, said when the wing boxes are complete they will be loaded on a barge and shipped to Nagoya Airport for loading on the Large Cargo Freighter. It will fly them to Everett, where they will be finished and prepared for final assembly.

The largest tool in any factory for the 787 is MHI's one-piece wing-box-skin tool. This allows MHI to create a one-piece wing skin that measures more than 72 feet in length.

Less than an hour's drive from MHI's factory is Kawasaki Heavy Industries' new 787 factory. KHI is building the airplane's forward fuselage section, keel beam, pressure bulkhead and aft wheel-well bulkhead, as well as its fixed trailing edge.

With work on aluminum fuselage panels for the 777 right next door, this facility highlights the difference between aluminum construction and composite construction. For the 777, KHI ships panels with countless rivets that are then constructed into fuselage barrels in Everett. But for the 787, KHI will create a one-piece barrel with significantly fewer connectors because the stringers (horizontal reinforcing components) are an integrated part of the structure—just like all other 787 fuselage sections.

Hirokazu Komaki, 787 program manager for KHI, noted that testing of most of the machines in the KHI composite manufacturing factory has already been completed. He added the company has started to build the "proof for production" parts that will be used to verify they are ready to start building production pieces later this year. Like the MHI parts, KHI's fuselage section will be placed on a barge and shipped to Centrair (Central Japan International Airport in Nagoya) for transport to North Charleston on board the Large Cargo Freighter. Its other structural elements will be sent to Fuji Heavy Industries (FHI) for integration with the center wing section.

FHI's Nagoya facility is where assembly of the first 787 begins. Similar to the other sites, it is characterized by its high-tech machinery, huge autoclave and clean room. Here, for the first time, parts will be joined to create completed 787 structures.

The transport tool in this factory—which moves the in-process structure from station to station—is a musical delight, sounding more like an American ice cream truck than an industrial heavy



PHOTO BY MARK WAGNER, AVIATION-IMAGES.COM



The door to the massive autoclave at Kawasaki Heavy Industries' new factory closes on composite parts that will verify the factory is ready to begin making production pieces for the first Dreamliner.

lifter. It plays a different tune for each direction that it moves. Yasuhiro Toi, FHI's 787 program manager, said the music is a safety feature that alerts employees when the transporter is moving.

Before assembly began, Hideyuki Sano, general manager of Manufacturing Engineering for the company, and Toi proudly showed off the first center wing-tank-skin panel. The center wing section is a more complex build than the barrels and is not a one-piece construction.

"You just have to look at it and think about the courage it took three years ago to move forward with an all-new airplane during a

really terrible time in our industry," Strobe said of the 787 program. "And then the thousands of decisions based on detailed analysis that had to be done in order to ensure this part will meet the safety and reliability requirements that will allow it to be in service well after most of us who have been involved in this effort have retired.

"The fingerprints of the entire Boeing team and our partners at FHI are on that panel, just like the rest of the parts that will follow," he added. "But to look at the first piece and see it really happening the way we planned it is very rewarding and very humbling." ■

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Continental Airlines last month ordered another 10 787-8 Dreamliners (top), along with 24 Next-Generation 737s.

BOEING GRAPHIC

Singapore eyes 787s as Continental orders another 10

Another major international carrier is poised to join the list of airlines that have selected the Boeing 787 Dreamliner.

Singapore Airlines on June 14 said it signed a letter of intent to purchase 20 Boeing 787-9s, with purchase rights for another 20 of the airplane. Deliveries will be scheduled between early 2011 and mid-2013, the airline said.

"The decision to purchase the 787-9 is the culmination of an extensive evaluation of the performance characteristics and operating economics promised for the different versions of Boeing's new 787 aircraft," the carrier said in a statement.

"We look forward to working closely with Singapore Airlines to finalize the order to support the carrier's unique offerings," Boeing said in a statement.

The Singapore announcement followed Continental Airlines' decision in early June to order another 10 787-8 Dreamliners. With that decision, Continental has 20 787s on order, the most of any U.S. airline. Continental also said it had ordered an undisclosed mix of 24 Next-Generation 737s.

Make it come true

How sites within BCA's Fabrication Division are supporting the 787

By DEBORAH BANTA DUSTMAN

Using robotics. Machining complex parts. Winning new business through innovative approaches.

These are just a few of the many tactics and strategies that Boeing Fabrication—the largest supplier to Boeing Commercial Airplanes—is following to secure roles on high-potential programs. The most notable of these programs is the Boeing 787 Dreamliner, which has tapped seven Fabrication business units to perform development, test and part-production work.

Fab's role on the 787 program validates its strategy of producing complex, critical and "best value" parts. The division's part-production work is focusing on areas of excellence with specific manufacturing capabilities. Fab's plan is to invest strategically in these areas so that plant, equipment and skills match up with the critical capabilities Boeing needs to support final assembly.

That investment, along with the skills of Fab's teammates, has led to Fab sites securing work on the 787 program. Here's a look at some of this 787 work. ■

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AUBURN, WASH.: TOMORROW IS TODAY

The Advanced Metal Structures manufacturing business unit at Boeing Auburn is capitalizing upon robotics and other new technologies and skills to execute its role on the 787 propulsion and fuselage team.

Dave Papenfuss, new product implementation manager for Advanced Metal Structures, said it's as if all of their dreams about the ideal components-manufacturing system—including technology, Lean manufacturing and intellectual property—have come together on the Dreamliner. "That's a fancy way of saying our combined capabilities now provide a competitive advantage that's difficult to beat," Papenfuss said.

This new combination of capabilities will enable the Auburn team to reduce pro-

duction costs, meet delivery schedules, ensure quality and provide new and challenging work for employees.

Leading their new work is production of the 787 tail cone muffler and aft engine-strut heat shields, set up in Lean cells to make best use of both robotics technology and technicians' skills.

In the tail-cone-muffler assembly cell, technician Sherry Durham will use an 1,800-ton press operating at 1,500 degrees Fahrenheit to form tail cone parts; a carbon dioxide six-axis laser to cut the parts; and a robot integrated with a spot welder to locate and weld parts together to build the 5.5-foot-tall tail cone. "With robots and other advanced equipment we're investing in, I'll be able to single-handedly build a 787 tail cone muffler from start to finish with fully Leaned-out processes," Durham said.

In another production cell, a laser will be used to scribe a complex pattern on mskant (coating) that will define a diffusion bond between two pieces of titanium—eventually becoming part of the heat shield that protects the engine strut from intense

heat emitted by engine exhaust.

In final assembly of the heat shield, a cell technician will preload more than 30 "details," or pieces, into a heavy jig, which then will be picked up by two robots working together to load the assembly into the automated cell. The two futuristic "Rosie the Riveters" will then swap out lifting fixtures to complete the heat-shield assembly by drilling and riveting nearly 1,000 fasteners per day—a task that would disable a human worker in a short time.

Beyond robotics, the Auburn Advanced Metal Structures team is embracing the opportunities and challenges of other new technologies. Among them: fine-grain titanium (a new type of material with properties that allow for much better low-temperature forming), friction stir welding and non-tank line processing to achieve special surface treatments.

These new technologies augment the site's highly specialized capabilities of diffusion bonding, laser welding, and superplastic forming—making Boeing Auburn the home of two of the world's biggest



Sherry Durham, Advanced Metal Structures assembly cell technician at Boeing Auburn, and a spot welding robot position and weld parts to build a tail cone muffler for the 787 Dreamliner.

JOE BEAL PHOTO

SPF presses. Superplastic forming is a process used to create formed metal parts under conditions of elevated temperature and applied pressure, where material is stretched on dies to obtain the desired part configuration, then trimmed to size.

“We’re able to build critical 787 parts that otherwise couldn’t be made using conventional methods,” said Peter Comley, an engineer in the superplastic-forming Materials & Process Technology group at the site’s Advanced Metal Structures site.

Expanded specialty capabilities that support new product development demonstrate the newly nimble posture of Boeing Auburn. In 2003, the site began focusing on emergent manufacturing capabilities to meet rapidly changing customer needs, including specialty manufacturing processes that aren’t sufficiently mature in general industry to support time- and cost-critical production.

OAK RIDGE, TENN.: DREAMING BIG DREAMS

The Boeing Oak Ridge team has been dreaming of hitting the big time since 1981. Now it looks like they have, and celebrating the site’s 25th anniversary this year seems that much sweeter, now that employees have plenty of work on substantial new development programs.

The dream-turned-reality for Boeing Oak Ridge includes a role on the 787. That job was earned by its revolutionary design concept and role as engineering, build and systems integrator for flight deck modules for the all-new airplane.

The airplane’s flight deck console houses the “brain and eyes” of the airplane—a key part of the system that enables safe, effective, ergonomic and comfortable airplane operation. The innovative “look and feel” of the 787 flight deck is a major factor differentiating the 787 from other commercial airplanes.

Oak Ridge’s innovative design features a monolithic, machined structure assembled using significantly fewer parts. That means reduced build complexity, weight and costs, along with increased quality. Richard Vonhatten, Oak Ridge lead design engineer for flight deck structural assemblies, said other advantages include fewer assembly tools, reduced foreign object debris, a stronger structure and a more flexible design that’s adaptable to all Boeing models.



RAY GRIMES PHOTO



LISA SMITH PHOTO

Above: From left, Boeing Oak Ridge 787 lead design engineer Richard Vonhatten and 787 assembly mechanics Joe Moore and Terry Thomas worked together to design, manufacture and deliver the first 787 forward panel support.

Left: The 787 flight deck console designed by Boeing Oak Ridge is a monolithic machined structure that offers reduced build complexity, weight and costs, with increased quality.

For Boeing Oak Ridge, winning work on the 787 was the catalyst to transitioning site strategy from a “build-to-print fabrication shop” to the strategy of a systems integrator with responsibility for design, build, and electrical control systems integration and test. This role is a significant move up the value chain, helping align the internal supplier with the 2016 Vision statement emphasizing large-scale systems integration as a Boeing core competency.

The Boeing Oak Ridge partnership with the 787 program also paved the way for the site to land other new contracts that fit its integrator strategy. Among these pacts: complex parts production and assembly work on the P-8A, a military derivative of the Next-Generation 737-800 aircraft.

PORTLAND, ORE.: HEAVY METAL

Parts production for the Boeing 787 is moving at a quick pace at Boeing Portland, which is responsible for manufacturing three complex-components work packages for the world’s largest industrial program.

Last August, the Boeing Portland team

took on the task of machining a new, high-strength titanium alloy to manufacture side-of-body chords—complex parts that provide structural load-bearing at the primary joint between the airplane’s wings and body. Boeing Portland expects to deliver the first shipset of side-of-body chords in August to program partner Fuji Heavy Industries of Japan.

With production on its second 787 work package well under way, Boeing Portland has delivered 100 percent on-time performance on all 10 shipsets of engine mounts to Rolls-Royce and General Electric. The 787 program-propulsion-systems partners will use the engine mounts as part of the test and certification program for engines designed for the Dreamliner.

In June, Boeing Portland started fabricating the first component in its third 787 work package: flap-actuation mechanisms that help move the airplane’s wing flaps during takeoff and landing. Boeing Portland’s first part delivery is scheduled for August to 787 program partner Hawker de Havilland, a Boeing subsidiary and Fabrication business unit with sites in Australia. ■

Good as GoldCare

Revolutionary 787 fleet support program complements airplane's technical achievements

By CHAZ BICKERS

With more than 400 orders and commitments, the sales success of the new Boeing 787 Dreamliner is testament to the efficiency and performance the airplane promises to deliver to customers when it enters service in 2008.

Yet the value of the 787 goes beyond its ability to outfly the competition. GoldCare, a comprehensive life-cycle-management service specially developed for the Dreamliner, offers a strategic new business choice for customers to acquire, operate and transition their fleets.

Under GoldCare, Boeing leads and inte-

grates a global team that supports customer fleets: It performs all maintenance and parts support, tracking airplane condition and configuration and guaranteeing airplane schedule reliability—all within a set, predictable per-flight-hour cost. This turnkey service, which includes Boeing employees from numerous organizations, gives the new jetliner—and Boeing—another discernible advantage in the competitive airplane market.

“We have an outstanding opportunity to further help customers by taking risk and complexity out of their operation and offering operational costs that directly reflect airplane usage,” said Bob Avery, vice president 787 Services & Support.

Avery said his team worked closely with customers, suppliers and the investment community over the last three years “to understand how we could offer a revolutionary set of services that matches the innovation of the airplane.” To deliver the GoldCare service, Avery developed a team with diverse skills covering airline maintenance and operations; airplane production and

supply-chain management expertise; business and financing development; and information systems development and large-scale systems integration experience.

One of the most important elements of GoldCare is that Boeing—and every supplier—is motivated to provide the best service to the customer. By structuring GoldCare on a dollar-per-flight-hour basis, Boeing and its supply chain are focused on reducing costs and improving airplane reliability.

GoldCare builds on the success of the Integrated Materials Management program offered by Commercial Aviation Services and contracted by nine airlines worldwide. IMM allows spares inventory to be held by suppliers and managed by Boeing, bringing fleet-wide economies of scale to individual operators.

Customers have the option to purchase the GoldCare IMM service with or without maintenance. The GoldCare IMM service, which includes service-level guarantees, ensures lower and more predictable material costs aligned with customer revenue and maintenance operations.

“Our strategy has been to draw on the skills and talents of our current IMM organization as well as existing IMM customers, to develop this new service,” said John Borst, director of GoldCare IMM. “It’s a great example of leveraging our strengths into new business opportunities.”

To operate efficiently, GoldCare also requires an information management system that leverages the 787’s ability to generate and transfer airplane health, maintenance and operational data. The GoldCare team has integrated proven Boeing information management tools (see box at right) into a seamless information-management system that interfaces with the GoldCare Operations Center in south Seattle.

Integrating the system requires technical knowledge that can be applied in the airline maintenance environment.

“GoldCare has assembled talented individuals from the airline industry who are directly shaping these technologies,” said

To fulfill the promise of GoldCare, Bob Avery, vice president of 787 Services and Support, built a team of employees with diverse airline, airplane, technology and supply chain management skills.



MARIAN LOCKHART PHOTO

Advantage maintained

How GoldCare, a comprehensive life-cycle-management service specially developed for the 787 Dreamliner, helps customers:

- **Minimizes risk.** GoldCare is provided at an agreed cost per flight hour, with guarantees for schedule-reliability and parts-availability service levels
- **Lowers operating costs.** Individual operators benefit from economies of scale for spares and maintenance generated by the entire GoldCare supplier-partner network.
- **Simplifies operations.** Customers have a single provider—the GoldCare team—with extensive capabilities for managing and planning maintenance, material and information.
- **Helps secure better financing.** GoldCare's ability to monitor the airplane closely means its asset value may be better-preserved over its life cycle—making the airplane a more attractive investment to financiers.

Mark Hester, GoldCare Internal Implementation Systems manager.

Per-flight-hour costing for maintenance and spares support in the commercial aviation industry already is employed by engine manufacturers with solutions such as TotalCare from Rolls-Royce, and OnPoint from GE. It is also increasingly the norm for third-party suppliers to provide maintenance and logistics services for airlines.

GoldCare builds on that industry momentum by using designated regional partners to provide maintenance, repair and overhaul (MRO) services, rather than Boeing attempting to provide those functions in-house.

“Customers need to have absolute trust in our team, so we have developed robust operating processes and scoured the world for top-tier MRO partners that are committed to delivering the high quality that Boeing and our customers demand,” said Jay Maloney, GoldCare Operations director.

GoldCare's proving ground will be on airline ramps in the highly competitive commercial aviation services sector—a \$60 billion annual market, about equal to that for new airplanes. Yet while Boeing captures around 50 percent of new airplane orders, the company captures about 5 percent of the services business.

The GoldCare sales team has customer proposals under consideration and said interest has been strong.

“The intense competitive pressures in the airline business mean that every customer is taking a long, hard look in the mirror and asking, ‘What do we do best and how do we add value?’” said Steve Aliment, vice president of Sales for Commercial Aviation Services. “For many, the answer does not include maintenance and spares management. So they are looking to find ways to reduce their costs in those areas, while preserving their high-quality service.”

As a strategic business choice for customers, GoldCare requires a more consultative style of sales engagement, Aliment said. “Customers commit the highest level of executive attention to examining GoldCare, with Boeing and the airline working together to root out every cost element in their maintenance and logistics operations. Only when we have a detailed model of how that particular customer's business works can we fully understand the value GoldCare will bring.”

With the first 787 due in service in mid-

Mark Hester (center), GoldCare Internal Implementation Systems manager, confers in the GoldCare 787 Operations Center with teammates Chris Nicosia (left) and Kurt Hunter, as they prepare the facility for serving airlines.



MARIAN LOCKHART PHOTO

Steve Aliment, vice president of Sales for Commercial Aviation Services, said customer executives' interest in GoldCare has been strong. The GoldCare sales team has proposals under consideration.

2008, early customers are approaching decisions on how to support the airplanes. As expected, that has increased customer interest in GoldCare. MRO partner contracting has begun, and Avery's goal is to sign the first GoldCare customer this year.

“Everything we're doing on GoldCare is aimed at helping our customers be more profitable and creating a preference for Boeing products and services,” Avery said. ■

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A system of tools

The GoldCare team has integrated existing Boeing information-management tools into a system that interfaces with the GoldCare Operations Center. Among these tools:

- **Airplane Health Management.** Monitors the health of an airplane in flight and relays that information to airline personnel on the ground.
- **Maintenance Performance Toolbox.** Serves as a single location for operator maintenance and repair data. This software toolset is hosted on MyBoeingFleet.com.
- **Electronic Flight Bag.** Digitally stores all documentation and forms, including paper log books that pilots typically carry onto airplanes.
- **Maintenance and Engineering Management.** Allows dynamic planning and replanning of maintenance tasks to optimize efficiency and keep airplanes in the air.



MARIAN LOCKHART PHOTO

Structured approach

Short-field performance package gives boost to operators of 737s

By DEBBY ARKELL

GOL Linhas Aéreas Inteligentes is one of the fastest-growing low-fare carriers in Latin America. It has a Southwest Airlines-style business model, using a single airplane model—the Boeing 737—for point-to-point travel.

Rio de Janeiro's Santos Dumont Airport is a key field in GOL's route structure. But the airport's runway length—4,600 feet—is short compared to other airports and cannot accommodate larger airplanes at higher approach speeds with full payloads. This posed a challenge to the carrier's growth plans.

When GOL announced its desire to purchase airplanes with the capacity of a 737-800 or 737-900ER—but with the ability to land on short runways, as its 737-700s can do—Boeing quickly responded to GOL's needs. Then—Boeing 737 Chief Engineer Mike Delaney and his team developed a set

of features called the short-field performance package to enhance both the short-field takeoff and the landing performance of the 737.

“Based on what we heard (from GOL) we pursued a combination of elements to achieve the performance our customer wanted,” Delaney said. “Together they optimize an already great design of a successful product.”

The short-field performance package illustrates how Boeing incorporates customer feedback into its products to meet customer

“Together they optimize an already great design of a successful product.”

—Mike Delaney, former 737 chief engineer, on the short-field performance package

needs—and remain competitive in the hotly contested jetliner market. The package is standard on all 737-900ERs, and is an option on the 737-600, -700 and -800.

Included in the package:

- A winglet lift credit, achieved through additional winglet testing, that allows the

use of lower landing-approach speeds.

- Takeoff performance improvements such as using sealed leading-edge slats on all takeoff flap positions, which allows the airplane to climb up and away more rapidly on shorter runways.

- A reduced idle thrust transition delay between approach- and ground-idle speeds, which improves stopping distances and increases field-length-limited landing weight.

- Increased flight-spoiler deflection from 30 degrees to 60 degrees, which aids brake performance when landing.

- A two-position tailskid at the rear of the aircraft. The tailskid protects longer-bodied 737-800s and -900ERs against inadvertent tailstrikes during landing, which allows higher aircraft approach attitudes and lower landing speeds.

Depending on the model of 737 and the option selected by the customer, the airplane can carry up to 18,000 pounds of additional payload at landing—or require up to 500 feet less runway to land. The same is true for takeoff weights and field lengths, increasing takeoff weight 280 to 6,360 pounds—or decreasing required field length 20 to 440 feet. This is a tremendous plus for carriers that routinely serve airports with short runways, such as GOL at Santos Dumont.

“The solution provided by Boeing is extraordinarily innovative and will give us conditions to increase the passenger traffic between São Paulo and Rio de Janeiro by 30 percent, offering safety and comfort to our customers,” said David Barioni, technical vice president of GOL.

Boeing 737 chief pilot Ray Craig and his crew recently completed an extensive flight-test program using GOL's first direct-purchase 737-800 and said the airplane performed well. The airplane will be certified by the U.S. Federal Aviation Administration this month and is scheduled to be delivered to GOL afterward.

For a relatively small investment, Boeing is getting a good return. To date, 10 carriers have ordered more than 250 jets with elements of the short-field performance package.

“Our engineers kept it simple, making minor parameter changes in design that significantly enhance the value to the customer,” Craig said. ■

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MARIAN LOOKHART PHOTO

Inside a 737-800 outfitted for short-field performance flight testing, Boeing 737 chief pilot Ray Craig (center) talks with members of the flight-test ground operations crew. Shown, from left, are Jasper Corleis, Shaun Newton, Craig, Larry Lewis, Bill Mantzke and Kevin Caldwell.

Ready to go

Boeing workers helped prepare shuttle for this month's flight

By Ed Memi

Boeing employees have played a major role in preparing for this month's Space Shuttle flight, the final test flight before future International Space Station assembly missions can resume.

The mission—STS-121, aboard Space Shuttle *Discovery*—will continue to test new equipment and procedures that increase the safety of shuttles while also delivering critical cargo to the ISS.

The biggest technical challenge has been to eliminate or reduce foam debris coming off the shuttle's external fuel tank. During *Discovery's* last flight in 2005, a 1-pound piece of foam insulation broke away from an air deflector called a protuberance air-load (PAL) ramp running outside of the tank. The PAL ramps smooth the flow of air across two externally mounted pressurization lines and an electrical cable tray.

NASA decided last year to remove the ramps, based on computer modeling that indicated the pressurization lines, cable tray and attachment fittings would withstand predicted aerodynamic forces during ascent. NASA called removing the PAL ramp the biggest change to the aerodynamic configuration of the shuttle in its 25-year history.

Boeing engineers worked closely with NASA, United Space Alliance and Lockheed Martin to determine the changes in aero-heating, static and dynamic loads on the external fuel tank. The analysis, combined with advanced wind-tunnel testing at NASA facilities, determined that the Space Shuttle is safe to fly.

"When the ramps are removed, air can travel underneath the cable tray and pressure lines. The flow under and around these components is what we assessed," said Tom McGowen, Boeing project manager for Space Shuttle Systems Engineer-



At the Space Station Processing Facility at Kennedy Space Center, Fla., the Boeing Checkout, Assembly and Payload Processing Services team oversees the lowering of the multipurpose logistics module Leonardo. The team is working to ensure a proper fit of the module as it is placed inside the payload transportation canister—which will travel on Space Shuttle *Discovery*.

NASA PHOTO BY KIM SHLETT

ing and Integration.

Other Boeing accomplishments for the STS-121 flight include

- Ensuring a replacement Trailing Umbilical System Reel Assembly (TUS-RA) can be safely carried in the shuttle's payload bay. On the ISS, a mobile base station moves along rails on the main solar-array truss to position the lab's robot arm for assembly work. The TUS-RA has power and data cables that un-reel or wind up in front of and behind the cart as it moves. One of these two cables was cut accidentally in 2005 when a safety device failed. Boeing station engineers helped troubleshoot the problem and devised a repair.

- Evaluating the effects of "tin whiskering" in avionics boxes. Tin whiskering is a phenomenon where tin develops thread-like growths from its surface. The concern is these whiskers could break off and cause an electrical short. Through analysis and testing, Boeing demonstrated there is sufficient redundancy in the orbiter design and the risks of an electrical short are very low.

- Assisting NASA and USA in developing new installation procedures for gap fillers installed between tiles. During the STS-114 shuttle mission, two gap fillers were protruding and had to be removed in space. ■

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A U.S. Marine Corps MV-22B Osprey executes a vertical takeoff from the flight deck of the amphibious assault ship *USS Wasp* as another waits to launch during flight operations in the Atlantic Ocean.

DOD PHOTO BY PETTY OFFICER 3RD CLASS TIMOTHY BENSKEN, U.S. NAVY

Set to soar

V-22 Osprey's year includes new focus on fleet operations

Going to this month's Farnborough International Airshow in the United Kingdom? Look for the Bell Boeing V-22 Osprey tilt-rotor aircraft, which will be a featured performer at the event.

Its starring role is, however, merely the latest of several milestone events and ceremonies marking the Osprey's new status following successful operational evaluation in mid-2005. These events culminated in U.S.

Defense Department approval for full-rate production, fleet operations and deployment.

Here's a look at the V-22's active first six months of 2006.

- In February, Defense Secretary Donald Rumsfeld and Marine Commandant Gen. Michael Hagee rode in an MV-22 to Camp Lejeune, N.C., to attend the establishment of the new Marine Corps Special Operations Command.

At the standup ceremony, VMX-22, the Marine tilt-rotor test and evaluation squadron, performed jump takeoffs from confined areas, conversions from helicopter to airplane mode, high-speed fixed-wing approaches and automatic hover.

- On March 1, at the Bell Boeing Osprey completion facility in Amarillo, Texas, the U.S. Air Force Special Operations Command took delivery of the first CV-22 Osprey configured for combat operations. That aircraft, CV-22 No. 1007, is the first Block B/10 Osprey built to meet Air Force Special Operations mission requirements.

The Air Force's 71st Special Operations Squadron accepted the new aircraft to support aircrew training at Kirtland Air Force Base, N.M., as the unit prepares for full operation in 2009.

The CV-22 is similar to the Marine Corps MV-22 but incorporates capabilities that enable the multimission aircraft to perform low-level high-speed flight and other Special Operations missions. The U.S. Air Force will purchase at least 50 CV-22s.

- Also in early March, Marine Medium Tiltrotor Squadron 263 (VMM-263) celebrated its redesignation as the Marines' first MV-22 fleet squadron. The ceremony at Marine Corps Air Station New River, N.C.,

A U.S. Air Force CV-22 Osprey aircraft prepares to land on the flight line at Holloman Air Force Base, N.M., in May. The Osprey and its crew were taking part in the filming of the movie "Transformers."

signals the Osprey's first operational service. VMM-263 will fly the MV-22 in combat assault and other combat support missions when it is fully operational in 2007, with plans to deploy to Iraq before midyear. "Next year, we're going to put [the V-22] into combat with great confidence," said Lt. Gen. John Castellaw, Marine Deputy Commandant for Air.

• Air Force Lt. Gen. Donald J. Hoffman, Military Deputy in the Office of the Assistant Secretary of the Air Force for Acquisition, visited Boeing Rotorcraft Systems in Philadelphia in May for briefings on the Bell-Boeing V-22 Osprey program.

"There has been a magnificent turnaround on the V-22 program in the past two years," Hoffman noted during his visit. "Everyone on the program deserves credit and congratulations not only for the great aircraft but for the improvement in affordability."

As the Osprey program gears up for full-rate production and fleet operations, it's on track to meet or exceed its commitment for a \$58 million MV-22 price by 2010. The cost-reduction initiatives that support reaching this cost target (see story at right) not only create demand from U.S. military customers but also from allied armed forces around the world. ■

Keep it lean

A look at some of the cost-reduction initiatives on the V-22 program

CRI 987: V-22 aft cart. New design permits transport, inspection, deflash and first assembly jig load. Eliminates parts-handling steps and flow time, increases shop safety.

Savings: \$6,000 per aircraft, \$2 million over program life

CRI 120: Small-part moving line. Moving fabrication line utilizing reusable curing bags and automated tool storage rack has reduced fabrication man-hours by one-third.

Savings: \$27,000 per aircraft, \$7 million over program life

CRI 1005: Reusable curing bags. Elastomeric vacuum bags save compaction cure preparation time, eliminate disposable nylon bags. Applicable to all hand layups on fabrication tables.

Savings: \$50,000 per aircraft, \$15 million over program life



U.S. AIR FORCE PHOTO BY AIRMAN 1ST CLASS RUSSELL SCALF

Goal in sight

The Bell Boeing MV-22 Osprey program is racing to meet a cost-reduction commitment of \$58 million per aircraft by 2010, thanks in part to innovative projects at the Boeing Rotorcraft Systems Composites Center of Excellence (CCoE) in Philadelphia.

Boeing Rotorcraft fabricates and assembles the tilt-rotor aircraft's fuselage with both large-scale composite sections and smaller components within the CCoE. Although the CCoE utilizes digital automated layup tools for large sections, detail parts still require labor-intensive hand layup.

Tom Kain, the CCoE Cost Reduction Initiative focal, worked with Tom Albertson, Manufacturing Research & Development; Tom Buddenhagen, Industrial Engineering; Rick Ross, shop manager; and the Small Parts Employee Involvement (EI) Team to implement a new moving line for small parts. The team's innovation, which began operation in April, promises to reduce at least \$8 million in V-22 small-part fabrication cycle time and cost and pay for itself after 21 aircraft. Thanks to these improvements, work that totaled 1,250 man hours per aircraft has been shaved to 950, Buddenhagen said.

"Our Fabrication teammates were doubtful at first," said Marty Connor, the Small Part EI Team leader. "But the team is enthusiastic about the new process because it does make everything more efficient."

The project also included a new vertical tool storage carousel that simplifies setup time. "Now it's easier to find layup tools and move them, some of which are pretty heavy, onto the work stations," Connor said. "Our layup mechanics not only save time looking for tools, but it reduces physical strain."

Another composite part process improvement, with broad potential application throughout the CCoE, involves using reusable elastomeric vacuum bags instead of the typical disposable bagging materials that keep composite parts compacted while they are cured in autoclaves. Torr Technologies of Auburn, Wash., designs the bags, which are uniquely shaped to fit each tool and ultimately save layup and cure preparation time. Because Boeing Rotorcraft needs quick turnaround for vacuum bag production, Torr agreed to set up a satellite production facility at L.J. Stephens & Son Inc. in nearby Essington, Pa. Reusable bags will help Boeing save about \$40,000 per aircraft, or \$15 million for the current V-22 program. The bags have been so successful that Boeing expects to utilize them throughout the CCoE.

The CCoE also found a way to cut costs by moving large V-22 components more efficiently. Kain, along with deflash mechanic John Mulfino, Jeff Forbes from Manufacturing Research & Development, and Dean Gaines and his Aft Assembly EI Team developed a new cart concept for transporting the Osprey's one-piece tail section from the Composite Center's fiber tow automated layup machine to the V-22 assembly line. The new cart rotates, providing better access to the part during the deflash operation, and minimizes loading and unloading the part using overhead cranes. The aft cart, which will save about \$6,000 per aircraft and \$2 million over the program's life, may also be incorporated into a moving component assembly line in the Osprey's focused factory.

"Our entire program team is committed to our cost targets," said Nina Prybolsky, manager, V-22 Affordability, "and we're confident that we'll meet or exceed our goal on schedule."

Back to basics

IDS program managers focus on fundamentals to drive performance

By DIANA EASTMAN

Pro golfers know it. So do generals and opera divas. If you want to succeed, you have to stay disciplined and focused on the fundamentals of your craft.

That age-old approach is the driving force behind Integrated Defense Systems' goal to improve program execution. As part of this back-to-basics strategy, the IDS Program Management and Business Excellence function is introducing new management tools and measurement systems, integrating and streamlining processes, and adding training programs to help promote consistency and higher performance.

Boeing Frontiers asked three IDS program managers—leaders who have profit-and-loss responsibility—to explain the role the basics play in leading their programs.

Greg Hyslop

Vice president and program manager, Airborne Laser

If our programs aren't successful, we don't have a company. So it is essential we are world-class in the way we manage our programs and stay intensely focused on developing the product and satisfying the customer.

A program needs good baseline control, meaning you have solid processes and are on plan with schedules, budget, requirements and technical performance. I tell my team, "Keep the simple things simple." Good processes for the basics of the program mean you can concentrate the team's intellectual capital on hard things. In Airborne Laser, we have many hard problems to solve, and

Greg Hyslop (right, behind table) reviews program metrics with Brian Terry (left, behind table) and other Airborne Laser teammates. Hyslop likes taking on multiple challenges and earned a doctorate in system science and mathematics while working full time.

I don't want us spending all of our energy and creativity on the simpler things.

You also need a comprehensive set of metrics that you review weekly to get a sense of the program's progress. If you are disciplined, it becomes more readily apparent when things start to come out of alignment or issues pop up. When you review the right information, you can ask the right questions,

dig deeper and make good decisions.

Another fundamental is to have a scorecard like the Best Practices, so you know where the program is being managed the right way and where you need to improve. Plus, it is vital to have good communication within your team and with your customer, suppliers and industry partners so everybody is working for the success of the program.

Finally, credibility is everything. Your personal follow-through and delivery on what you say you are going to do is critical. In the tough times on a program, what you have to fall back on is your own credibility.

Practices make perfect

The eight Boeing Program Management Best Practices form an integrated management system for performing to plan, maximizing value and meeting customer expectations. They represent the best of Boeing and apply to programs of all types and sizes.

Those Best Practices are

- Business Plan Creation and Review.
- Business Offer.
- Supplier Integration.
- Organization.
- Program Execution and Control.
- Risks, Issues, and Opportunity Management.
- Help Needed and Independent Review.
- Program Communication.

Shelley Lavender

Program manager, F/A-18 E/F Super Hornet

If we are disciplined and follow the best practices, we will have good performance. But to get the most from the Boeing Program Management Best Practices and create real value for our customer, we need to wrap them in an open, honest culture where our teams are engaged.

Leaders set direction, but they have to engage with their teams and listen to ensure we are moving in the right direction. You get the best ideas from the folks who know the



MARIAN LOCKHART PHOTO



Shelley Lavender (center), meeting with Daniel Nelson (left) and Paul Niewald, was recently named program manager on the F/A-18E/F Super Hornet. She's been using Program Management Best Practices for more than 10 years.

PETER GEORGE PHOTO

processes, are designing and building our products, and are working with the technology. If you're not engaging with them, how can you capture their great ideas to improve business and make us more competitive?

An open, engaged culture leads to continuous learning and improvement for both individuals and the organization. No matter how good or disciplined we are, there is always someone we can learn from. Our competitive advantage is the talent in our teams.

As a team member, sometimes you have to work at being engaged. For example, when my daughter got tired of her piano lessons, I told her, "We are going to sit here and practice; you can either fuss or you can concentrate and we will get done a lot faster and you'll learn more." That is positive engagement. Here, we are on the job for more than 40 hours a week, so we might as well give it our most. If we end up enjoying it, we do much better and get more from it—and so does Boeing.

Gus Urzua

**Vice president,
Air Force Integrated Logistics**

There is no silver bullet or one aspect of program management that is more important than another. To be successful, you

Gus Urzua (left), talking with Alice Eichert, strives to create balance on and off the job. He started a softball tournament three years ago for his integrated product teams in Southern California.

need to maintain continuity and keep your attention on the basics—people, technical and financial—of high performance.

Executing on the basics means using everything at your disposal to move forward: the Program Management Best Practices as well as standard metrics, tools and systems, plus support from the IDS functions.

Discipline is being able to orchestrate and juggle these fundamental elements without getting wrapped up in the moment. You can't be good one day and bad the next,

or let a crisis cause you to ignore one area over another. You must maintain balance for the sake of your organization and your customer. Balance also means you know there's more to life than work. I believe today I am a better person, leader, husband and father because I learned to focus on maintaining balance on the job and at home.

I also believe attitude comes first, with aptitude a close second. You can be the smartest person in the world, but if you don't have passion for what you do, and you can't genuinely show it, you are not going to be as effective. Program managers set the tone; your positive attitude can help you pull the best from your team, make them part of the journey and take ownership on where the program is going.

We have more than 300 folks at our customers' locations supporting fielded products, who are scattered across the United States and in Europe and Japan. Just one employee out there with the wrong values and attitude can cause headaches that could take Boeing a long time to reverse. ■

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For more information, visit https://pm.web.boeing.com/best_practices/best_practices.asp on the Boeing Web.

TONY ROMERO PHOTO



ABL

Teammates working toward '08 intercept test

BY LYNN FARROW AND MARC SELINGER

The Boeing-led industry team for the Airborne Laser is confident it can meet the program's goal of conducting its first missile intercept test in late 2008.

"We have a good plan to get to our lethal demo in 2008, and the team has every confidence it can make it," said Greg Hyslop, ABL vice president and program director.

Boeing is the prime contractor for the program, which will place a high-energy chemical oxygen-iodine laser in a modified Boeing 747-400F to detect, track and destroy ballistic missiles in their boost phase of flight.

In 2005, the team completed two "knowledge points," the U.S. Missile Defense Agency's way of measuring success. Flight tests were completed with the beam control/fire control and battle management systems. The team also fired the high-energy laser for long duration and at lethal levels of power in a laboratory at Edwards Air Force Base, Calif.

In 2006, the aircraft moved to Wichita, Kan., where employees are strengthening the rear of the aircraft to accommodate installation of the high-energy laser's six modules. The team is also preparing for Low-Power System Integration-Active (LPSI-A) ground testing, a key milestone scheduled for this year. The ABL team took a major step toward LPSI-A recently when it demonstrated the ability to locate a ballistic missile target, track the target with simulated return from its target illuminator laser, and then compensate for distortions on the path to the target using simulated return from the ABL's beacon illuminator laser. During the remaining elements of LPSI-A ground testing, the illuminators will be installed, integrated and tested in the aircraft.

The program will start installing the high-energy laser in the aircraft in early 2007, leading to the intercept test in late 2008.

Here's a cutaway look at the ABL and some of the systems that operate within it. ■

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Beam Control System

Lockheed Martin

- Target acquisition and tracking
- Fire-control engagement sequencing and aim point selection
- Shaping and adjustment of high-energy laser beam power and intensity
- Stable line-of-sight control to target
- Calibration and diagnostics for autonomous real-time operations and post-mission analysis



Active Ranging System

Boeing

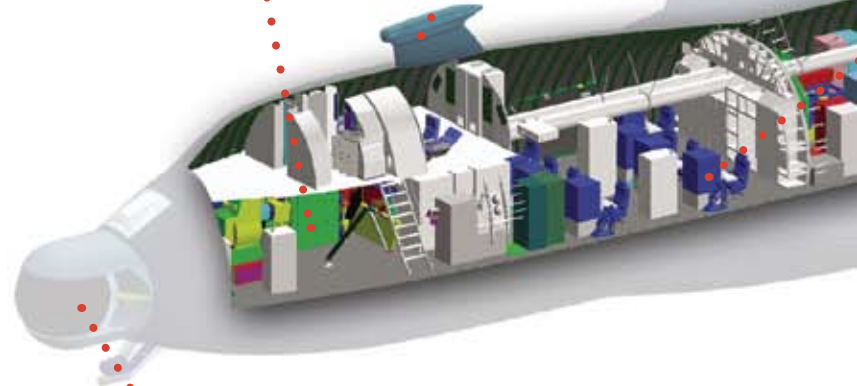
- Modified low-altitude navigation and targeting infrared system with high-power CO₂ laser
- Target acquisition from sensor cue, target tracking and pointing of CO₂ laser for ranging
- Help in determining missile launch point and impact point



Battle Management System

Boeing

- Human-machine interface
- Surveillance and target identification
- Launch and impact point prediction
- Theater interoperation and communications
- Target detection, identification, prioritization and mission planning
- Modular console architecture
- Extensive use of common software
- Standard voice and data links (Link 16/TIBS) to theater assets
- Open systems-based architecture
- Kill assessment



Nose-Mounted Turret

Lockheed Martin

- 1.5-meter telescope in turret to focus and collect return image and signals
- Design validated by extensive Boeing testing
- Composite construction for roll strength
- Window stowage to protect against debris

Laser-li



ent

interface
 tracking
 t-point predictions
 ability and
 identification,
 domination
 construction
 commercial hardware
 l secure data links
 heater assets
 ed software



Illuminator Optical Bench

Lockheed Martin

- State-of-the-art, diode-pumped solid-state lasers
- Beam shaping and transfer, and alignment optics
- Lightweight composite bench and spaceframe
- Modular design as line replaceable unit for ease of maintenance



Advanced Resonator Alignment System

Northrop Grumman

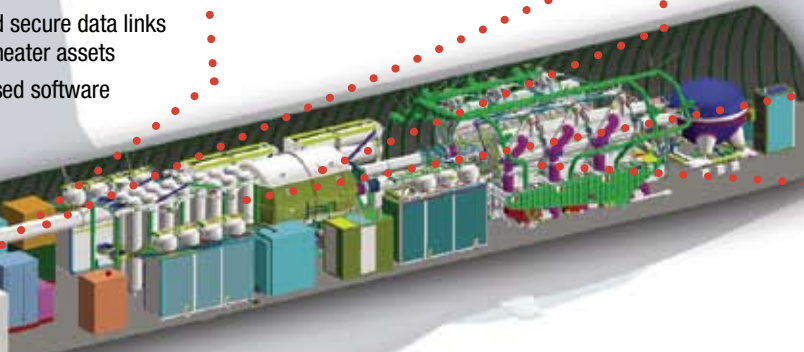
- “Benchless” laser resonator supporting distributed optics
- Active bench alignment system isolating optics from disturbances
- Diagnostics suite measuring high-energy laser performance
- Fast steering mirrors for stable handoff to beam-control system



Fuel Supply

Northrop Grumman

- Storage of fluids and pressurants for high-power laser operations—e.g., hydrogen peroxide, ammonia and helium
- Composite-overlap construction for weight and safety—featuring high life cycle, vibration resistance and impact tolerance



High Energy Laser

Northrop Grumman

- Chemical oxygen-iodine laser technology
- World record for chemical efficiency established
- Advanced materials—plastics, composites, titanium—for reduced weight
- Modular design for graceful degradation
- Aircraft-safety and field-maintainability design

BOEING GRAPHIC

ocus beam on missile and
 ing wind-tunnel tests
 ell
 st birds and bad weather

ke focus



TLCS at a glance

Program length: 34 years

Fleet covered: 40 MK2/MK2a U.K. Chinooks

Program value: \$360 million for first five years

Program tasks: All non-first-line field maintenance, technical support, field and engineering support, supply chain management, integrated logistics

During the next 34 years, Boeing will perform most maintenance on U.K. Chinooks (left) and provide logistics support for the fleet.

TLCS(S) for helicopters

Boeing offers lifetime of support for U.K. CH-47s

By BRAD MUDD

Boeing is working to increase the availability and lifespan of the United Kingdom's fleet of CH-47 Chinook helicopters through a new, long-term partnership with the Ministry of Defence (MOD).

The Through Life Customer Support program (TLCS) for the U.K. fleet of 40 MK2/MK2a Chinook heavy transport helicopters began May 22. During the next 34 years, Boeing will be responsible for performing most maintenance on the helicopters away from the field. Boeing also will provide technical support, and field and engineering services for the fleet.

The program is expected to save the United Kingdom at least \$295 million. The first five years of the program are worth \$360 million to Boeing.

Boeing's responsibility is to ensure an agreed number of aircraft are available for operations at all times. U.K. employees

will staff about two-thirds of the program, and most suppliers will be from the United Kingdom. Boeing engineers who have experience with the helicopter will be located with the fleet and linked up with the Philadelphia-based Chinook program.

This performance-based logistics contract is one of a new generation of MOD contracts that combines support efforts into one partnership with industry. In the past, several small contracts covered the wide range of support for a single U.K. weapons platform, said Group Capt. Mark Sibley, Chinook Integrated Product Team Leader with the Defence Logistics Organisation.

"Trying to coordinate those contracts was difficult, but most importantly, it was not providing the most efficient support to our frontline troops," Sibley said. "With [the new contract] we have built a support regime that focuses on reducing through-life costs while improving, or at least maintaining, our operational capability."

U.K. military personnel will still perform first-line maintenance in the field, but Boeing people will oversee all other, more intensive work. The partnership does not include engine maintenance, work on

U.K. common avionics, or training, but those may be added in the future.

The program has the short-term goal of keeping U.K. Chinooks available for operations. Long term, the partnership aims to extend the life of the fleet to 2040.

"With TLCS we have a long-term partnership, and we both have the same goals," Sibley said. "We will work together to see how we can reduce the cost of support and increase the operational effectiveness of this aircraft. Every aspect of the operation and support of the aircraft is fair game to be challenged to identify improvements and efficiencies. There are no sacred cows."

James O'Loughlin, director for the U.K. TLCS program for Boeing, said much of the early work has focused on ensuring warfighters in the field did not see a drop in availability when the program started May 22. "They have Chinooks deployed right now to Afghanistan and Iraq, so it has been important that we perform well to keep those helicopters supported in the field," he said.

The U.K. TLCS program demonstrates the ability of Support Systems, an IDS business center, to work with an existing platform, maintain availability, lower cost and extend the life of equipment. "I believe our work on the TLCS program will be of great interest to other countries flying the Chinook helicopter, helping us grow in this market," said Peri Widener, Army Integrated Logistics Support Programs executive for Boeing. ■

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Weathering the future

GOES-N satellite to provide more precise, earlier storm alerts

Here's how it GOES

The unique design of GOES allows its primary sensors to "stare" at Earth and frequently image clouds, monitor Earth's surface temperature, and sound Earth's atmosphere for its vertical temperature and water vapor distribution. GOES can track atmospheric phenomena, ensuring real-time coverage of short-lived dynamic events, such as severe local storms and tropical hurricanes and cyclones.

Boeing furnished GOES' space environment monitoring instruments as well as its communications subsystem with search-and-rescue capability to detect distress signals from land, sea, and air. Boeing also integrated GOES' imager, sounder and solar X-ray imager. The imager produces visible and infrared images of Earth's surface, oceans, cloud cover and severe storm atmosphere. The sounder provides vertical temperature and moisture profiles of the atmosphere. The solar X-ray imager monitors the sun's X-rays for the detection of solar flares. This early warning is important, as solar flares affect not only the safety of humans in high-altitude missions, such as the Space Shuttle, but also military and commercial satellites.

The first of three Boeing-built next-generation GOES-N satellites was deployed in late May. The satellites will help lead to earlier and more precise weather alerts.

By DIANE STRATMAN

When the Boeing Mission Operations team in Suitland, Md., handed over control of the GOES-N spacecraft to NASA in June to begin operational testing, it was just the latest in a series of successful milestones for the satellite.

GOES-N, the most advanced U.S. weather and Earth observation satellite, was launched on May 24. It was an all-Boeing mission with a Boeing Delta IV rocket lifting the Boeing-built spacecraft from Cape Canaveral Air Force Station, Fla.

The mission of GOES-N is to provide more accurate prediction and tracking of severe storms and other weather phenomena. That means earlier and more precise warnings for the public—which helps save lives and property.

The spacecraft will do that by continuously observing and measuring meteorological phenomena in real time across the Americas and their surrounding oceans. That information will then be transmitted to the National Oceanic and Atmospheric

Administration (NOAA), NASA, and oceanic and atmospheric scientists.

"This satellite will serve the nation by monitoring conditions that trigger dangerous weather, and it will serve the world by contributing vast amounts of observational data, as part of our contribution to the Global Earth Observation System of Systems," said retired Navy Vice Admiral Conrad C. Lautenbacher, undersecretary of commerce for oceans and atmosphere and NOAA administrator.

Forecasters are not the only beneficiaries of GOES-N technology. When the U.S. Coast Guard is searching the open seas and every second counts, the GOES-N enhanced ability to pinpoint distress calls will significantly reduce response time and enable search-and-rescue personnel to deploy appropriate resources to save lives. NASA engineers designing future spacecraft will benefit from GOES-N's capability to detect and measure activities such as solar flares and magnetic fields.

"GOES is one of those unique programs that touch the life of every person in the nation," said Steve O'Neill, president, Boeing

Satellite Systems International. "People depend on accurate meteorological information daily. The application of data received from the satellites will ensure the public receives increasingly precise information."

On June 4, after GOES-N achieved geosynchronous orbit, NOAA christened the spacecraft "GOES-13."

The successful launch marked the fifth overall flight by the Delta IV family of launch vehicles.

"We are very proud of the role we played by giving the GOES-N spacecraft a great ride," said Dan Collins, vice president and general manager of Boeing Launch Systems. "On the heels of last year's devastating storm season, we all knew how important the GOES-N launch was, and the team worked very hard to make sure we were successful. When we couple this launch with the recent launch of CloudSat and CALIPSO on board a Delta II, the Delta team has contributed to improving our understanding of weather, saving lives for years to come. This is really something to be proud of." ■

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'Key to our business'

Dev Banerjee heads the Systems Engineering Horizontal Integration Leadership Team at Integrated Defense Systems. IDS is identifying and implementing ways to improve its systems engineering performance.

JUANITO HOLANDEZ PHOTO

IDS forges ahead with plan to strengthen systems engineering

By RICHARD ESPOSITO

The U.S. Department of Defense, each of the military services and NASA are calling for more robust systems engineering planning and practices in their programs. To align with these requirements, Integrated Defense Systems President and CEO Jim Albaugh put systems engineering on a short list of major focus areas for 2006.

In response, IDS Engineering has begun to identify and implement needed systems engineering improvements. A number of steps are already completed or under way. And although the discipline has the word "engineering" in it, most anyone supporting an IDS program must know what systems engineering is—and help support improvements.

"Systems engineering really is key to our business. There is just no way around that," said John Tracy, IDS vice president of Engineering and Mission Assurance.

What is systems engineering? It's "a defined, disciplined, repeatable process that ensures integration of engineering disciplines and integration among all disciplines

and functions, including suppliers at all tiers, to produce a system," Tracy said. "The process is applied to the entire product life cycle and is a critical competency enabling Boeing's success in the role of a large-scale systems integrator."

Recent government acquisition policy directives require contractors improve their systems-engineering performance. In addition, an internal IDS audit found programs not meeting cost or schedule targets all had something in common: incomplete or inconsistent execution of systems engineering.

To tackle this, the IDS Systems Engineering Horizontal Integration Leadership Team looked at many parameters, including process and metrics, risk, requirements, change management, and cost and affordability, said HILT leader Dev Banerjee. "We analyzed the evaluation results, identified root causes and systemic issues, and created a detailed three-year action plan to correct these deficiencies," he said.

More stringent systems-engineering accountability requirements already have been added to Engineering, program and business leader Vision Support Plans for 2006. Among them: Each program should have someone responsible for systems engineering and will do a self-assessment of its systems-engineering capabilities.

In addition, all programs must develop a Systems Engineering Management Plan. A

SEMP is a living document that helps program teams and technical management execute throughout the program lifecycle and the product supply chain.

Strengthening systems engineering execution on programs also includes suppliers and teammates. Key suppliers may be required to develop their own SEMP. The Systems Engineering HILT is working with Supplier Management to develop an organizational environment and practices to better manage supplier-requirements flow-down and technical-product integration.

Another requirement calls for mandatory systems engineering overview training for all recently hired engineers. A new online training course was introduced recently and is being made available to other IDS functions such as Supplier Management.

These actions drive home a key point: Systems engineering is not just the province of IDS' roughly 6,000 systems engineers. Steve Goo, IDS vice president of Program Management and Business Excellence, has called systems engineering "the technical heart of program management." Added Dan Korte, IDS vice president of Supplier Management: "As programs become more complex in a net-centric environment, systems engineering will be the key competency needed to manage the increasingly complex interfaces involved in sourcing and partnering." ■

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From learning to action

Team Strategic Action program helps Boeing seize growth chances and develop leaders

BY ROBERT STERLING

Imagine assembling a team of experts who were given tools to design a business strategy to enter new markets. Imagine that the team executed those plans—and generated \$100 million in revenue without selling a single rivet.

The example may not seem plausible. But it's happening, thanks in part to the

Team Strategic Action program, which is helping cross-functional teams chart the course and find a way for Boeing to access new markets. TSA, a program within the Learning, Training and Development organization, utilizes a business-driven action-learning design that ties learning to real business growth while helping leaders develop themselves.

"With the help of TSA, our Intelligence, Surveillance and Reconnaissance team found a way to deliver a service around ISR to an emerging and robust international market outside of the defense industry," said Steve Krause, director, IDS Business Development and ISR team member.

The ISR team—sponsored by Phantom Works President Bob Krieger but now reporting in to IDS Advanced Systems—has gener-

ated \$100 million in revenue to date, focusing on providing services in new markets.

Specifics about this particular project cannot be discussed, as they are sensitive, but the service involves capabilities similar to Boeing's platform launch business with "very different offerings," Krause said.

TSA, held at the Boeing Leadership Center in St. Louis, is an eight-week program that's broken up into four distinct modules over a period of months. Three business teams operate concurrently to keep program costs in check and best leverage resources.

Cherie Teriet, TSA program manager, said team members thoroughly examine a marketplace and the underlying factors that dictate customers' decisions. This enables the business teams to gain a rich, fact-based insight of a particular market and tailor solutions that meet customer demand. Teams must have executive sponsors, who challenge them to create new strategic pathways for business growth.

"The perception among many is if you're training and not at your desk, you're not productive. TSA trains while helping our business grow, not to mention helping our leaders develop," said Bonnie Stoufer, vice president, Learning, Training and Development.

"The value of TSA is while the program is standardized with tools teams can use, it still allows for tremendous creativity, since teams enter the program at different business-maturity levels with varied expectations," Teriet said.

Along with ISR, another TSA team, Advanced Air Traffic Management, is making good progress. In just four months, the AATM team charted the course to find a strategy that would affect the Next Generation Air Transportation System (NGATS), especially in key markets such as China. AATM team member Greg Parker said that such a strategy requires the involvement and teaming of many players. The project's impact remains to be seen, but the team has achieved a number of milestones.

"If we can open more markets to NGATS, we'll position ourselves to sell more airplanes. That's ultimately what this program is about, and we're moving forward," Parker said.

Business growth is at the heart of the TSA program, but none of that growth would be possible without solid leadership skills. For Krause and the ISR team, one of the company's leadership attributes, "finds a way," has taken on a dual meaning.

"Not only did the team find a way to enter the market with a new services offering," Krause said, "it also helped customers afford a service they wanted but were reluctant to invest system acquisition resources in." ■

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Team Strategic Action lead Christine Daines of Mission Systems charts the course with the assistance of consultant Luke Hedrick. Daines said her teammates' intense focus has enabled them to accomplish much in an eight-week period.



RON BOOKOUT PHOTO

Tools and systems for an important job

Precision Engagement & Mobility Systems is the home of aircraft, weapons and networks that serve critical functions

PE&MS at a glance

Official name of business center: Precision Engagement & Mobility Systems

President: John Lockard

Headquarters: Crystal City, Va.

Employees: 25,000

Major locations: Puget Sound region of Washington state; Long Beach, Calif.; Mesa, Ariz.; St. Louis; Philadelphia

Divisions: Airborne Anti-Submarine Warfare & Intelligence, Surveillance & Reconnaissance; Global Mobility Systems; Global Strike Systems; and Rotorcraft Systems.

A.J. Walker ties down a blade on an Apache Longbow in Mesa, Ariz. The Apache Longbow is a program in the Rotorcraft Systems division of Precision Engagement & Mobility Systems.

Precision Engagement & Mobility Systems, one of three Integrated Defense Systems profit-and-loss centers, is responsible for military aircraft and weapons, as well as the systems that tie them together. PE&MS employees work on aircraft that serve functions from defending freedom to delivering needed supplies following natural disasters.

It's easy to see why PE&MS employees are passionate about the jobs they do and the programs they work on. They are dedicated to providing customers the capabilities they need when they need them.

Boeing Frontiers recently sat down with John Lockard, president of Precision Engagement & Mobility Systems, to discuss the business, its future and the role each team member plays.

Q: What do you see as the main strength of PE&MS?

A: The main strength of Precision Engagement & Mobility Systems is our people and the entire teams' focus on delivering innovative products and systems for warfighters. The PE&MS team is striving to set the standard for world-class program management, employing the industry's best practices and demonstrating peak performance to meet internal and external commitments.

Q: What are your top priorities?

A: We intend to focus on business excellence. A large part of the recent business realignment within IDS is really about improving execution and creating value through network-enabling technologies. We are finding there's a new level of capability that comes from putting

network interaction into our current products. For example, we have a major focus program underway right now with the U.S. Navy to incorporate network capability into the F/A-18. As you can see from the names of the four divisions (Global Mobility Systems; Airborne Anti-Submarine Warfare & Intelligence, Surveillance & Reconnaissance Systems; Rotorcraft Systems; and Global Strike Systems), our alignment is about producing capability and connecting products through networks to provide a whole new level of capability to our customer.

Q: Where do you see the PE&MS business going in the international market?

A: The international market is a real growth opportunity for PE&MS. Our F-15 Eagle sales continue with Korea and Singapore, and we are currently working with Korea on an F-15K follow-on buy. In Japan, the F-15 and F/A-18E/F Super Hornet are two great candidates for Japan's FX fighter competition. Our biggest international opportunity, though, is in India. India is expected to issue a request for proposal (RFP) soon for up to 126 aircraft for their Multi-Role Combat Aircraft Program. It potentially represents one of the largest acquisitions of combat aircraft by an international customer since the early 1990s. The P-8A aircraft also has enormous potential in India.

Q: What are some of the most important decisions to be announced near-term?

A: We have a busy year ahead of us. Just to name a few programs,



BOEING GRAPHIC

After an excellent year in development, the P-8A program remains on cost and on schedule.

Four-part harmony

Below and on Pages 34 and 35, *Boeing Frontiers* looks at each of the four divisions within Precision Engagement & Mobility Systems.

PE&MS division profile: Airborne ASW & ISR

Full name: Airborne Anti-Submarine Warfare & Intelligence, Surveillance & Reconnaissance Systems

Vice president and general manager: Tony Parasida

The Airborne ASW & ISR team is determined to leverage the knowledge and success—and increase the presence—of Boeing in this growing market. The most recent Quadrennial Defense Review—a Defense Department report that spells out the United States' defense program for the coming two decades—has a major focus on obtaining a better understanding of what's happening in the world every day. Airborne ASW & ISR's ability to provide this capability will be key to the division's growth.

Key programs:

- P-8A
- Airborne Warning and Control System (AWACS)
- Airborne Early Warning & Control (AEW&C)

Notable opportunities and recent achievements:

- The P-8A had an excellent year in development and remains on cost and on schedule. Any country that currently flies maritime patrol aircraft is a potential P-8A customer.
- Work continues with NATO on an AWACS upgrade.
- Both Australia's and Turkey's first AEW&C airplanes are now being modified.

■ FEATURE STORY

we expect South Korea's Airborne Early Warning & Control decision. The U.S. Air Force selection of a new Combat Search and Rescue (CSAR-X) platform also is expected this fall. We have two CSAR-X offerings: One is the HH-47 based on the Chinook and the other is a partnership with Sikorsky on the HH-92.

The C-17 continues to gain strong support in the U.S. Congress. We also have let the international community know that if they are interested in the C-17, now would be the time to buy, as we hope to preserve that critical airlift capability for the future. In addition to Australia and the U.K., other allies have expressed interest in the C-17. Boeing joined L-3 Integrated Systems and Alenia to compete for the U.S. Army/Air Force Joint Cargo Aircraft program. We are looking forward to the U.S. Air Force Tanker competition and are interested in seeing that RFP. We're working closely with the Army to define a Block III Apache upgrade.

Q: What's the future of unmanned systems?

A: There is a significant market for a variety of unmanned systems with a vast range of applications. We have the systems integration, communications and payload technologies to provide such platforms. Boeing has contracts with the U.S. Marine Corps, U.S. Navy and the U.K. Ministry of Defence's Joint UAV Experimentation Program for ScanEagle. This long-endurance vehicle is proving itself every day

in Iraq and in the Persian Gulf, and has more than 14,000 combat flight hours under its belt. *(Editor's note: ScanEagle is a 4-foot-long unmanned aerial vehicle (UAV) with imagery capabilities that allow tactical commanders to develop a clearer battlefield picture.)*

We were disappointed to see the X-45A Joint Unmanned Combat Air System demonstrator program come to an end, but we're fully prepared to engage in competition for any follow-on efforts with both the Navy and Air Force. We stand ready to meet next generation, unmanned long-range strike needs that may emerge in the future. We know how to build manned long-range bombers, and as the 64 missions we've flown with X-45A demonstrated, we're well on our way to realizing an unmanned capability as well.

The Rotorcraft Systems organization also is building the future of the rotary wing industry with the Canard Rotor/Wing, the A160 Hummingbird UAV and Joint Heavy Lift concepts.

Q: How do you plan to help foster communication across PE&MS?

A: In my experience there is nothing more important than tagging up with your team every single day so that you understand the complexities and possible problems encountered throughout your organization. We have established in the new PE&MS organization an operating rhythm to foster and strengthen communication at every level of our business. This process includes daily phone calls

PE&MS division profile: Global Mobility Systems

Vice president and general manager: Ron Marcotte

Global Mobility Systems programs provide airlift, tanker and integrated mobility solutions to customers around the world. The team currently is focused on C-17 domestic and international campaigns, as well as upcoming competitions for the U.S. Air Force Tanker and the Joint Cargo Aircraft. The Derivative Airplanes Program leverages the strength of Boeing Commercial Airplanes with the knowledge and talents of Boeing's mobility heritage to create top-notch products; the DAP team is pursuing additional sales of 737-based C-40 aircraft.

Key programs:

- C-17 Globemaster III
- KC-767 Tanker Programs
- Derivative Airplane Programs
- Advanced Global Mobility Systems

Notable opportunities and recent achievements:

- KC-767 work continues. Deliveries are scheduled to start this year to Japan and in mid-2007 to Italy.
- Global Mobility Systems stands ready to meet requirements the U.S. Air Force will spell out in its forthcoming tanker competition.
- C-17: Australia signed to buy four aircraft, with other customers expected. Also, the C-17 fleet recently reached 1 million flight hours.

A Boeing-built U.S. Air Force C-17 Globemaster III from the 14th Airlift Squadron, Charleston Air Force Base, S.C., releases flares over the Atlantic Ocean near Charleston during a training mission.



U.S. AIR FORCE PHOTO BY TECH. SGT. RUSSELL E. COOLEY IV

and weekly reports to get a status of the business and ensure that potential roadblocks are addressed on the spot. We also host monthly leadership-team meetings so that all executives understand our business, as well as quarterly “deep dives” and biannual reviews. We are establishing a culture of openness so that issues are worked top-to-bottom internally and externally.

Q: What can employees do to contribute to the success of the business?

A: Let me make this clear: Without employees there is no success. Each employee contributes valuable expertise that is crucial in performing to plan.

Throughout the organization, we have implemented Employee Involvement and High Performance Work Teams, in the spirit of the Lean+ initiative. These programs increase employees’ influence on work environment, productivity, elimination of redundancy and cost savings. These programs have proven beneficial to our business and will remain in place to enhance long-term growth.

I have asked every one of the managers in our organization to focus on better-than-plan. But it will take more than outstanding performance to meet this goal. I’ll need each employee to identify opportunities to improve processes, eliminate redundancy and then bring those ideas forward to their managers. Working collectively, we will accomplish our goals. ■

F-15s have accumulated more than 6 million flight hours with the U.S. Air Force and four international customers: Korea, Saudi Arabia, Japan and Israel. In 2008, Singapore will be added to the list after it receives the first of 12 F-15SGs.



PE&MS division profile: Rotorcraft Systems

Vice president and general manager: Mike Tkach

Rotorcraft Systems programs, including the CH-47 Chinook, AH-64 Apache and V-22 Osprey, provide proven vertical-lift solutions to customers throughout the world. There are more than 800 Chinooks and 1,000 Apaches in service worldwide. The V-22 is in the process of being fielded with the U.S. Marine Corps after receiving government approval to move forward with full-rate production.

Key programs:

- AH-64D Apache Longbow
- CH-47 Chinook
- V-22 Osprey

Notable opportunities and recent achievements:

- MV-22 Osprey is now operational; operational testing of the CV-22 begins later this year.
- Japan recently received its first two AH-64D Apache Longbows.
- The new CH-47F is currently in production for the U.S. Army. The CH-47F features a modernized airframe and a Rockwell Collins Common Avionics Architecture System advanced digital cockpit to meet the needs of current and future warfighters.

PE&MS division profile: Global Strike Systems

Vice president and general manager: Chris Chadwick

Global Strike Systems answers an emerging requirement in the Defense Department, and increasingly with international customers, for systems capable of projecting global power. Building on combat-proven weapon systems including the F/A-18, F-15, B-1B and JDAM, Global Strike Systems is focused on enhancing value by incorporating networked-enabled capabilities into existing platforms—and increasing affordability through initiatives such as Lean+, one of four Boeing companywide growth and productivity initiatives.

Key programs:

- F-15E Strike Eagle
- F/A-18E/F Super Hornet
- F-22 Raptor
- B-1 bomber
- B-2 bomber
- Harpoon Block III
- Joint Direct Attack Munition (JDAM)
- Small Diameter Bomb
- Standoff Land Attack Missile–Expanded Response (SLAM–ER)
- T-45 Training System

Notable opportunities and recent achievements:

- F-15 Eagle sales continue with Korea and Singapore; GSS is currently working with Korea on an F-15K follow-on buy.
- F-15 and F/A-18E/F Super Hornet are candidates for Japan’s FX fighter competition.
- India is expected to issue a request for proposal soon for up to 126 aircraft for its Multi-Role Combat Aircraft Program. The F/A-18E/F could be a candidate.
- The new Block II F/A-18E/F Super Hornet, equipped with the Active Electronically Scanned Array radar, is in production for the U.S. Navy.
- The EA-18G Growler, the electronic warfare version of the F/A-18, will conduct its first flight this year.

Simulating Success

How do modeling and simulation activities, capabilities benefit Boeing? Let us count the ways—9 of them

By DEBBY ARKELL

Hands-on experience often can be the best way to tackle complex problems or master challenging skills. But when it comes to navigating intricate, variable-laden scenarios, or combat situations involving complex military maneuvers using expensive equipment, “on-the-job training” often is not a prudent approach.

That’s why Boeing Integrated Defense Systems, Commercial Airplanes and Phantom Works engage in a wide variety of modeling and simulation activities, designed to provide ever more realistic simulations to internal customers across the enterprise—and to external customers as well.

“There is a tremendous amount of diversity in modeling and simulation being worked on at Boeing, encompassing very complex issues within a very broad spectrum,” said Ron Fuchs, director of Modeling and Simulation for IDS. “Right now there are more than 200 needs for new modeling and simulation capability, and more coming all the time.”

Boeing analysts have a variety of tools available—or under development—that can demonstrate concepts and provide significant cost savings by exploring ideas, developing systems, testing and manufacturing within a virtual environment before committing to specific approaches.

As such, Boeing is a full-service provider: Its modeling, simulation and analysis capabilities run the gamut from concept exploration to lifetime support of a product.

Here’s a look at nine ways modeling and simulation techniques help Boeing and its customers. ■

debra.j.arkell@boeing.com

Editor’s note: This list is not intended to be all-inclusive of modeling, simulation and analysis capabilities at Boeing.



The P-8A proposal had its origins in computer-based modeling techniques. Boeing analysts used a variety of performance-modeling tools to demonstrate the capabilities of the 737 compared with the U.S. Navy legacy platform and deliver a comprehensive and credible concept of operations.

1 Product proposal

Analysts use computer-based modeling techniques extensively to model a proposed product or system to determine if an idea could result in a viable program. This is where the P-8A proposal originated. Boeing experts used a variety of performance modeling tools to demonstrate the capabilities of the 737 compared to the Navy’s legacy platform—and to show how this product could suit the Navy’s mission requirements. The tools demonstrated to the customer the proposed product was superior to the competitor’s product, and modeling and simulation tools provided robust data for the 250-page concept of operations that ultimately won Boeing the contract.

2

Detailed product design

Developing the details of—and manufacturing requirements for—a complex product or system is determined more readily using modeling and simulation activities. People on the U.S. Army's Future Combat System program are working with suppliers on product producibility and assembly simulation, and variation analysis. Product producibility and

assembly simulation evaluate designs and define build sequences for a product. Simulations identify tooling, facility and ergonomic issues before the product design is released, minimizing problems in the factory. Variation analysis assesses the impact of different assembly sequences and tooling concepts on final product form, fit and function.



BOEING GRAPHIC

JOE OLMO'S PHOTO



Boeing workers at the FCS System of Systems Integration Lab in Huntington Beach, Calif., simulate activity along nodes in a communication network, forming and breaking and reconnecting systems in support of Boeing's Future Combat System program. This element of FCS is considered to be a mobile, ad hoc, self-forming, self-healing network.

3

Modeling factory environments

When analysis validates a product's viability and it's time to build, Boeing analysts apply factory-modeling methodologies to determine the optimal process to create various products. Using the physical elements of a manufacturing environment, process plans and other data, they can visualize and validate an optimal production environment before

facility construction starts, identify potential bottlenecks, and establish lead times for tool and capital procurement. They also model the flow of a product through a factory. Alternate flows and resource plans are easily evaluated before introducing hardware into the factory.

4

Product or system testing

Models and simulations are used to test products or prototypes in a variety of simulated environments. This is particularly true of warfare (see reason 9 on page 39). Modeling and simulation has been an extremely important element of Future Combat System testing. The hundreds of vehicles, sensor platforms and networked computer systems in the FCS system of systems will be tested in a large-scale distributed simulation facility called the FCS System of Systems Integration Lab. The SoSIL provides a synthetic combat environment for simulating the entire FCS Brigade Combat Team. FCS vehicles and platforms will initially be simulated systems in the lab. As FCS development progresses, simulated systems will be replaced by operational hardware and software.

system of systems will be tested in a large-scale distributed simulation facility called the FCS System of Systems Integration Lab. The SoSIL provides a synthetic combat environment for simulating the entire FCS Brigade Combat Team. FCS vehicles and platforms will initially be simulated systems in the lab. As FCS development progresses, simulated systems will be replaced by operational hardware and software.

The Boeing Commercial Airplanes 777 Engineering Team used data from flight-test 777 airplanes with simulation and modeling tools to validate proposed system enhancements to the 777-200LR and 777-300ER programs. Depicted here is a simulation, based on actual flight-test data, visualizing airplane performance during a flight-test maneuver.

5

IMAGE COURTESY PETER RYER



Modeling variants or enhancements to existing products or systems

Models and simulations are useful when proposing new courses of action, identifying new uses for a product or determining the viability of product enhancements. Many Boeing programs use such tools as a normal course of business. The 777 Engineering Team applied simulation and modeling tools to actual data from flight-test 777 airplanes. This helped demonstrate the quality of airplane handling, such as lateral and longitudinal control, and performance in a variety of circumstances—and validated system enhancements on both the 777-200LR and 777-300ER programs.



PHOTO COURTESY ALTEON

6

Training systems and maintenance

Flight simulators such as those found at Boeing subsidiary Alteon are prime examples of the benefits of simulation training systems. Using flight simulators, customer pilots are immersed in the operational environment, enhancing their learning experiences. For example, pilots can practice recovery maneuvers related to a controlled descent into terrain without actually being in a true high-risk scenario. Flight simulator time costs approximately one-tenth as much as an actual flight.

Using flight simulators, Boeing Commercial Airplanes customers are immersed in a realistic flight environment, enhancing their learning experience. Using computer-generated visuals to simulate surroundings, pilots can practice a variety of maneuvers related to high-risk situations without ever being in jeopardy.

7 Financial or cost modeling

Modeling financial risk is extremely useful to businesses such as Boeing Capital Corporation. In 2004 BCC rolled out a new software modeling tool that looks at financial data and

all of BCC's customers in aggregate, along with historical market data. The software provides a clearer picture of how each financing decision affects BCC's total exposure to risk. Examining all risk factors simultaneously helps decision makers understand how to mitigate volatility in the financing business and make better predictions.

Network communications

Tactical military communications networks—such as Joint Tactical Radio System Cluster 1—are beginning to resemble the Internet in their complexity. The scale of these networks makes it cost-prohibitive, if not impossible, to conduct field tests with real deployed units. Modeling and simulation of such networks in a laboratory environment is the most economical means to test and validate candidate networking protocols. Network simulations can be constructive (where all elements are simulated) or virtual

(where some real elements are involved). The Tactical Wideband InterNetworking Systems Lab in Anaheim, Calif., is an environment that acts as a distributed virtual test bed, and the Boeing Transformational Communications Laboratory in El Segundo, Calif., performs a similar function for satellite communications.

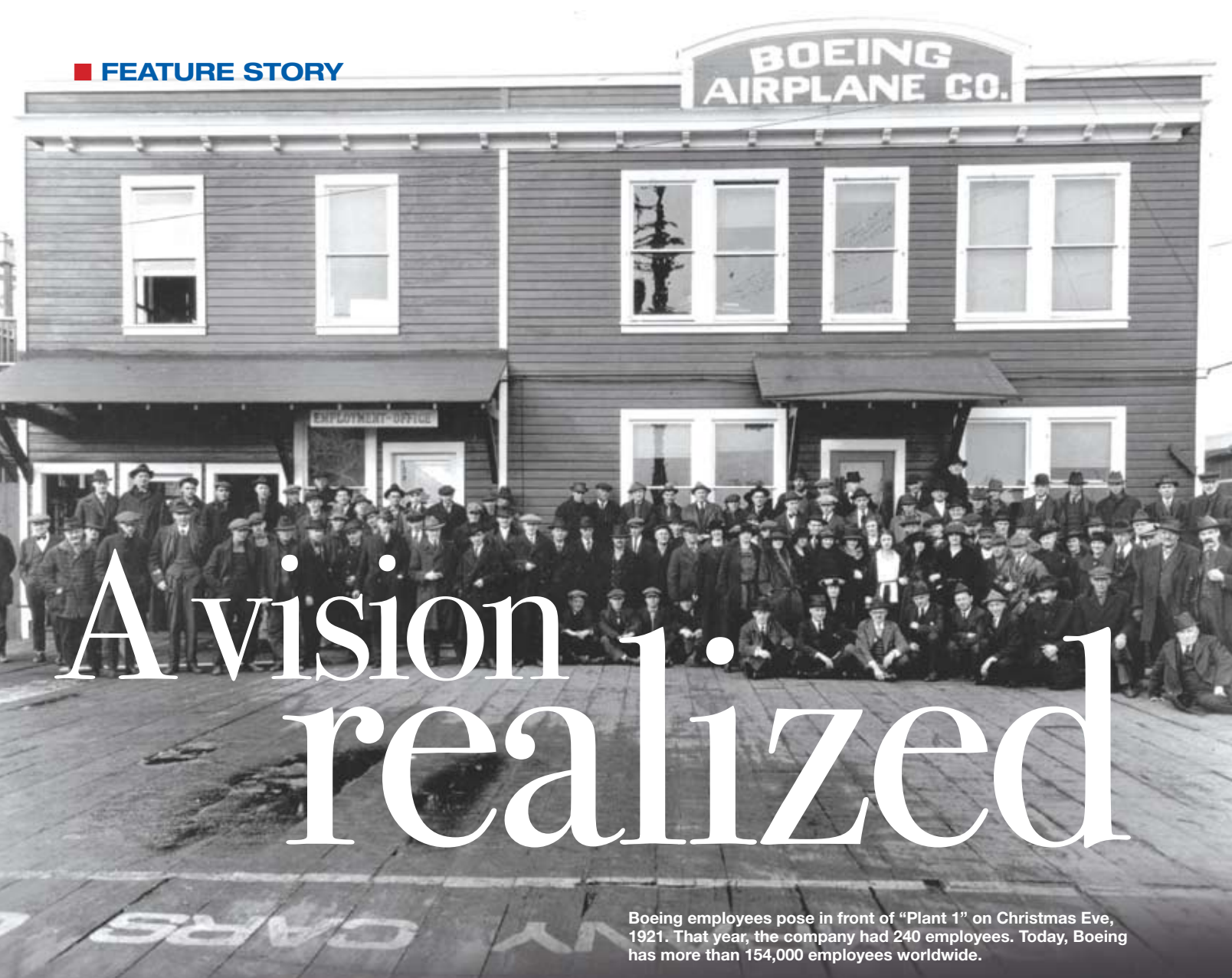


Simulated warfare

Evaluating the effectiveness of warfighting systems requires diverse, highly complex computer simulations that model warfare from different perspectives. At the Virtual Warfare Center, for example, Boeing engineers and customers use special types of virtual simulations with human participants to create, modify and assess concepts of operation as well as tactics, techniques and procedures. Boeing also employs tools such as Joint Warfare System, an advanced, theater-level campaign-analysis simulation tool developed and managed by the Joint Forces Command—to assess how Boeing advanced concepts will perform in warfare campaigns of the future.

DAVE MARTIN PHOTO

At the Virtual Warfare Center in St. Louis, Boeing engineers and customers use virtual simulations with human participants to create, modify, and assess concepts of operation as well as tactics, techniques and procedures.



A vision realized

Boeing employees pose in front of "Plant 1" on Christmas Eve, 1921. That year, the company had 240 employees. Today, Boeing has more than 154,000 employees worldwide.

Boeing celebrates its 90th anniversary this month. Here's a pictorial look at some of the people who have worked to make Bill Boeing's vision come true.

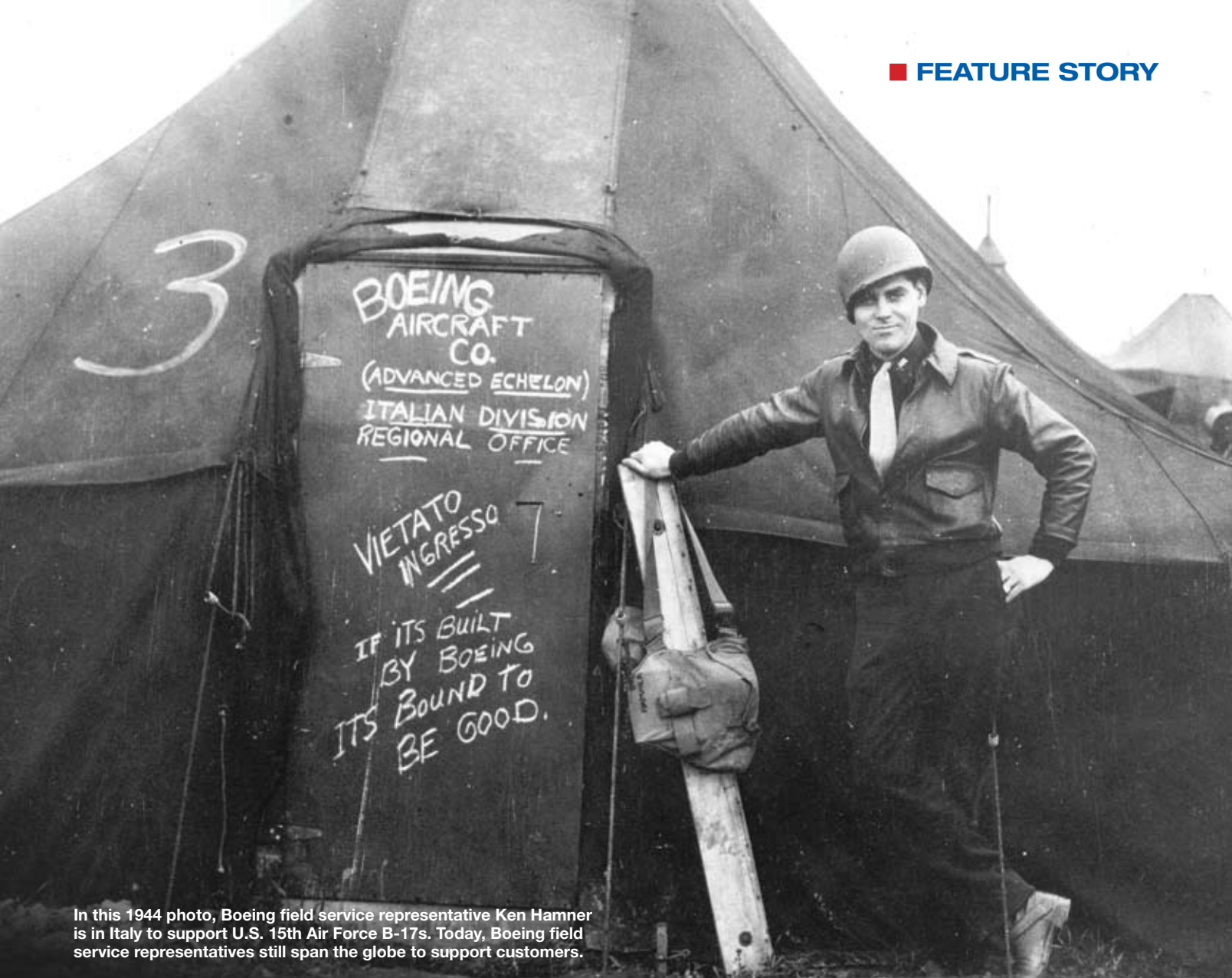
By MICHAEL LOMBARDI

Ninety years ago this month, the 21 people Bill Boeing employed to build and maintain his two B&W airplanes became employees of Pacific Aero Products Company. A year later, the company would have a more familiar name: Boeing Airplane Company.

No one who walked into the boat house on Seattle's Lake Union or the "Red Barn" on the Duwamish River on July 15, 1916, could have imagined what their legacy would be—no one, except perhaps Bill Boeing. While most of the world saw the airplane as a novelty that had some military value, Bill Boeing saw a future where the

airplane would serve mankind for transportation and commerce as well as national defense. This vision was articulated in the company's articles of incorporation, which had provisions not only for manufacturing airplanes but also "to act as a common carrier of passengers and freight by aerial navigation ... operate schools of aviation, and for teaching of all branches of knowledge and of the arts and sciences in any way connected with or useful to the operation of aeroplanes."

Bill Boeing advanced this vision with a passion and drive that guided his company through a postwar downturn that forced all but three American airplane manufacturers out of business. He kept his company going by building furniture and speed boats until Boeing



In this 1944 photo, Boeing field service representative Ken Hamner is in Italy to support U.S. 15th Air Force B-17s. Today, Boeing field service representatives still span the globe to support customers.

finally secured a major U.S. Army contract in 1921.

Before that decade's end, Bill Boeing would build his aviation interest into one of America's largest corporations. United Aircraft and Transport Corporation was formed in 1929 combining a host of airframe manufacturers, including the Boeing Airplane Company, as well as engine manufacturer Pratt & Whitney and several airlines, including Boeing Air Transport. The corporation built planes and engines, conducted schools for pilots, built airports, and managed airlines that flew passengers and freight across the United States. In less than 15 years Bill Boeing not only had transformed his business, but also helped create a national aviation infrastructure. Elements of Bill Boeing's United Aircraft and Transport Corporation survive to this day as The Boeing Company, United Technologies and United Airlines.

Today The Boeing Company still is guided by the passion and vision of Bill Boeing, combined and further strengthened with the legacies of other famous aviation pioneers and their companies:

Donald Douglas, J.S. McDonnell, Dutch Kindelberger, Howard Hughes, Lloyd Stearman, Frank Piasecki and Elrey Jeppesen.

While Boeing and the companies that have joined it can trace their history through hundreds of successful products, the key to the company's success remains the same: the employees who have walked through the office and factory doors over the last 90 years. Some of these people form a who's who of aviation history: Ed Wells, Tex Johnston, William Allen, Ed Heineman, Arthur Raymond, Harrison Storms, Scott Crossfield, Lee Atwood. Hundreds of thousands of others are not so well known, and yet aviation history would not have been built without them—the seamstresses and riveters, machinists and truck drivers, and accountants and office assistants who all have been critical to the success of The Boeing Company. The photos on the following pages show some of these individuals.

To all Boeing employees, past and present, congratulations and thank you for 90 amazing years. ■

michael.j.lombardi@boeing.com

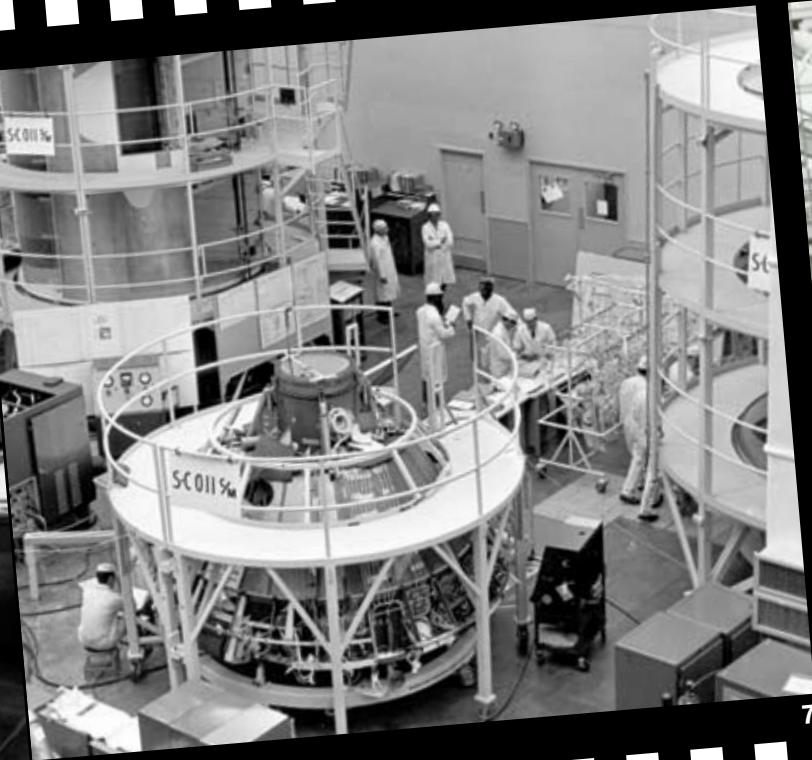


1 A machine shop at the Berliner Joyce Company in Dundalk, Md., circa 1933. Berliner Joyce, together with General Aviation (Fokker of America), became the foundation for the formation of North American Aviation in 1934.

2 Workers at North American Aviation's Kansas City, Kan., plant join the center and rear fuselage of a B-25D Mitchell bomber. Moving-line manufacturing techniques helped NAA build more than 40,000 airplanes during World War II.



3 4



7 8

3 Long before there was Rosie the Riveter, women played a major role in the airplane industry. Here at Boeing Plant 1 in 1927, seamstresses are preparing to cover the fuselage of a Boeing FB-5 Navy carrier fighter.

4 Working late into a December night in 1957, flight-line employees in Renton, Wash., ready the first 707 for testing in preparation for its first flight.

5 Production of Mercury spacecraft moved into high gear in St. Louis during 1960. The spacecraft were built in super-clean "white rooms."

6 In this 1964 image, the Douglas DC-9 tool engineering department is busy at work.

7 North American Aviation employees in Downey, Calif., assemble the command and service modules for Apollo spacecraft 011, which was used in a successful unmanned suborbital flight test in August 1966.

8 Hughes Helicopter employees in 1983 assemble the Model 500E in Culver City, Calif., at the same facility where Howard Hughes built his famed HK-4 Hercules Flying Boat—better known as the "Spruce Goose."

You could get your Share

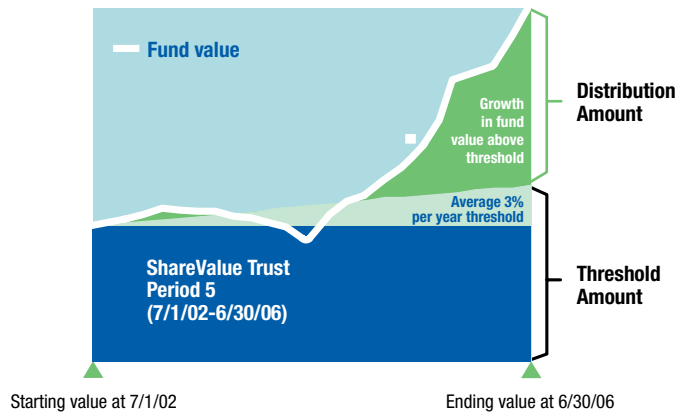
How the ShareValue Trust program works—and why you could be in line to benefit from it

Period 5 for ShareValue Trust—Boeing’s long-term employee incentive plan—ended June 30. Achieving productivity and growth targets plays a key role in establishing the basis for the Boeing stock price. A stock price over the period threshold results in a stock payout. At press time, the Boeing stock price was above the threshold for a distribution, which would occur the first week of August.

How does ShareValue Trust work? Here’s a quick Q&A.

Q: How do I know if I’m going to get a payout?

A: The ShareValue Trust fund features seven overlapping four-year investment periods (see chart below). Each period is four years long (with the exception of the first period, which was two years). Every two years, one period ends and another begins. Period 5



Will employees get a payout from the ShareValue Trust?
Yes, if the SVT fund’s value—shown by the white line (which is based on the price of Boeing stock)—tops the threshold (black bracket). The total amount of the fund to be distributed is represented by the dark green space, which stands for the difference between the threshold and the actual size of the fund.

ended June 30; currently we’re in Period 6—which ends June 30, 2008—and Period 7, which started July 1 and ends June 30, 2010.

Distributions take place at the end of each investment period—but only if the fund has exceeded the threshold.

Q: What’s the threshold?

A: At the end of an investment period, the fund needs to be above a stated minimum value, known as the threshold, for participants to receive a distribution. The value of the fund that exceeds the thresh-

old is distributed to U.S.-based employees in the form of stock (non-U.S. employees receive cash). For Period 5 to pay out, the Boeing stock price needed to be at least \$47 on June 30, Period 5’s ending date. As of June 26, the stock price—calculated as the average of the day’s high and low New York Stock Exchange prices—was \$83.54.

To give Boeing employees an incentive to continue supporting company growth and productivity, the threshold increases each year. The threshold for Period 6, which ends June 30, 2008, is \$54.

Q: Where did the SVT fund come from?

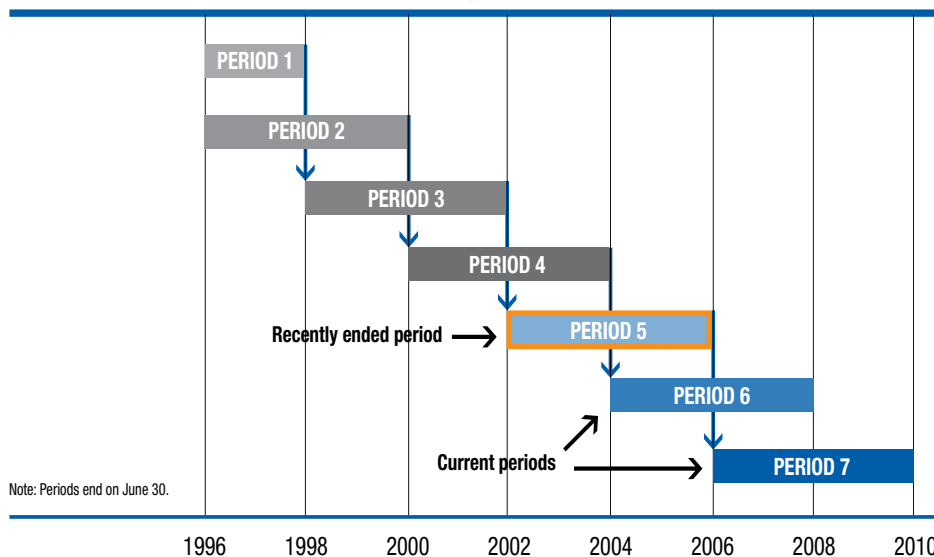
A: In 1996, Boeing established a 14-year fund with more than \$1 billion invested in Boeing stock. This fund was set up to increase employee focus on increasing shareholder value over the long term. The company has added \$700 million to the fund to account for people joining the company through acquisitions. The size of the fund can change when share prices change or when the company reinvests dividends.

Q: How’s the distribution calculated?

A: That’s determined by how much the fund has grown above the threshold value by the end of an investment period. The total distribution is divided among all eligible current and former employees, based on their months of participation during the four-year investment period. ■

For more information, visit www.boeing.com/share.

ShareValue Trust’s overlapping investment periods



This chart shows how the seven ShareValue Trust investment periods overlap.

Making a difference

All Boeing employees play an important role in improving shareholder value and contributing to the four companywide growth and productivity initiatives. Here's how some Boeing employees said their everyday work makes a difference.

My daily life is centered around continuous improvement and Lean. As manager of Industrial Engineering, my group is responsible for developing new processes—or improving existing processes—and deploying them consistently across all assembly programs in Production Operations, working with various other organizations.

For example, we are in the process of developing and deploying the Tool Module Inventory System. The system lets the operators manage their toolboxes themselves and order new tools or replacements as needed. After the tool is requested, instead of an operator waiting at the Tool Crib window, the tool is delivered to the operator—which takes non-value-added time out of the manufacturing process. We also share best practices across all the Boeing manufacturing sites through the Industrial Engineering Process Action Team.

—Chandler Varma
Manager, Industrial Engineering
St. Louis

Over the past few years, Lean initiatives have really become a “we” activity. At first, people were resistant to change. But once everyone saw how huge the improvements were, they really embraced the new processes. As a result, we've accomplished a lot, such as simplifying ordering methods and working with suppliers to reduce inventory on hand. We've reduced our inventory \$2.24 million in flow days 1 and 2. And we have several teams committed to ongoing Lean initiatives and working toward meeting even higher goals.

—Brad Metzger
Supervisor, Materials Management
Renton, Wash.

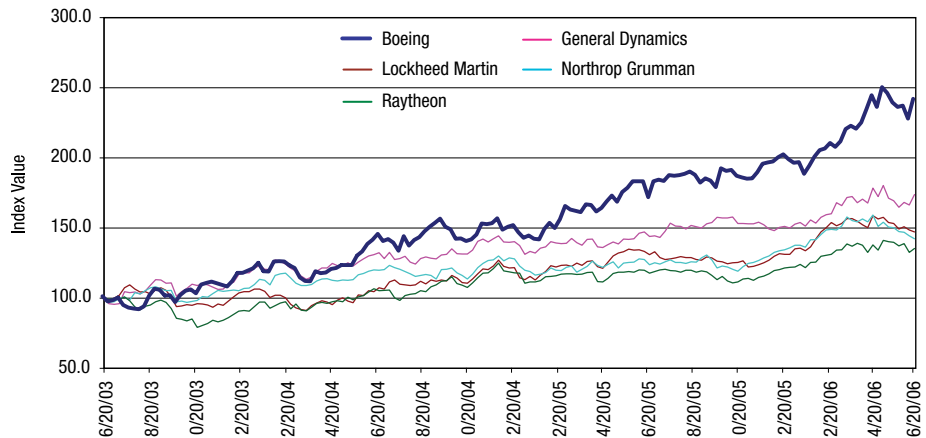
Every day, I work on finding ways to connect Boeing and our employees to the communities where we live and work. Between monetary donations and volunteer hours, Boeing's efforts in the community really make a difference. I think when our employees see the good the company's doing, it makes them proud to work here. And, when employees have pride in the company, they tend to be more productive—which adds to shareholder value.

—Karin Leslie
Community investor
Seattle

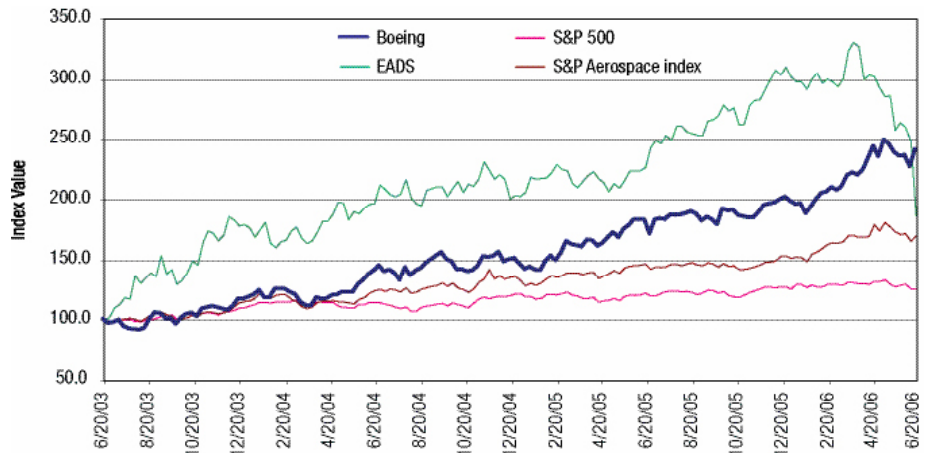
STOCK WATCH

The chart below shows the stock price of Boeing compared to other aerospace companies, the S&P 500 index and the S&P 500 Aerospace and Defense index. Prices/values are plotted as an index number. The base date for these prices/values is June 20, 2003, which generates three years of data. The prices/values on that date equal 100. In other words, an index of 120 represents a 20 percent improvement over the price/value on the base date. Each data point represents the end of a trading week.

Boeing vs. U.S.-based competitors (3-year)



Boeing vs. stock indexes and foreign competitors (3-year)



Comparisons:

4-week, 52-week

	Price/value as of 6/16/06	Four-week comparison		52-week comparison	
		Price/value as of 5/19/06	Percent change	Price/value as of 6/17/05	Percent change
BOEING	85.54	84.61	1.1%	64.62	32.4%
U.S. COMPETITORS					
General Dynamics	66.12	64.47	2.6%	56.02	18.0%
Lockheed Martin	71.32	74.33	-4.0%	64.66	10.3%
Northrop Grumman	63.01	66.47	-5.2%	56.40	11.7%
Raytheon	44.58	46.05	-3.2%	39.50	12.9%
FOREIGN COMPETITORS					
EADS *	19.81	27.39	-27.7%	24.06	-17.7%
U.S. STOCK INDEXES					
S&P 500	1251.54	1267.03	-1.1%	1216.96	2.8%
S&P 500 Aerospace and Defense Index	342.04	349.06	-2.0%	295.82	15.6%

* Price in Euros

SERVICE AWARDS:

Boeing recognizes the following employees in July for their years of service.

50 Years

Frank Burgett
Ronald Malecki
Elton Schmitt

45 Years

Richard Bowers
Ralph Brown
Clarence Bryan
James Combs
Eric Griesheimer
Dean Hillard
Ronald Lee
Kathryn Sigmund
John Volk
Anthony Yanez

40 Years

Dick Amemiya
Lemual Becraft
Robert Beran
Harry Beyer
Michael Bond
Bennie Bowell
Larry Bruns
Joseph Buffa
Richard Bymers
John Cashman
Roy Catron
Raymond Chong
James Connell
Loren Criss
Adrienne Dahl
James Devlin
Katherine Fickes
Roy Flounoil
Frank Friet
Rita Guardado
Charles Hall
Lonnie Henry
James Hook
Tom Jensen
Lee Lalonde
David Larson
Robert Lenz
William Lindell
William Lokken
Stanley Lowe
Larry Marshall
Robert Mitchell
Mary Morris
Joseph Morrison
Terry Purtle
Nicholis Rainsberry
David Reed
Linda Reed
Christian Riddle
Ernest Romero
Robert Schilling
Robert Schultz
Roger Seeman
Jerry Sherrick
Robert Simonds
Jacqueline Skinner
Judith Thomas
Charles Underwood
John Wagner
Max Whittlesey
Nancy Young

35 Years

Carol Andrus
Gloria Arriola
Georgia Barnett
William Bower
Billy Burroughs
Jesse Coker
Philip Cowell
Patsy Crum
Alexis Cunningham
Melissa Dodson
James Forte
William Gerdts
Gregory Gilliam
Robert Graf
Francis Gregory
John Harada
Richard Johnson
Barbara Jones
Carol Joslin
Neil Kessler
Larry Leiter
Doris Lenox
Leif Logan
David Maynard
Vicki Miller
Clarice Mortenson
John Ritland
Kenneth Schaffer
Walter Smith
William Swinhardt
Lou Terry
Susie Umstead
John Willis
Sandra Wilson
Wilson Wong
Curtis Wooley

30 Years

Steven Alberts
Richard Austin
Nicholas Baker
Larry Barner
Olyn Boyle
Allan Brown
Ronald Brown
Larry Butler
Laverne Cadamey
Dennis Cardenas
Marsha Clark
Judith Claudius
Cynthia Cohens
William Collins
Rosa Cortez
Sandra Davis
Lawrence Dawson
Alfredo Del Mundo
Mark Dooley
James Dyke
Sharon Elstran
Charles Evans
Russell Evans
Gasper Fatta
David Force
Anita Gale
Jan Graham
Michael Green
Jerry Gross
Robert Grover

Julius Gurly
Michael Hand
Donna Hanneken
Kathryn Hay
Gary Helm
Karen Hirota
James Hubbard
Gary Hunley
Donald Jacoby
Stanley Jankowski
Gilbert Jernigan
Donna Joiner
David Kawai
John Keich
Nancy Kindem
Kenneth King
Larry Kinney
Christine Kung
Donald Lambeck
Charles Lee
Geraldine Lewis
Richard Lewis
William Lipscomb
William Londono
Norman Lymmer
Robert Maddex
Charles Matlock
Michael Matsumoto
Larry Mayer
Darr McClure
William McConnell
Earl Moore
Ronald Nation
Don Norris
Janet Oakes
Edward O'Leary
Teddy Pablo
Cathy Palio
Thomas Pappas
Ronald Paul
Eugene Peterson
Samuel Piacentini
Michael Plomski
John Redwine
Evelyn Rheinschmidt
Christian Rice
Raymond Robin
Mary Rodgers
Kenneth Russworm
Clifford Ryffel
Steven Schaffer
Henry Schulz
Bradley Scott
Eugene Seiffert
Arthur Serrano
David Shapiro
Britt Sheets
Timothy Simpson
William Slanina
James Spears
Edward Stoll
Donald Stone
Richard Swymeler
Gerard Trepagnier
Roman Valdez
Connie Valdez-Gallas
Cristina Vegas
Lloyd Wade
George Ward

William Wilbur
Pichit Wongchinda
Robert Wright
Bruce Wyciskala
Jerome Zlaket
Maurice Zollner

25 Years

Maria Adams
Ronald Adams
Thomas Agalstoff
Steven Ai
Kevin Aleshire
Michael Alexander
John Allen
Thana Alusi
Macedonio Anaya
David Anderson
Robert Anderson
Lawrence Anzalone
Michael Armstrong
John Arnts
David Atler
Daniel Bailey
Richard Banaga
Larry Barber
Robert Barclay
Deborah Barnhill
Paul Barrett
Susan Barrett
Kathleen Bates
John Benning
Michael Bentz
Steve Berg
George Berry
Danny Bienvenu
Nancy Bissell
Anne Blaikie
Stephen Boak
Thomas Boulanger
Kenneth Boullion
Paul Brenner
Herbert Bridgeman
Larry Brossart
Sherman Brown
Sheldon Bruce
Robert Brydges
Nick Buenbrazo
David Burde
Eugene Cabral
Richard Calverley
Jeffrey Campbell
Matthew Cawthorne
Richard Chao
Jimmy Chase
Leih-Wei Chen
Paul Cheng
Gary Clark
Sharon Collier
Edgar Collins
Ricky Conzelman
Pedro Cordoba
David Craig
Douglas Crawford
Michelle Cuneo
Laurence Cunningham
Michael Davis
Steven Decoux
David Dessenberger

Randall Dick
John Dickinson
Douglas Dietz
Sandra Dilkes-Webster
Roy Dillon
Dennis Dobrowski
William Dolezal
Dale Donnelly
Raymond Donofrio
Ronald Dorband
Jonathan Duquette
Stephen Dutrow
David Earle
Michael Eccles
Mark Edwards
Charles Elmer
Mark Elsemore
Edward Emery
Steven Eng
Kevin Escue
Glen Evans
Vernon Evans
Steven Exe
John Fang
Stanley Feldman
Bruce Fisher
Ralph Fisher
Linda Flegel
Michael Florian
Gail Foley
Scott Foster
Richard Fowler
Karin France
James Freebury
Patricia Gaddy
Daniel Gamblin
Douglas Garrison
Charles Geller
Pamela Giroux
Ronald Glover
David Gonzalez
Bryan Goodier
Brent Goodman
Jefferson Gough
Guy Granger
Donald Graves
Steven Gray
John Griffith
Ronald Grimes
David Guichard
John Gunderson
Cindie Gunwall
Jerome Gurke
Hamilton Ha
Lisa Hagmaier
Clifford Halstead
James Hamilton
William Hanna
Susan Hansen
Bruce Harkness
Ahmad Hatamleh
Barbara Hawkins-Johnson
Richard Hawkinson
David Haworth
Joel Hays
David Heck
Michael Hegger
Steve Hernandez
Harry Hertzberg
Daniel Higgs
David Hoepfinger
David Hoffman
Lissa Hollenbeck

James Holloran
Robert Holz
Marc Horner
Jung Howe
Peter Hughes
Daniel Hull
Darrell Huntley
Steven Hutchings
Lynne Ichiyama
Chon Im
Ricky Inman
Vance Jacobs
Bryan Jobs
Kelly Johnson
Larry Johnson
Marty Jolly
Park Journey
Charles Judson
Richard Juneman
Peter Jung
John Jutte
Steven Kakalecik
James Kayser
Robert Keever
Paul Kiehn
Michael Kilmon
Daniel Kim
Lane Kinoshita
Stephen Kirsch
Istvan Kiss
Karl Knickrehm
Fredrick Knutzen
John Kocina
Neil Kocina
Stephen Kosar
Kenneth Kragness
Jim Kramer
Joel Krohn
Carl Kunstmann
Garland Kurz
Edward Kushner
Wieslaw Kwieciec
David Kwong
Rita Kyselka
Cynthia Landry
Walter Langkait
Terry Lannner
John Lansed
Marijane Lansing
Glen Larocca
Glenn Laroya
Beth Lawless-Walsh
Benny Lawson
Charles Le
Stephen Lear
Kathleen Lechner
Don Lee
Loren Lee
Stanley Lefever
James Leigh
Craig Leroy
Leroy Lewis
Connie Licciardone
Mark Liffing
John Linden
Bruce Lindstrom
Susan Lingenfelter
Jean Liu
Frances Lohner
Alejandro Lopez
Deborah Lovick
Michael Lucas
Mark Macke

Christopher Maddox	William Moorefield	Alan Pennell	Roney Rustia	Robert Steele	John Waters
Richard Madison	William Moritz	Richard Pentzold	Joseph Samocho	Deborah Sterk	Cecelia Watkins
Joseph Magdaleno	Lee Morris	Barbara Perry	Damien Sanchez	David Sterling	David Watters
Mark Magnuson	Douglas Mosier	Jerry Perry	Kevin Sausedo	Michael Stevens	David Webb
Patrick Mannelly	Timothy Murphy	Gregory Phillips	James Schinke	John Stoesz	Mark Weeks
Jonathan Maram	Gerald Mussett	Jeffery Pierce	Marylou Schoolcraft	Roy Stogsdill	Lynda Weldon
James Marshall	Lloyd Navarro	Robert Piszker	John Schramm	Donna Stribling	Kyle Welke
Deborah Matthai	Lorraine Neff	Brian Plotkin	Thomas Schulz	Elwood Stringer	Patrick Whalen
Dennis Mayfield	John Neller	Roger Poortvliet	Eric Schulze	Rebecca Stults	Philip White
Irene McCallister	Chris Nelson	Gregory Poulsen	Ernest Schuster	Mark Sullivan	Bruce Wight
James McClaflin	Deborah Nelson	Charles Powell	Eric Schwartz	Kenneth Sun	Peter Wilcox
Susan McClelland	Jay Nelson	Dinesh Pradhan	Kenneth Schwinck	Robert Swanson	Stephen Wilkening
Frank McCracken	Roxanne Nelson	Teresa Preston-Patella	David Searcy	Raymond Swindler	Arthur Williams
David McCutcheon	Timothy Nelson	Scott Prysock	Kip Sears	Steven Swope	Ralph Wilson
Rudy McCaniel	Jack Nethercot	Steven Raddatz	Edward Segura	David Thomas	Roger Winecki
Brian McGrath	Robert Newell	Bret Ransom	Richard Shaw	Dianna Tolley	John Wittenberg
Dennis McInnis	Anthony Newman	Patsy Reddick	Steve Sheeran	Perry Tominaga	Mary Woodriff
Derek McLuckey	Ha Nguyen	Susan Reid	Janet Sherrick	Daniel Towns	Arlen Woods
Timothy McMahan	Viet Nguyen	Gregory Rensch	Virgil Sides	Vernon Toyoda	John Woolworth
Daniel Meadows	Edward Nicholls	Dale Retrum	Paul Simonsen	Simon Tran	Sonia Wooten
Ronald Medlin	Hugh Odham	Steven Oldhams	Sondra Sims	Robert Troll	John Wroe
Gary Meier	Scott Ohrberg	Paul Richter	Richard Sites	Sandra Trueman	Frances Yamasaki
Carol Merritt	John O'Leary	Michael Riley	Karen Skaggs	Kevin Turnbull	Gretchen Yoder
Cathleen Mettler	Patricia Orf	Clyde Ring	Kenneth Slade	Jane Uchimura	Grant Zenkner
Antonio Micale	Susan Orlicky	Leonel Rivera	Douglas Slater	Eugene Vanbreuseghen	Dennis Zimmerman
Bruce Micklewright	Leslie Otterson	William Roach	Kevin Smith	Andrew Vandress	George Zivojnovich
Robert Miksit	James Ouderkirk	Lois Roberts	Roger Smith	Janet Vannoy-Galm	Eric Zube
Katherine Miller	Bruce Owens	Sandra Rominger	Steven Smith	Howard Veith	Richard Zubers
Paul Miller	Charles Packer	Christopher Rood	William Smith	John Vreuls	
James Mills	Raymond Palmason	Kenneth Rossetto	Kurt Sontag	William Wamble	
Randy Mincks	Lynette Patmor	Dorothy Rowe	Alexander Spencer	Dau-Sing Wang	
Luke Montoya	Shirley Patrick	Martin Ruddy	Michael Spirko	William Wassenberg	
David Moore	Ronald Patton	Mark Ruhl	Dorraine Stafford	Cynthia Waters	

RETIREMENTS: The following employees retired in May from The Boeing Company.

Masanori Abo, 18 Years	Lillie Brown, 33 Years	James Davis, 25 Years	Mary Fowler, 30 Years	Ronnie Johnson, 26 Years
Cheryl Adamscheck, 16 Years	Allan Brozek, 24 Years	Masako Davison, 32 Years	Carl French, 30 Years	Bradford Jones, 32 Years
Darsh Aggarwal, 19 Years	Paul Bruce, 21 Years	David Day, 15 Years	John Fuller, 14 Years	Robert Jones, 9 Years
Ruben Aguirre, 39 Years	Val Brustad, 28 Years	Lawrence Decambra, 23 Years	Freny Gandhi, 24 Years	John Kalina, 8 Years
Arnold Alvarado, 14 Years	Eunice Bryanton, 9 Years	Robert Degidio, 22 Years	Nandor Gaspar, 31 Years	David Kaplan, 41 Years
Ronald Amimoto, 19 Years	Mary Buergey, 22 Years	Sonya Deling, 14 Years	Irene Gendron, 16 Years	Ronald Kellams, 34 Years
Kurt Amundsen, 38 Years	Robert Bukoski, 24 Years	Edith Dersch, 22 Years	Patrick Gill, 31 Years	Richard Kellogg, 21 Years
Emeterio Ancheta, 20 Years	Linda Burfening, 38 Years	Robert Desrochers, 22 Years	Frances Glasscock, 29 Years	Lynn Kesler, 41 Years
Jack Anderson, 37 Years	Halley Buzick, 28 Years	Elwood Deutscher, 17 Years	John Gleadle, 39 Years	Lee Kessler, 35 Years
Lana Anderson, 35 Years	Alberto Cabellon, 19 Years	Jerry Dixon, 35 Years	Kathryn Goldman, 14 Years	Roger King, 18 Years
Glenda Arnold, 31 Years	Larry Carlson, 18 Years	Darlene Dohi, 23 Years	Patricia Gramata, 23 Years	Arthur Kirby, 39 Years
Sara Aytes, 31 Years	Gary Carnie, 24 Years	Kenneth Doll, 27 Years	Thomas Haley, 27 Years	Michael Knowles, 33 Years
Richard Backs, 41 Years	Jeannette Carroll, 17 Years	Xavier Dominguez, 40 Years	James Hall, 15 Years	Phyllis Kroeger, 10 Years
William Bauer, 38 Years	James Casassa, 27 Years	Richard Doremus, 31 Years	Walter Hall, 24 Years	Michael Kuhlman, 31 Years
Raymond Beatty, 37 Years	Douglas Caton, 31 Years	James Doyle, 24 Years	Richard Hallman, 10 Years	Victor Kukrall, 28 Years
Beatrice Beeman, 30 Years	Diane Chambers, 20 Years	Michael Draper, 29 Years	Kathleen Hamilton, 19 Years	Katharine Lafond, 30 Years
Roy Berg, 36 Years	Evelyn Cheesbrough, 20 Years	Leon Draxler, 26 Years	Nancy Handy, 26 Years	Robert Langley, 27 Years
Richard Black, 8 Years	Jean Chemsian, 25 Years	William Dunne, 17 Years	Vernon Harmon, 40 Years	Larry Larsen, 38 Years
Ronny Bockelman, 21 Years	Wen-Mo Chen, 25 Years	Edward Dyche, 32 Years	Alvin Harper, 42 Years	Donna Larson, 17 Years
Louis Boone, 19 Years	Mark Clark, 8 Years	Karlheinz Eisinger, 36 Years	Mose Harris, 40 Years	Charles Laubach, 19 Years
Robert Botteron, 29 Years	Gary Cloninger, 39 Years	Michele Espinosa, 40 Years	William Harrison, 31 Years	Leonard Law, 28 Years
Ronald Bouvier, 18 Years	Michael Colito, 31 Years	Jay Evertt, 21 Years	Robert Heesen, 44 Years	Charles Leigh, 43 Years
Lula Boyd, 27 Years	Jackie Collins, 33 Years	Robert Ewart, 16 Years	Janet Heritage, 20 Years	Linda Leverett, 31 Years
Thomas Boyle, 21 Years	George Compton, 24 Years	Ben Farner, 33 Years	Albert Hess, 16 Years	Robert Linn, 34 Years
Donn Bradford, 25 Years	Donna Conn, 22 Years	Gene Fifield, 44 Years	Margaret Hoffman, 21 Years	James Lix, 40 Years
John Bradley, 41 Years	Kevin Connell, 26 Years	Domingo Figueroa, 19 Years	Edward Hounsell, 34 Years	Eduardo Luraghi, 25 Years
James Branche, 26 Years	Samuel Contreras, 23 Years	John Firstenberg, 27 Years	William Hudson, 11 Years	Candace Lydston, 20 Years
Kathryn Brand, 27 Years	Sandra Cope, 33 Years	Larry Flesher, 32 Years	Rosemary Huerta, 31 Years	Frederic Madenwald, 20 Years
Gayle Brantner, 42 Years	Edward Costello, 31 Years	Linda Flores, 31 Years	Beverly Hurt, 24 Years	Richard Markgraff, 23 Years
Daniel Braun, 27 Years	Loretta Coston, 20 Years	Joan Flynn, 20 Years	William Jackson, 48 Years	George Marlow, 20 Years
John Brawley, 28 Years	Bruce Cramer, 41 Years	Johnny Ford, 41 Years	Ronald Janott, 38 Years	James Martin, 30 Years
Dale Brooks, 29 Years	John Cupps, 13 Years	Delveda Fortier, 27 Years	Daniel Jenkins, 27 Years	Gale McCoy, 24 Years
Julia Brown, 10 Years	Jonathan Dann, 30 Years	Leroy Fournie, 35 Years	Jay Jenkins, 18 Years	Robert McDaniel, 42 Years
			Raymond Jex, 40 Years	Cynthia McGavran, 17 Years
			Joyce Johnson, 27 Years	Jack McGuire, 42 Years
			Mary Johnson, 18 Years	James McIntosh, 32 Years
				Michael McLeod, 32 Years

■ MILESTONES/AROUND BOEING

William McNeil, 41 Years
John Meisch, 26 Years
Richard Meyer, 32 Years
Stanislaw Milkowski, 34 Years
Stephen Miller, 23 Years
Junior Morris, 20 Years
Susan Morrissey, 11 Years
Dennis Muretta, 42 Years
Dennis Nation, 27 Years
Charlene Nichols, 24 Years
John Nordin, 30 Years
Tony Novak, 39 Years
Patricia Ohara, 28 Years
Donald Ohlson, 31 Years
Olin Olmstead, 27 Years
Sandra Olsonawski, 20 Years
Joseph Orsi, 5 Years
George Palenchar, 20 Years
Richard Palmer, 22 Years
Ivan Parkhurst, 34 Years
Theodore Pearl, 37 Years
Ralph Pelikan, 40 Years
Susan Pena, 16 Years
Walter Pena, 25 Years
Edwin Pfeifle, 30 Years
John Piersall, 36 Years
Richard Pinckert, 38 Years
Linda Pochmerski, 18 Years
Herman Poole, 20 Years
William Preston, 25 Years
Jean Ray, 19 Years
Michael Reardon, 26 Years
Danny Renaud, 24 Years
Theodore Reyhner, 39 Years
Douglas Richards, 29 Years
Henry Richardson, 41 Years
Ernie Richter, 17 Years
Edna Ridgell, 16 Years
Sharon Riebe, 20 Years
Ronald Rockafellow, 17 Years
Gail Rogers, 26 Years
Max Rogers, 22 Years
Glen Rose, 26 Years
Robert Ross, 23 Years
Lloyd Rougutt, 27 Years
Alexander Rutman, 9 Years
John Saliba, 10 Years
Ernesto Salvador, 17 Years
Stephen Sargent, 26 Years
Thomas Scheivert, 44 Years
Charles Schluck, 29 Years

John Schmid, 32 Years
Mary Schroeder, 25 Years
John Schur, 34 Years
Leonard Scruggs, 27 Years
Mark Sears, 20 Years
Harry Shaw, 27 Years
Roger Shaw, 26 Years
Frank Shirk, 37 Years
Raleigh Sifford, 44 Years
Marcia Sims, 19 Years
Alfred Smith, 23 Years
Beverly Smith, 17 Years
Carol Smith, 29 Years
Edgar Smith, 35 Years
Stephen Smith, 22 Years
Patricia Sowers, 7 Years
Carol Spencer, 18 Years
Darcy Sprague, 23 Years
Mary Stanley, 36 Years
Michael Steine, 21 Years
Trevor Stephenson, 28 Years
Jerry Stirret, 39 Years
Larry Stokke, 29 Years
Edward Storozuk, 12 Years
Clarise Strock, 20 Years
Stanley Strong, 18 Years
Ronald Swansbro, 25 Years
Dennis Tabor, 35 Years
Jesse Talley, 44 Years
Lewis Tidd, 45 Years
Lea Townsley, 22 Years
Calvin Tucker, 28 Years
Robert Turney, 32 Years
James Untz, 26 Years
Robert Vancott, 20 Years
Reginald Varga, 30 Years
Gaylord Walden, 8 Years
Raymond Ward, 20 Years
Richard Weaver, 21 Years
Leonard Wickens, 18 Years
William Wilbur, 23 Years
William Wilkins, 19 Years
Kathleen Winget, 14 Years
William Wysong, 14 Years
Hyok Yi, 13 Years
Scott Young, 16 Years
John Yuna, 22 Years
Norman Yutani, 42 Years
Ricardo Zabot, 28 Years
Isidro Zuniga, 38 Years
Jesus Zuniga, 38 Years

IN MEMORIAM

The Boeing Company offers condolences to the families and friends of the following employees, whose deaths recently have been reported.

- Emeric Angers**, navigational instrument mechanic; service date Feb. 22, 1960; died June 11.
Diane Baker, flight line decorative repairman; service date March 31, 1978; died June 3.
John Bostick, materials processes/requirements facilitator; service date Sept. 19, 1986; died June 6.
Andrew Caro, engineer/scientist; service date May 23, 1983; died April 20.
Michael Eilers, mechanic; service date Oct. 21, 1986; died May 25.
Nancy Flory, office administrator; service date Oct. 8, 1982; died May 20.
Stephen Hickey, field test technician; service date Oct. 7, 1985; died June 11.
Sylvester Hunter, structures installation; service date Sept. 8, 1981; died June 7.
Joseph Koch, manager; service date Dec. 2, 1985; died June 1.
Mary Olivas, office administrator; service date March 26, 1996; died May 28.
Karen Turner, quality systems specialist; service date Nov. 4, 1985; died May 23.

A Zenit-3SL vehicle lifts off from the Odyssey Launch Platform in the Pacific Ocean. With this June 18 launch, Sea Launch successfully delivered PanAmSat's Galaxy 16 communications satellite to geosynchronous transfer orbit.



SEA LAUNCH PHOTO

ENERGY MANAGEMENT HONORS 6 TEAMS' ACTIVITIES

The Energy Management organization honored six Boeing teams last month for outstanding and innovative energy-conservation projects.

"By reducing energy use at Boeing, these teams contribute to the Boeing Internal Services Productivity initiative," said John Norris, U.S. Southern and Eastern regional energy manager for Boeing Energy Management, an organization within Shared Services Group's Site Services unit. "Everyone can learn from their insights to improving our operating efficiency."

Teams from Boeing sites throughout the United States submitted 22 nominations from projects in 2005 that resulted in savings of more than \$2.9 million and netted rebates from local energy utilities of \$1.78 million.

Norris said the Boeing Energy Award both recognizes energy-saving achievements and helps spread good ideas throughout the company.

Each team received a 2005 Boeing Energy Award at a ceremony in Renton, Wash. The winning teams are

- Anaheim (Calif.) Technocrats Team. Members: Ashok Varma, Bill Tolman, Steve Emmi, Ernst Bucher, Steve Evans, Tony Ciaramitaro.
- Long Beach (Calif.) Controls Upgrade Team. Members: Jeff Haberman, Tom Mohler, Steve Ashford.
- El Segundo (Calif.) Lighting Improvement Team. Members: Rick Hallock, John Concialdi, Jack Shannon, Ken Patterson.
- St. Louis Systems Replacement Team. Members: James Danielson, Michael Brugnara, John Ferguson, James Reiter, Richard Koch, Donald Hager, Kevin Arcynski, Darrel Caselton, Billy Rollins, David Estes.

AROUND BOEING

- Frederickson (Wash.) Chiller Replacement Team. Members: Kyle Chandler, Jon Larscheid, Dave Putnam.
- El Segundo Employee Awareness Team. Members: Rick Hallock, Dan Konkel, Mas Nakawatase, Gary Robinson, Chuck Spanski, James Trejo, Christina Lupichuk.

DELTA II, SEA LAUNCH RECORD SUCCESSFUL LAUNCHES

The Boeing Delta II program and Sea Launch recorded successful rocket launches in June.

A Boeing Delta II launch vehicle on June 21 successfully carried into orbit an experimental payload for the joint U.S. Defense Advanced Research Projects Agency (DARPA), U.S. Air Force and U.S. Naval Research Laboratory team.

Liftoff of the Delta II 7925-9.5 configuration vehicle took place from Cape Canaveral Air Force Station, Fla. The payload was successfully deployed approximately 30 minutes after liftoff.

Jointly developed by DARPA, the Air Force and the Navy, the Micro-Satellite Technology Experiment (MiTeX) is an experimental payload that will help identify, integrate, test and evaluate small satellite technologies. The Naval Research Laboratory provided the upper stage used to propel MiTeX into geosynchronous orbit.

Meanwhile, Sea Launch on June 18 successfully delivered PanAmSat's Galaxy 16 communications satellite to geosynchronous transfer orbit. A Zenit-3SL vehicle lifted off from the Odyssey Launch Platform, positioned at 154 degrees west longitude in the equatorial Pacific Ocean. A ground station at Hartebeesthoek, near Pretoria, South Africa, acquired the first signal from the satellite shortly after spacecraft separation. With this mission, Sea Launch has now successfully launched four satellites for PanAmSat and 20 satellites overall.

Boeing is one of four international partners in Sea Launch.

PROFESSORS BEGIN BOEING WELLIVER FELLOWSHIP

Twelve university professors representing engineering, business and information technology are taking part in the 12th annual Boeing Welliver Faculty Summer Fellowship Program.

The objective of the eight-week program, which began June 20, is to provide the fellows with a better understanding of the practical industry applications of engineering, business and IT skills so they may influence the content of undergraduate education. The fellows will spend six weeks of this program at sites across Boeing, where they will be aligned with a mentor and engage with the work force.

The program is sponsored by Boeing Enterprise University Relations and the Boeing Higher Education Integration Board.

777 CONTINUES ITS MANUFACTURING TRANSFORMATION

The 777 program last month made progress toward implementing the Boeing Production System when for the first time it moved an airplane in final assembly out of the traditional slant position and placed it nose-to-door at the Everett, Wash., factory.

This configuration ultimately will enable a moving assembly line for the 777—which is one of the objectives of implementing BPS for 777 manufacturing and part of Lean+, one of four Boeing companywide growth and productivity initiatives.

Placing airplanes nose-to-door also clears space in Everett's 40-25 building for the 777 Program to continue with other changes to its production system. The area where the airplanes sat in the slant position will be designated to support-systems-installation work.

This particular milestone is one of a series of recent changes to transform the way employees build 777 jetliners. The key to this successful transformation has been employee involvement, the team leading the effort said.

"We have a great chance of success here with employee engagement," said Mike Saiki, BPS Implementation manager for final assembly interiors. "This is an opportunity to engage employees and make them a part of the effort. They get to define it, and the employee involvement leads to more great ideas."

The BPS is a holistic look at the extended commercial airplane enterprise, aligning improvement efforts to meet customer needs, reduce costs, improve quality and shorten lead times from order to delivery. These improvements reduce waste and infrastructure and streamline the flow of material, parts and products through the system to ultimately create simpler processes for products that are assembled more easily. ■

A Boeing Delta II launch vehicle carries into orbit the Micro-Satellite Technology Experiment, an experimental payload for a joint U.S. Defense Advanced Research Projects Agency, U.S. Air Force and U.S. Naval Research Laboratory team.



CARLETON BAILE PHOTO



Making safe products even safer

By DEBBY ARKELL

As Boeing continues its efforts to make its products more environmentally friendly, one Commercial Airplanes team has made great strides in replacing a potentially hazardous material.

Mechanics commonly install bushings or spherical bearings in joints to prevent wear and increase structural durability. These parts are used in thousands of locations on a typical aircraft. The applied loads and the wear environment typically determine the type of metal the parts are made from.

Most bushings and bearings used on Boeing airplanes are made from an alloy called aluminum-nickel-bronze (Al-Ni-Br), which can withstand loads of 60,000 pounds

per square inch. When higher strength is required, Boeing uses parts made with copper-beryllium (Cu-Be). Cu-Be can withstand loads up to 140,000 pounds per square inch.

Cu-Be is used in about 5 percent of all bushings and 25 percent of all spherical bearings in production. The potential problem is that inhaling beryllium dust particles can cause berylliosis, a form of metal poisoning.

The problem is not significant, as Boeing buys most bushings and bearings in a finished condition; and it has specific safety precautions in place to protect workers and mitigate exposure when parts require honing.

Further, Boeing carefully monitors beryllium exposure levels to ensure the safety of its employees, and the company also recognizes the potential for exposure at sup-

Material & Process Technology employee Dan Kane measures a bushing made from a copper-nickel-tin alloy in the Renton, Wash., lab. Kane said static and rotating joints made with this alloy can be designed much smaller than in past designs.

plier and customer locations. That's why Boeing has led the charge in identifying a Cu-Be alternative. Working with suppliers, a Renton, Wash., Material & Process Technology team led by Dan Kane, Chris Meyer and Shannon Swanson analyzed a variety of alternatives to find one with strength and wear resistance equivalent to Cu-Be.

"We tested several possible alternative alloys, but only one had potential for

"In comparison with copper-beryllium, the new copper-nickel-tin alloy is far less hazardous."

—Dan Guth, Boeing Safety, Health and Environmental Affairs toxicologist

Boeing's purposes as a direct replacement for Cu-Be: copper-nickel-tin (Cu-Ni-Sn)," Kane said. "The material is difficult to manufacture, because tin doesn't dissolve easily into the other elements, making it challenging to get consistent properties, but it is the only one that showed potential."

In recent months Boeing has worked with a supplier to improve Cu-Ni-Sn's performance, resulting in a material Boeing calls BMS7-373. This alloy is available for new designs and for shops wishing to replace certain Cu-Be parts where higher strength is not required. For these parts Cu-Ni-Sn is an attractive alternative to Al-Ni-Br because not only can it withstand greater loads, but it also provides a notable weight reduction. A version that will directly replace Cu-Be is in testing and is scheduled to be available by year-end.

Once the replacement is fully adopted, it will lead to simpler processes. "No longer will there need to be separate, specific safety processes to contain beryllium dust and protect workers from it," Kane said.

Boeing Safety, Health and Environmental Affairs experts in toxicology and industrial hygiene have evaluated Cu-Ni-Sn. "In direct comparison with copper-beryllium, the new copper-nickel-tin alloy is far less hazardous," said Dan Guth, Boeing SHEA toxicologist. ■

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MARIAN LOCKHART PHOTO



A million hours of service to the world.

We're proud to celebrate an important milestone for the C-17, the world's most capable airlifter: A million hours of flight. This remarkable accomplishment is a testament to its unmatched ability to support troops

and deliver humanitarian relief virtually anywhere, anytime. We salute the C-17 crews, support teams, as well as the men and women who help build the C-17 and make it an invaluable asset around the globe.



Honeywell



This C-17 team ad developed by Integrated Defense Systems celebrates the airlifter achieving the major milestone of one million flight hours. This ad is part of a new, nine-part campaign that focuses on the important role the C-17 plays in supporting military and humanitarian needs worldwide. The campaign runs in key defense trade magazines, regional military installation newspapers and Washington, D.C.-area publications throughout the year.

BOEING
Forever New Frontiers



THE NEW 747-8. NEWS WITHOUT THE NOISE.

BOEING
Forever New Frontiers



THE NEW 747-8. EFFICIENCY IS THE BIG IDEA.

At this month's Farnborough Air Show, one primary focus for Boeing Commercial Airplanes is the new 747-8 Intercontinental. In support of the jetliner, these billboards will be posted at prominent locations in the London area and at Heathrow Airport. The ads will underscore the airplane's key selling points of operating efficiency and noise reduction, made possible by incorporating technologies developed for the Boeing 787 Dreamliner. These billboards are part of a global advertising campaign that began with the program's launch in November 2005.